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TÜRK OMURGA CERRAHİSİ DERNEĞİ

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TÜRK OMURGA CERRAHİSİ DERNEĞİ

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## TÜRK OMURGA CERRAHİSİ DERGİSİ

Türk Omurga Cerrahisi Dergisi, Türk Omurga Cerrahisi Derneği'nin resmi yayın organıdır. Türk Omurga Cerrahisi Derneği, Prof. Dr. Emin Alıcı önderliğinde az sayıda üye tarafından 1989 yılında İzmir (Türkiye)'de kuruldu.

Derneğin kuruluş amacı:

- Omurga cerrahisi ile uğraşan Ortopedi ve Travmatoloji uzmanları ile Nöroşirurji uzmanlarını bir araya getirerek omurga cerrahisi ile ilgili bilgi ve birikimlerini paylaşmalarını sağlamak,
- Omurga cerrahisi konusunda çalışan hekimlerin sayılarını artırmak ve ülkemizde gelişmiş bir tıp disiplini haline getirmek,
- Omurga cerrahisi konusundaki gelişmeleri takip etmek ve üyelerine aktarmak,
- Uluslararası ve ulusal kongre, sempozyum ve kurslar düzenleyerek, omurga cerrahisi eğitimi vermek,
- Omurga cerrahisi eğitiminde standardizasyonu sağlamak,
- Omurga cerrahisi konusundaki bilimsel çalışmaları

özendirmek ve bu konudaki çalışmaları içeren dergi ve kitaplar çıkarmak,

- Tüm bu çabalarla Türk omurga cerrahisini geliştirmek ve Dünya omurga cerrahisine bu yolla katkıları sağlamaktır.

Türk Omurga Cerrahisi Dergisi, Türk Omurga Derneği'nin resmi yayın organıdır. Derginin amacı, Türk omurga cerrahilerinin çalışmalarını ve literatürdeki yeni gelişmeleri yayınlamak tüm Türk tıp camiasının ve özellikle omurga cerrahisiyle uğraşanların bilgi ve görgüsünü artırmaktır. Ayrıca dergi, dernek üyeleri hakkındaki gelişmeleri, omurga cerrahisi ile ilgili bilimsel kongre ve toplantıları, yeni çıkan yayın ve kitapları dergi abonelerine duyurmak amacını gütmektedir.

Türk Omurga Cerrahisi Dergisi'nin geçmişi, Türk Omurga Cerrahisi Derneği geçmişi kadar eskidir.

Derneğin ilk kez İzmir Çeşme' de düzenlediği kongre ile eş zamanlı olarak ilk 4 sayı yayınlanmıştır. İki yılda bir düzenlenen uluslararası kongrelerde sunulan çalışmalar, derneğin özendirmesiyle yazarları tarafından orijinal makale haline getirilmiş ve dergide yayınlanmıştır.

Dergi, klinik ve temel araştırma, davetli derlemeler ve olgu sunumları şeklindeki Yayın Kurulunun onayladığı orijinal makaleleri İngilizce veya Türkçe olarak yayınlar. Çalışmalar, en az iki hakem tarafından değerlendirildikten sonra yayınlanabilir. Yayın Kurulu, yayını kabul etme, düzeltilmesini isteme ve yayınlamama hakkına sahiptir. Dergi, her üç ayda bir çıkar ve dört sayıda bir cilt tamamlanır.

Türk Omurga Cerrahisi Dergisi'nde yayınlanan çalışmalardaki bilimsel veri, bilgi ve çıkarımlar ile ilgili bilimsel etik ve mediko-legal sorunlar yazının yazarlarının sorumluluğundadır, konuyla ilgili editörün ve yayın kurulunun hiçbir sorumluluğu yoktur.

Son yıllarda artan bilimsel etik ve mediko-legal sorumluluk bilinci dergimiz için temel esasları oluşturur.

Bilimsel çevrelerin ve toplumun da beklentisi bu yöndedir. Dergimizde yayınlanan makalelerde, alıntıların mutlaka kaynak belirtilerek kullanılması zorunluluğu vardır. Dergimiz, hasta haklarına saygılı olup, dergide yayınlanan çalışmalarda hasta onay formlarının olmasına özen gösterir ve hastaların kimliklerini deşifre edecek şekilde isimlerinin kullanılmasına, fotoğrafların göz bandı olmaksızın basılmasına izin vermez. Çalışmalara ait etik kurul onaylarının olmasını zorunlu tutar. Yazarlar, ticari kuruluşlardan maddi destek almışlarsa bu durumun açıkça belirtilmesini şart koşar. Dergimiz yazarlardan destek alınan kuruluşun makalenin içeriğine karışmadığına, yayınlanmasına müdahale etmeyeceğine ve izinsiz başka bir yerde kısmen veya tamamen yayınlanmayacağına dair taahhüt ister.

Türk Omurga Cerrahisi Dergisi, dernek üyelerine ve abonelere ücretsiz olarak dağıtılmaktadır.

Derginin yayın ve dağıtım giderleri, dernek üye aidatlarından, kongre gelirlerinden ve dergiye alınan reklâm bedellerinden sağlanmaktadır. Reklâm bedelleri aktüel fiyatlara göre belirlenir. Dergi ya-

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yın kurulu, bir veya birden çok ticari kuruluşla sponsorluk anlaşması yapmaya yetkilidir. Ancak ilgili kuruluşlar, asla derginin bilimsel içeriğine, tasarımına, yayınların yayınlanma sırasına ve sürecine müdahale edemezler.

Türk Omurga Cerrahisi Dergisi, Birleşmiş Milletler, "Global Compact" sözleşmesine uyacağını taahhüt etmiş ve bunu bir bildiri ile Birleşmiş Milletlere bildirmiştir. Bu meyanda, dergimiz genelde insan haklarına, özelde hasta haklarına ve deneysel çalışmalarda hayvan haklarına saygılı olunması gerektiği inancında olup, yayınlanan çalışmalarda bu prensiplere uyma zorunluluğu getirmiştir.

Son yıllarda klinik olarak ilgili bilimsel gelişmeler, çağdaş ölçüler, daha sofistike istatistiksel yaklaşımlar ve iyi formüle edilmiş araştırma planlarının artan kullanımını ve üst düzey raporlamayı içermektedir. Bilimsel yazılar, diğer yazılar gibi, yaratıcı bir süreci yansıtır, sadece bir eylemi değil. Bir raporun kalitesi tasarıdaki fikrin ve araştırmanın yönetilmesinin kalitesine bağlıdır. İyi hazırlanmış sorular veya hipotezler, tasarı ile ilişkilidir. İyi hazırlanmış hipotezler tasarımı gösterir ve tasarı da hipotezi gösterir. Bir raporun etkililiği kısıklık ve odak ile ilgilidir. Az noktaya dikkat çekmek yazarların kritik konulara odaklanmasını sağlar. Kısıklık ve özlük tekrardan kaçınma (birkaç istisna hariç), sade stil ve düzgün gramer ile elde edilir. Pek az orijinal makalenin 3000 kelimeden fazla olmaya ihtiyacı vardır. Daha uzun makaleler temel yeni metotlar raporlanıyorsa veya bir literatür araştırması yansıtıyorsa kabul edilebilir. Yazarların ağıdalı ifadeden kaçınması gerekmesine rağmen, etkili iletişim sağlayan kritik bilgi çoğu kez soruların (veya hipotezler veya anahtar konular) tekrarlanması anlamına gelir. Sorular Özet, Giriş ve Tartışma bölümlerinde belirtilmeli, ve yanıtlar Özet, Sonuçlar ve Tartışma bölümlerinde yer almalıdır.

Pek çok derginin makaleleri formatlamak için yönergeler yayınlamasına rağmen, yazı stilleri yazarların az veya çok kurulu ve alışkanlık edindikleri bir yazma stiline sahip oldukları için çeşitlidir.

Türk Omurga Cerrahisi Dergisi, geleneksel olarak genel yönerge olarak AMA stilini kullanmaktadır. Ancak pek az bilimsel ve tıbbi yazarın bu stilleri öğrenmek için zamanı vardır. Bu nedenle dergimiz düzgün dilbilgisi ve sade etkili iletişim sınırları içinde bireysel stillere hoşgörü ile yaklaşmaktadır.

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## THE TURKISH JOURNAL OF SPINAL SURGERY

The Turkish Journal of Spinal Surgery is the official publication of the Turkish Spinal Surgery Society. The Turkish Spinal Surgery Society was established in 1989 in Izmir (Turkey) by the pioneering efforts of Prof. Dr. Emin Alici and other a few members. The objectives of the society were to:

- establish a platform for exchange of information/ experience between Orthopedics and Traumatology Specialists and Neurosurgeons who deal with spinal surgery
- increase the number of physicians involved in spinal surgery and to establish spinal surgery as a sophisticated medical discipline in Turkey
- follow the advances in the field of spinal surgery and to communicate this information to members
- organise international and national congresses, symposia and workshops to improve education in the field
- establish standardization in training on spinal surgery
- encourage scientific research on spinal surgery and publish journals and books on this field
- improve the standards of spinal surgery nationally, and therefore make contributions to spinal surgery internationally.

The Turkish Journal of Spinal Surgery is the official publication of the Turkish Spinal Surgery Society. The main objective of the Journal is to improve the level of knowledge and experience

among Turkish medical society in general and among those involved with spinal surgery in particular. Also, the Journal aims at communicating the advances in the field, scientific congresses and meetings, new journals and books to its subscribers. The Turkish Journal of Spinal Surgery is as old as the Turkish Spinal Surgery Society. The first congress organized by the Society took place in Çeşme, Izmir, coincident with the publication of the first four issues. Authors were encouraged by the

Society to prepare original articles from the studies presented in international congresses organized by the Society every two years, and these articles were published in the Journal.

The Journal publishes clinical or basic research, invited reviews, and case presentations in English or Turkish after approval by the Editorial Board. Articles are published after they are reviewed by at least two reviewers. Editorial Board has the right to accept, to ask for revision, or to refuse manuscripts. The Journal is issued every three months, and one volume is completed with every four issue. Responsibility for the problems associated with research ethics or medico-legal issues regarding the content, information and conclusions of the articles lies with the authors, and the editor or the editorial board bears no responsibility.

In line with the increasing expectations of scientific communities and the society, improved awareness about research ethics and medico-legal responsibilities forms the basis of our publication policy.

Citations must always be referenced in articles published in our journal. Our journal fully respects to the patient rights, and therefore care is exercised in completion of patient consent forms; no information about the identity of the patient is disclosed; and photographs are published with eye-bands. Ethics committee approval is a prerequisite. Any financial support must clearly be disclosed. Also, our Journal requests from the authors that sponsors do not interfere in the evaluation, selection, or editing of individual articles, and that part or whole of the article cannot be published elsewhere without written permission.

The Turkish Journal of Spinal Surgery is available to the members of the society and subscribers free of charge. The publication and distribution costs are met by membership fees, congresses, and the advertisements appearing in the journal. The advertisement fees are based on actual pricing.

The Editorial Board has the right for signing contracts with one or more financial organizations for sponsorship. However, sponsors cannot interfere in the scientific content and design of the journal,

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and in selection, publication order, or editing of individual articles.

The Turkish Journal of Spinal Surgery agrees to comply with the “Global Compact” initiative of the UN, and this has been notified to the UN. Therefore, our journal has a full respect to human rights in general, and patient rights in particular, in addition to animal rights in experiments; and these principles are an integral part of our publication policy.

Recent advances in clinical research necessitate more sophisticated statistical methods, well-designed research plans, and more refined reporting. Scientific articles, as in other types of articles, represent not only an accomplishment, but also a creative process. The quality of a report depends on the quality of the design and management of the research.

Well-designed questions or hypotheses are associated with the design. Well-designed hypotheses reflect the design, and the design reflects the hypothesis. Two factors that determine the efficiency of a report are focus and shortness. Drawing the attention to limited number of subjects allows the author to focus on critical issues. Avoidance from repetitions (apart from a few exceptions), a simple language, and correct grammar are a key to preparing a concise text. Only few articles need to exceed 3000 words, and longer articles may be accepted when new methods are being reported or literature is being reviewed. Although authors should avoid complexity, the critical information for effective communication usually means the repetition of questions (or hypotheses or key subjects). Questions must be stated in Summary, Introduction and Discussion sections, and the answers should be mentioned in Summary, Results, and Discussion sections.

Although many journals issue written instructions for the formatting of articles, the style of the authors shows some variance, mainly due to their writing habits. The Turkish Journal of Spinal Surgery adopts the AMA style as a general instruction for formatting. However, not many authors have adequate time for learning this style. Thus, our journal is tolerant to personal style within the limitations of correct grammar and plain and efficient communication.

## YAZARLARA BİLGİLER

### Türk Omurga Cerrahisi Dergisi (www.jtss.org),

Omurga Cerrahisi Derneği'nin yayın organıdır. Omurga hastalıkları ile ilgilenen hekim grubuna doğrudan hitap eden multidisipliner, hakemli bir dergidir ve spinal bilginin gelişimine önemli katkıda bulunacak orijinal çalışmaların yayınlanması amacıyla düzenlenmiştir. Dergi, klinik ve temel araştırma, davetli derlemeler ve olgu sunumları şeklindeki Yayın Kurulunun onayladığı orijinal makaleleri İngilizce veya Türkçe olarak yayımlar. Çalışmalar, en az iki hakem tarafından değerlendirildikten sonra yayımlanabilir. Yayın Kurulu, yayını kabul etme, düzeltilmesini isteme ve yayınlamama hakkına sahiptir. Dergi, her üç ayda bir çıkar ve dört sayıda bir cilt tamamlanır.

- Türk omurga cerrahisi dergisi, yıl içinde 4 kez yayınlanır: Mart, Haziran, Eylül ve Aralık.

- Türk omurga cerrahisi dergisine İngilizce özet (Summary) ve İngilizce anahtar kelimeler (Key Words) bölümlerine sahip, "Omurga Cerrahisi" ile ilgili:

I- Orijinal klinik ve laboratuvar araştırma yazıları,

II- Vaka takdimleri,

III- Derleme yazılar kabul edilir.

Dergiye ulaşan çalışmanın, başka bir yerde daha önce yayınlanmamış (özet veya ön rapor dışında) veya yayın için değerlendirme aşamasında olmaması gerekir. Yayında adı geçen her çalışmacının, çalışmaya katılmış olduğu düşünülür. Tüm yazarlar, çalışmayı okuduklarını ve içeriği ile Türk Omurga Cerrahisi Dergisi'ne gönderilmesini onayladıklarını ekteki "Başvuru Mektubu"nda olduğu gibi ayrı bir yazı ile bildirmelidirler. Çalışmanın doğruluğu ile ilgili son sorumluluk, dergi, editörler veya yayıncıya değil, yazarlara aittir. Başvuru mektubunda ayrıca herhangi bir ticari kuruluştan destek alıp almadıklarını da açıkça belirtmelidirler.

Hastanın isminin ve bilgilerinin saklanması esastır. Hastanın kimliğinin dikkatli bir şekilde korunacağını garanti edilmesi ve çalışmada insanlar üzerinde yapıldığı belirtilen herhangi bir deneysel çalışmanın, hasta bilgilendirilerek ve insan denekler üzerinde yapılan deneysel araştırmalarda öngörülen ve tüm yazarların görüş birliğine vardığı yasal çerçevesinde uygulanması, yazarların sorumluluğudur.

Hastalardan yazılı izin alınıp ve bu belge çalışmayla birlikte dergiye yollanmadıkça hastaların tanınmaması için gözleri kapatılmalı ve fotoğraflardan isimleri çıkartmalıdır.

- **İzinler:** Yazarlar, ekte yer alan örnekteki gibi (Yayın Hakkı Devri Mektubu) ayrı bir yazı halinde, çalışmanın daha önce başka bir dergide yayınlanmadığını ve değerlendirmede olmadığını bildirmeleri gerekir. Yazarlar aynı zamanda çalışmalarının tüm yayın haklarını dergimize devrettiklerini bu yazı ile bildirmelidirler. Yazarların, başka bir yerde yayın-

lanmış olan alıntı, tablo ve resimlerin kullanılabilmesi için telif hakkı sahibinden (genellikle yayıncı) yazılı izin almaları ve göndermeleri gerekir.

Derlemelerin formatı, orijinal verileri bildirenlerinkinden farklı olacaktır. Fakat ortak prensiplerin çoğu uygulanır. Bir incelemenin bir "Özet", bir "Giriş" ve bir "Tartışma" bölümüne ihtiyacı vardır. Giriş bölümünün odaklanmış konulara ve bu konular için bir gerekçeye ihtiyacı vardır. Yazarlar çalışmalarını diğer mevcut materyalden (monografi, kitap bölümleri) ayırtan benzersiz yaklaşımları okuyucuya sunmalıdır. Konular "Giriş" bölümünün son paragrafında verilmelidir. Bir incelemenin "Giriş" bölümü, orijinal materyali veren belgelere dayanan bir makale ile birlikte dört paragraftan uzun olması gerekmez. Daha uzun "Giriş" ler odağı kaybetmeye yatkındır, bu nedenle okuyucu hangi yeni bilginin sunulacağından emin olamaz.

"Giriş"ten sonraki bölümler nerdeyse her zaman belirli incelemeye özgüdür, fakat tutarlı bir şekilde düzenlenmelidir. Başlıklar (ve uygunsa alt başlıklar) paralel yapı izlemeli ve benzer konular yansıtmalıdır (örneğin tanısal kategoriler, metot seçimi, cerrahi müdahale seçimi gibi). Okuyucu sadece başlıkları göz önüne aldığında, incelemenin mantığını anlayacak şekilde açık olmalıdır. "Tartışma", gözden geçirilmiş literatürle uyumlu bir bütün olarak ve "Giriş"te belirtilen yeni konuların kapsamında birleştirir. Sınırlamalar, verilmiş bir çalışmadakinden ziyade literatürdekileri yansıtmalıdır. Bu sınırlamalar, teşhisin veya tedavi seçiminin az veya çok belirli değerlendirilmesine engel olan literatürdeki boşluklarla ilgili olacaktır. Literatürdeki çalışmalar kısaca araştırılmalıdır. Okuyucu sadece sınırlamaları araştırarak literatürü perspektife oturtur. Yazarlar "Tartışma" bölümünün, "Özet" bölümünün sonunda kısa haliyle verilecek olmasına benzer şekilde özet ifadeler ile bitmelidir.

Genel olarak bir inceleme, konuya göre değişiklik göstermekle birlikte, belgelere dayalı bir makale ile karşılaştırıldığında daha geniş bir literatür incelemesine ihtiyaç duyar. Bazı konulara tüm bir monografide bile, (örneğin osteoporoz) kapsamlı şekilde atıfta bulunulamaz. Bununla beraber yazarların bir incelemenin tüm literatürü temsil ettiğini, ve bunun büyük olması durumunda çok sayıda referansa ihtiyaç duyulduğu unutulmamalıdır.

- **Orijinal makaleler:** "Başlık sayfası", "Özet", "Anahtar Kelimeler", "Abstract", "Key Words", "Giriş", "Materyal-Metot", "Sonuçlar", "Tartışma", "Çıkarımlar" "Kaynaklar" bölümlerini içermelidir. İngilizce olan orijinal makalelere Türkçe "Özet" ve Türkçe "Anahtar Kelimeler" bölümü eklenmelidir.

- **Başlık (80 karakter, boşluklar dahil):** Özet bölümünün okuyucunun dikkatini çekmesinde önemli olduğu gibi, başlık da aynı önemi taşımaktadır. Az sayıda kısa kelime ile soru ortaya atan veya soru cevaplayan başlıklar, sadece konuyu belirten başlıklardan daha başarılı olacaktır. Ay-

rica "Bisfosfonatlar kemik kaybını azaltır" gibi başlıklar ana mesajı etkili şekilde taşır ve okuyucuların daha çok aklında kalır.

- **Başlık Sayfası:** a) Çalışmanın açıklayıcı bir başlığını, b) Tüm yazarların tam isimleri ve akademik unvanlarını, c) Sorumlu yazarın adını, adresini, faks ve telefon numarasını, e-posta adresini, d) Sorumlu yazardan farklı ise "ayrı basımların" gönderilme adresini içermelidir. Başlık sayfası ayrıca hastalardan gerekli izinlerin alındığına ve etik kurul onayının olduğuna dair bilgiyi de içermelidir. Başlık sayfasında mutlaka "Kanıt Düzeyi" belirtilmelidir. Bunun için ekte yer alan Tablo-1'e bakılabilir. Ayrıca çalışmanın Tablo-2'de listesi yer alan konulardan hangisine girdiği (en fazla 3 konu) belirtilmelidir.

- **Özet:** İkinci sayfada, İngilizce yazılar için Türkçe, Türkçe yazılar için İngilizce, 150-250 sözcüklük bir özet yer almaktadır. Özet başlıca; geçmiş bilgiler, çalışmanın amacı, materyal-metot, sonuçlar ve çıkarımlar (Background Data, Purpose, Material- Methods, Results and Conclusion) bölümlerini içermelidir. İngilizce ve Türkçe özet birebir aynı olmalıdır.

Genel olarak bir Özet bölümü makalenin tamamı tamamlandıktan sonra yazılmalıdır. Bunun sebebi, yazma sürecinin düşünceyi ve hatta belki de amacı nasıl değiştirdiği ile ilişkilidir. Yazar(lar) ancak verilerin dikkatli gözden geçirilmesi ve literatür ile sentezinden sonra etkili bir özet yazabilir.

Günümüzde pek çok okuyucu basılı materyallerde aramaktansa, internet bazlı veritabanları aracılığıyla tıbbi ve bilimsel bilgiye erişiyor. Erişimin dışında okuyucunun giriş başlıklar ve özetlerden geçtiği için sağlam başlıklar ve özetler okuyucun dikkatini daha etkili şekilde çeker. Bir okuyucunun tüm makaleyi inceleyip incelemeyeceği çoğunlukla zorlayıcı bilgi içeren bir özete bağlıdır. Zorlayıcı bir Özet soruları veya amaçları, metodları, sonuçları (çoğunlukla nicel veriler) ve neticeleri içerir. Bunların her biri bir veya iki ifadeyle verilebilir. "Bu raporun açıkladığı konu ..." gibi ifadeler çok az faydalı bilgi verir.

- **Anahtar Kelimeler :** Bilimsel indekslerde ve arama motorlarında standart kullanılan kelimeler seçilmelidir. Anahtar kelime sayısı en az 3 en fazla 5 adet olmalıdır.

- **Giriş (250 – 750 kelime):** Makale konusuyla ilgili tarihsel literatür bilgisini içermeli, problem ortaya konulmalı, çalışmanın amacı ve problemin çözümü için yapılanlar anlatılmalıdır.

Giriş kısmı en kısa bölüm olduğu halde belki de en kritik bölümdür. Giriş bölümü konuları etkili bir biçimde belirtmeli, bu konular ve sorular için gerekçeleri formüle etmelidir. Bununla beraber çalışmaların çoğu şunlar için yayınlanır: (1) tamamen yeni buluşları bildirmek için (nadiren vaka raporlar, fakat bazen temel veya klinik çalışmalar); (2) daha önceden

raporlanan çalışmaları teyit etmek için (örneğin vaka raporları, küçük ilk seriler); (3) veriler ve/veya sonuçlar çelişkili ise literatürdeki çelişkileri takdim etmek veya belirtmek için. Araştırmalar ve diğer özel makalelerin dışında bu üç amaçtan bir tanesi genelde Giriş bölümünde belirtilmelidir.

İlk paragraf genel konuyu veya problemi sunmalı ve önemini belirtmelidir, ikinci ve belki üçüncü bir paragraf gerekçeleri sunmalı, ve bir son paragraf soruları, hipotezleri ve amaçları belirtmelidir. Bazıları gerekçeleri ve hipotezleri formüle etmeyi Aristo mantığı (tasımsal model) olarak düşünebilir ve şu formu ele alabilir: A, B ve C ise, D, E ve F'dir. A, B ve C öncülleri kabul edilmiş olguları yansıtırken, D, E veya F mantıklı çıkarımlar veya tahminleri yansıtır. Öncüller en iyi yayınlanmış yayınlardan çıkar, fakat mevcut veri yoksa yayınlanmış gözlemler (tipik niteleyici), mantıklı iddialar veya fikir birliği kullanılabilir. Bu öncüllerin gücü aşağı yukarı veriler ile gözlemlerin azalan sırasında veya fikre karşı olan iddiadır. D, E veya F mantıklı sonuçları yansıtır. Gözlem sıralarını açıklamalar (D, E veya F) mantıklı şekilde takip eder. Bu nedenle hipotezleri formüle ederken, deneyleri tasarlayan ve sonuçları raporlayan araştırmacılar tek bir açıklamaya bağlı kalmamalıdır.

Gerçekten yeni materyallerin olduğu ender istisnalarla birlikte, yazarlar gerekçeler öne sürerken temsili literatüre referans vermemelidir. Bu gerekçeler yenilik ve soruların geçerliliğini kurar ve literatüre yerleştirir. Yazarlar öncülleri ilgili aktarmalar ile sade bir şekilde belirtmeli ve alıntılar ile yazarlarının isimlerini tanımlamaktan kaçınmalıdır. Bu yaklaşımdaki istisnalar yeni bir metod için gerekçe geliştirmekte gerekli olduğunda geçmiş metodların tanımını, veya geçmiş örnek oluştururken önemli olduğunda yazarların isimlerine ithafı içerir. Alıntıların açıklamaları uygun görülürse Tartışma bölümünde takip edebilir. Bir gerekçe hazırlarken, her türlü yeni müdahale belli sorunları çözmek içindir. Örneğin, yeni implantlar (konsept olarak yeni değilse) daha önceki implantlar ile yaşanan sorunları bertaraf etmek için belirli kriterlere göre tasarlanır. Amaç yeni bir tedavinin raporlanması ise çalışmanın öncülleri, açıklanan sorunları (mümkünse nicel sıklıklarla) içermelidir ve onlara atıfta bulunmalıdır.

Son paragrafta mantıklı olarak öncekilerden başlar ve çalışmanın değişkenlerine (bağımlı, bağımsız) göre belirtilecek sorular veya hipotezleri açıklamalıdır. Çalışma değişkenlerine göre dayandırılmayan konular anlamlı şekilde belirtilemez. Raporun odağı bu sorulara odaklanmayla ilgilidir ve rapor literatürde iyi şekilde açıklanmış cevapları olan sorulardan kaçınmalıdır (örneğin idiopatik skolyozda en fazla rotasyon olan omur apikal omur mudur?). Sadece yeni ve açıklanmamış bilgi varsa veriler, belirtilmiş soruları cevaplama gereği dışında bildirilmelidir.

- **Materyal-Metot (1000-1500 kelime):** Hastaların epide-miyolojik, demografik bilgileri, klinik ve radyolojik çalış-maları, cerrahi teknik, sonuçların değerlendirme metodu ve istatistik çalışmalar bu bölümde ayrıntılı olarak belirtil-me-lidir.

Prensip olarak "Materyal ve Metot"lar çalışmayı tekrar-la-mak için başka araştırmacı için yeterli detayları içermelidir. Uygulamada ise, bu tür detaylar ne pratiktir ne de istenir çünkü pek çok metot daha önce daha detaylı olarak yayın-lanmıştır ve ayrıca uzun tanımlar okumayı zorlaştırır. Bu-nunla beraber, Materyaller ve Metotlar bölümü tipik olarak en uzun bölümdür.

Klinik çalışmaları raporlarken yazarların ülkelerinin kanun-larına ve düzenlemelerine göre etik komitelerinin veya kurumsal inceleme kurulunun onayını belirtmek zorun-dadırlar. Uygun yerde bilgisi verilen onay belirtilmelidir. Bu onay "Materyal ve Metot" bölümünün ilk paragrafında belirtilmelidir.

Başlangıçta okur temel çalışma tasarısını görmelidir. Yaz-ar-lar daha önce raporlanmış metotları sadece kısa bir şekilde tarif etmeli ve atıfta bulunmalıdır. Yazarlar bu metotları de-ğiştirdiğinde bu değişiklikler ilave açıklama gerektirir. Klinik çalışmalarda hasta sayısı ve demografisi başta belirtilmeli-dir. Klinik çalışmalar dahil olan ve hariç olan kriterleri, serile-rin ardıl mı veya seçilmiş mi olduğunu; seçilmişse seçimde rol oynayan kriterleri belirtmelidir. Okuyucu bu tanımdan yargının tüm potansiyel kaynaklarını, teşhisi, istisnayı, tek-rarı veya tedavi fikrini anlamalıdır. Temel olarak gelecek ça-lışmalar için harcanan çaba ve masraf ile, çoğu yayınlanmış klinik çalışmanın geçmişe dayalı olması şaşırtıcı değildir. Bu tür çalışmalar çok kez geçmişe dayalı olduğu için haksız yere eleştirilir, fakat bu çalışmanın geçerliliğini ve değerini ortadan kaldıramaz. Dikkatli bir şekilde hazırlanmış geç-mişe dayalı çalışmalar mevcut olan bilgilerin çoğunu sunar. Bununla beraber yazarlar takipte kayıp, zorluklar, eksik veri ve geçmişe dayalı çalışmalarda yaygın olan çeşitli fikir for-maları gibi potansiyel problemleri tanımlamalıdır.

Yazarlar istatistiksel analiz kullanırsa, Materyaller ve Metot-lar bölümünün sonunda kullanılan tüm istatistiksel testleri belirten bir paragraf yer almalıdır. Birden fazla test kulla-nıldıysa yazarlar hangi testlerin hangi veri seti için kullanıl-dığını belirtmelidir. Tüm istatistiksel testler varsayımlar ile ilişkilidir, verilerin bu varsayımları karşılayacağı açıkça gö-rülmezse yazarlar ya destekleyici verileri sunmalıdır yada alternatif testler kullanılmalıdır. Önem seviyesi seçimi ka-nıtlanmalıdır. 0,05'lik alfa ve 0,80'lik beta seviyesi seçil-me-si yaygın olmasına rağmen bu seviyeler bir şekilde isteğe bağlıdır ve her zaman uygun değildir. Bir hata çıkarımının ciddi olduğu durumda, klinik veya biyolojik önemi de-ğer-lendirmek için çalışma tasarısında farklı alfa ve beta seviye-leri seçilebilir.

- **Sonuçlar (250-750 kelime):** "Sonuçlar" mümkün oldu-ğunca anlaşılır ve özet belirtilmeli, ayrıntılı sonuçlar tablo-larda verilmelidir. Okuyucunun daha iyi anlayabilmesi için sonuçlar bölümü alt başlıklarla bölünebilir.

Sorular veya konulara "Giriş" bölümünde yeterli şekilde odaklandıysa, "Sonuçlar" bölümünün uzun olması gerek-mez. Genelde okuyucuyu metotların geçerliliğine ikna et-mek için bir veya iki paragrafa ihtiyaç duyulur, açıkça ortaya konan her soru veya hipotezi anlatan bir paragraf ve son olarak yeni ve beklenmeyen bulguları raporlayan parag-raflar. Her paragrafın ilk (konu) cümlesi konuyu belirtmeli veya soruyu yanıtlamalıdır. Okuyucu "Sonuçlar" bölümün-deki her paragrafın sadece ilk cümlesini göz önüne aldı-ğında, yazarın çıkarımlarının mantığı açık olmalıdır. Tüm rakam ve tablolara yapılan parantez içi ithaflar, yazarı ve-rilerin yorumunu yazılı olarak yapmaya zorlar; önemli olan materyal veriler değil yazarın verileri yorumlamasıdır.

Verilerin istatistiksel raporlanması özel dikkat gerektirir. Bazı sonuçları vurgulamak için artar veya azalır (veya daha fazladır veya daha azdır) ifadeleri ile birlikte ve karşıla-ştırmalı kısımlardan hemen sonra p (veya başka istatistik) değerini parantez içinde belirtmek daha etkilidir. Buna ilave olarak, istatistiksel olarak farklı veya önemli ölçüde farklı olan koşullardan kaçınmak okuyucunun istatistiksel önemden bağımsız olarak istatistiksel değeri biyolojik veya klinik açıdan önemli olarak kabul edip etmeyeceklerine karar verme imkanı verir. Felsefe ve stil konusu olmasına rağmen, asıl p değeri, önceden konmuş seviyelerden daha düşük bir değer belirtmekten daha fazla bilgi taşır. Ayrıca Motulsky'nin dikkat çektiği üzere, "Bir sonucun çarpıcı ol-madığını okuduysanız, düşünmeye devam edin ... Önce, güven aralığına bakın ... İkinci olarak eğer orada olsaydı bir çarpıcı farkı bulmak için çalışma nın gücünü sorgulayın." Bu yaklaşım okuyucuya biyolojik veya klinik etkililik konu-sunda daha iyi fikir verecektir.

- **Tartışma (750-1250 kelime) :** Tartışma bölümü spesifik unsurlar içermelidir: bunun için problem veya sorunun tekrar belirtilmesi, sınırlamalar ve varsayımların araştırıl-ması, literatürdeki bilgiler ile bir karşılaştırma, karşılaştı-rmanın bir sentezi ile sonuca ulaşmak gereklidir. Problem veya sorunun yeniden belirtilmesinin vurgu amacıyla kısa olması gerekmektedir. Bunun sonrasında varsayımların ve sınırlamaların verilmelidir. Sınırlamaları araştırmadaki başa-rısızlık, yazarın bilmemesi veya göz ardı ettiğini seçmesini gösterir, bu da okuru yanlış yönlendirir. Bu sınırlamaları araştırma sadece kısa olmalıdır, fakat tüm eleştirel konular tartışılmalıdır ve okuyucunun sonuçları kafasında şüpheye düşürmemesi sağlanmalıdır.

Sonrasında yazarlar verilerini literatürde belirtilen veriler ile karşılaştırmalı ve/veya karşıtlıklarını bulmalıdır. Genel olarak bu raporların çoğu Giriş bölümünde bahsedilen ge-

rekçeleri içerecektir. Verilen bir çalışmanın özellikleri nede- niyle, veriler ve gözlemler literatürdekiler ile karşılaştırılabilir olmayabilir, en az eğilimleri içermemesi yaygın değildir. Nicel karşılaştırmalar, çalışmadaki verilerin yaklaşık değer olduğu konusunda okuyucuyu en etkili şekilde ikna eder, ve tablolar veya rakamlar bilgiyi etkili şekilde verir. Mümkün olduğunda çelişkiler belirtilmeli ve açıklanmalıdır; bir çelişkinin açıklaması açık olmadığı zaman bu da belirtilmelidir. Sadece makaledeki verilere dayalı olan sonuçlar nadiren kesindir çünkü literatür neredeyse her zaman önceki bilgileri içerir. Herhangi bir raporun kalitesi bu karşılaştırmaların bağımsız doğasına bağlı olacaktır. Son olarak, yazar(lar) verilerini literatürdekiler ile sentezlemelidir. Hiçbir eleştirel veri gözden kaçmamalıdır, çünkü karşıt veri bir görüşü etkili şekilde çürütebilir. Yani nihai sonuçlar sadece sundukları yeni veriler ile değil ayrıca literatürdekiler ile de uyumlu olmalıdır.

- **Çıkarımlar :** Çalışma sonucunda yazarların vardığı yargılar ve öneriler kısaca belirtilmelidir. Bu bölümde çalışmada elde edilen bilimsel verilere dayanmayan tahmin ve kişisel fikirleri içeren cümlelere yer verilmemelidir.

- **Kaynaklar :** Kaynakların bilimsel indekslerde bulunabilir olmasına dikkat edilmelidir. Kişisel görüşme bilgilerine kaynaklarda yer verilemez. **Kaynaklar alfabetik sıra ile dizilmeli ve yazı içinde mutlaka site edilmeli, site edilmeyen kaynaklar listede yer almamalıdır.** Sempozyum ve Kongre bildiri sunumlarının özetleri makale ile birlikte yollanmalıdır. Aşağıdaki listeleme yöntemi kullanılmalıdır.

**Referanslar (ithaflar)** öncelikle emsal taranmış dergiler, standart ders kitapları veya monografi, veya kabul görmüş ve sabit elektronik kaynaklardan elde edilmelidir. Yazarlar verilerin yorumuna bağlı alıntılar için genellikle sadece yüksek kalitede emsal taranmış kaynaklar kullanılmalıdır. Özetler ve sunulan makaleler kullanılmamalıdır çünkü bu kategorilerdekilerin çoğu emsal taramadan geçirilmemiştir.

Gerek görülürse, yazarlardan herhangi bir kaynağın tam metni istenebilir. Veriler, yayınlanmamış bir kaynaktan alınmışsa, çalışmanın adı ve yeri gibi bilgiler verilmelidir. Gönderilen fakat henüz basım için kabul edilmemiş olan yazılar ve kişisel görüşmeler, metinde site edilmelidir. Dergi isimlerinin kısaltmaları için Index Medicus içeriğindeki "list of journals" bölümüne başvurulabilir veya <http://www.nlm.nih.gov/tsd/serials/lji.html> adresinden liste elde edilebilir. Kaynaklar, şu şekilde düzenlenmelidir:

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1. Berk H, Akçalı Ö, Kiter E, Alıcı E. Does anterior spinal instrument rotation cause rethrolisthesis of the lower instrumented vertebra? J Turk Spinal Surg 1997; 8 (1):5-9.

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3. Paul LW, Juhl JH. The essentials of Roentgen interpretation. Second Edition. Harper and Row, New York 1965, pp: 294-311.

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4. Stauffer ES, Kaufer H, Kling THF. Fractures and dislocations of the spine. In: Fractures in adults. Vol 2. Eds.: Rockwood CA, Gren DP, JB Lippincott, Philadelphia 1984, pp: 987-1092.

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#### **Toplantılarda Sunulan Bildiriler:**

8. Rhoton AL: Microsurgery of the Arnold-Chiari malformation with and without hydromyelia in adults. Presented at the annual meeting of the American Association of Neurological Surgeons, Miami, Florida, April 7, 1975.

- **Tablolar:** "Tablolar", Arap rakamlarıyla metin içinde geçiş sıralarına göre numaralandırılmalıdır. Her bir tablo, ayrı bir sayfada verilerek tablo başlığı ve açıklamalı yazısı eklenmelidir. "Tablolar", yazının içine sıkıştırılmamalı, çalışmanın tekrarından çok eki olmalıdır. "Tablolar"daki bilgiler yazıdan bağımsız incelense bile kolaylıkla fikir verecek nitelikte açık ve anlaşılır olmalıdır. "Tablolar"da verilen bilgiler yazı içinde tekrarlanmamalıdır. "Tablolar"da mümkünse istatistiksel ortalamalar, standart sapma, t ve p olasılık değerlerine yer verilmelidir. Tabloda yapılan kısaltmalar tablo altında açıklanmalıdır.

Rakamlar ve tablolar metinde materyali tekrar etmemeli, tamamlamalıdır. "Tablolar", yazılı şekilde tanımlaması zor olacak olan bilgiyi yoğun şekilde sunarlar. Metinde kısa ve öz olarak tarif edilen materyal tablo ve rakamlar ile anla-

tilmamalıdır. Örneğin klinik çalışmalar çoğu kez sonuçları yorumlamada önemli olmalarına rağmen makalede ortaya konan sorular için kritik olmayan demografik veriler için tamamlayıcı tablolar içerir. İyi odaklanmış çalışmalar "Giriş" bölümünde belirtilen her soru ve hipotez için sadece bir veya iki tablo veya rakamlar içerir. İlave materyaller beklenmeyen sonuçlar için kullanılabilir.

İyi yapılandırılmış "Tablolar", kendiliğinden açıklayıcıdır ve sadece bir başlığa ihtiyaç duyar. Her sütun birimlerle birlikte bir başlık içerir. Fakat rakamların sembollerin anlamlarını da içerecek şekilde bazı açıklamalara ihtiyacı olabilir. Gerekli veri açıklamalarına ek olarak rakam göstergeleri ortaya konan sorular çerçevesinde ana noktaları içermelidir; açıklamalar tam cümleler olarak yazılmalıdır. Okuyucu "Giriş" bölümünün son paragrafında soruları okuyabilmelidir, sonra "Sonuçlar" bölümünün her paragrafının ilk cümlesinde ve rakam açıklamalarında yanıtları bulabilmelidir.

- **Resim ve Şekiller:** Tüm figürler, metin içinde sırasıyla numaralandırılmalıdır. Her resim/şekil in arkasında, üzerinde numarasını, üst kenarını gösteren ok işaretini ve ilk yazarın adını içeren bir etiket bulunmalıdır. Siyah-beyaz baskılar, parlak kağıt üzerinde olmalıdır (9x13 cm). Resim/şekil üzerindeki yazının harf karakteri, figür küçülünce okunaklı olacak şekilde büyük olmalıdır. Profesyonel olmayan, daktilo karakterleri kabul edilmez. Resim/şekil açıklamaları, referanslardan sonra, ayrı bir kağıda yazılmalıdır. Dergi, yazının değerini arttıracak olan renkli baskıları da kabul eder. Ancak, bu baskılar, yazarlar ödeme yapmadan yayınlanamaz. Yazarlar, renkli baskılar için ödeme yapmazlarsa, siyah-beyaz basılmasını isteyebilirler. Elektronik yolla yollanan çalışmalar için resimler jpeg ve tiff formatında olmalı, 300 dpi üstünde rezolüsyona sahip olmalıdır. Resimler numaralandırılmalı, mutlaka yazı içinde site edilmelidir.

- **Stil:** Yazı şablonu, "American Medical Association Manual of Style (9th edition)" verilerine göre biçimlendirilir. Stedman's Medical Dictionary (27th edition) ve Merriam Webster's Collegiate Dictionary (10th edition), standart referanslar olarak kullanılmalıdır. İlaç ve terapötik ajanlar, kabul edilen jenerik ve kimyasal isimlerine göre yazılmalı ve kısaltma kullanılmamalıdır. Kod numaraları, ancak jenerik ismi bulunamıyorsa, kullanılmalıdır. Bu durumda, ilacın kimyasal yapısını veren kimyasal maddenin ismi ve şekli elde edilmelidir. ilaçların ticari isimleri, jenerik isminden sonra parantez içinde verilmelidir. Marka kanununa uymak için yazıda adı geçen her ilaç veya cihazın imalatçısının isim ve yeri belirtilmelidir. Ölçüm birimleri için metrik sistem, ısı ölçümü için Celsius kullanılmalıdır. Geleneksel birimlerden çok Standart birimlerin kullanılmasına dikkat edilmelidir.

Kısaltmalar, yazıda ilk kullanıldığı yerde, her tablo ve her figürde tanımlanmalıdır. Bir firma ismi bildirilecekse, imalatçının isim ve adresi (şehir ve ülke) verilmelidir.

Standart kısaltma listesi için, "Council of Biology Editors Style Guide" (Council of Science Editors, 9650 Rockville Pike, Bethesda, MD 20814 adresinden ulaşılabilir) veya diğer standart kaynaklara başvurulabilir.

- **Teşekkür :** Mali olmayan tüm teşekkürleri bu bölümde belirtiniz. Şu cümleyle başlayabilirsiniz: "Yazarlar ...'e teşekkür etmek ister". Teşekkür bölümünde, farmasötik endüstri dahil, tüm destekler bildirilmelidir.

#### - **Pratik İpuçları :**

1- Bu ifadelerin tüm kritik materyali içerip içermediğini ve mantıksal akışın açık olup olmadığını doğrulamak için metin içinde her paragrafın sadece ilk cümlesini okuyunuz.

2- "...bu raporun açıkladığı konu..." gibi Özet ifadelerden kaçınınız. Bu tür ifadeler okuyucu için temel bilgi vermez.

3- Özet bölümünde referans ve istatistiksel değerlerden kaçınınız.

4- Geçmişe dayalı örnek kurma haricinde alıntı yapılan yazarların isimlerini kullanmaktan kaçınınız. konuyu belirtiniz ve alt yazıyla alıntı veriniz.

5- Giriş bölümünün son paragrafında "...verilerimizin raporunuz sunuyoruz..." gibi cümlelerden kaçınınız. Bu tür ifadeler okuyucunun (ve yazarın!) dikkatini kritik konulara odaklamasını engeller.

6- Tablo ve rakamlara parantez içinde atıfta bulunun ve tablonun bir cümlemin öznesi veya nesnesi olduğu ifadelerden kaçınınız. Parantez içindeki atıflar tablo ve rakamın değil, tablo ve rakamlardaki bilginin yorumunu vurgular.

7- Giriş bölümünden Tartışma bölümüne kadar düzenli olarak kelimeleri sayınız.

- En fazla sayıda revizyona neden olan konuları şunlardır:

1- Açık sorular ve cevaplar verilmemiştir. Hastaları dahil eden tüm metinler için Türk Spinal Cerrahi Dergisi, açık bir birincil araştırma sorusu gerektiren Delil Düzeyi yayınlar. Bu soru açık bir şekilde cevaplanmalıdır.

2- Başlık sayfasında bir Delil Düzeyi belirtiniz. Düzey ne kadar yüksek olursa o kadar iyi olur.

3- Hasta popülasyonları, okuyucunun çeşitli eğilim formlarını araştırması için yeterli şekilde tanımlanmamıştır.

4- Çalışma sınırlamaları Tartışma bölümünde bulunmamıştır.

5- Aktarılmamış veya eksik referanslar; uygun formatında olmayan referanslar.

6- Eksik telif hakkı transfer formları.

7- Daha önce yayınlanmış materyal için eksik izinler (tablolar, şekiller)

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## Başvuru Mektubu Örneği:

### Türk Omurga Cerrahisi Dergisi

Sayın Editör,

Ekte Türk Omurga Cerrahisi Dergisi'nde incelenmek üzere "....." başlıklı bir metin gönderiyoruz.

Adı geçen yazarlar çalışmayı tasarladılar (parantez içinde uygun yazarların isimlerini yazınız), verileri topladılar (parantez içinde uygun isimlerini baş harflerini yazınız), verileri analiz ettiler (parantez içinde uygun yazarların isimlerini yazınız), ilk taslakları yazdılar (parantez içinde uygun yazarların isimlerini yazınız) ve veri ile analizin tutarlılığını sağladılar (parantez içinde uygun yazarların baş isimlerini yazınız).

Tüm yazarların bu metnin içeriklerini ve son halini gördüğünü ve onayladığını ve çalışmanın başka bir yerde tamamen veya kısmen yayınlanmadığını kabul ettiklerini teyit ederim.

Bu yazışmayı sağlayan yazar olarak ben (ve diğer yazarlar) Türk Omurga Cerrahisi Dergisi'nin tüm yazarların çalışmasının herhangi bir kısmını destekleyen ticari kurum ile bir sözleşme veya anlaşma imzalamış olabileceğini belirtmesini istediğini anlıyoruz. Ayrıca bu bilginin, çalışma incelenirken gizli tutulacağını ve yazımsal kararı etkilemeyeceğini, fakat çalışma yayınlanmak üzere kabul edilirse çalışmada bir ifşaat açıklaması yer alacağını kabul ediyoruz. Aşağıdaki açıklamaları, benim ve diğer yazarların çalışmayla ilgili olarak ticari ilgisi olmadığını belirtmek amacıyla seçtik.

1) Tüm yazarlar çalışma için toplanmış tüm veya bir kısım verilerin yayımını sınırlayacak veya her hangi bir sebepten yayımı geciktirecek şekilde, bu çalışmayla ilgili olarak ticari bir anlaşma imzalamadığını beyan ederler.

2) Yazarlardan biri veya birkaçı (isimleri) bu çalışmayla ilgili ticari bir anlaşma imzaladığını, ancak bu anlaşmaların ticari kurumun verilere sahip olma veya kontrol etme ve gözden geçirme ve değiştirmesine müsaade etmeyeceğini ve yayımlanmasını geciktirmeyeceğini veya önleyemeyeceğini taahhüt ederiz.

3) Yazarlardan biri veya birkaçı (parantez içinde uygun yazarların isimlerini yazınız) bu çalışmayla ilgili ticari bir anlaşma imzaladığını ve bu anlaşmaların ticari kurumun verilere sahip olma veya kontrol etme ve gözden geçirme ve değiştirme hakkına sahip olduğunu bildiririz ve fakat yayımlanmasını geciktirmeyeceğini ve önleyeceğini taahhüt ederiz

Saygılarımla,

Yazışmadan sorumlu yazar

## **Yazarlık Sorumluluğu, Finanssal İfşa, ve Telif Hakkı Transferi**

METİN BAŞLIĞI:

YAZIŞMAYI YÜRÜTEN YAZAR:

YAZIŞMA ADRESİ:

TELEFON / FAKS NUMARALARI:

Her yazar aşağıdaki açıklamayı okumalı ve imzalamalıdır; eğer gerekliyse bu belgeyi fotokopi ile çoğaltmalı ve orijinal imzaları için diğer yazarlara vermelidir. Doldurulmuş formlar yazı kuruluna gönderilmelidir:

### **SUNUM KOŞULLARI**

**SAKLI HAKLAR:** Telif hakkının dışında, çalışmayla ilgili diğer özel haklar yazarlar tarafından elde tutulmalıdır.

**ORJİNALİTE:** Her yazar çalışmaya katkısının orijinal olduğunu ve bu anlaşmaya girmek için tam yetkisinin olduğunu garanti eder. Ne bu çalışma ne de benzer bir çalışma yayınlanmıştır. Ayrıca bu yayının değerlendirmesi altındayken başka bir yerde yayınlanmak üzere de gönderilmemiştir ve gönderilmeyecektir.

**YAZAR SORUMLULUĞU:** Her yazar, çalışmanın yayın sorumluluğunu almak üzere, düşünsel içeriğe, verilerin analizi ve çalışmanın yazılmasında yeterli ölçüde yer aldığını doğrular. Her biri çalışmanın son versiyonunu incelemiştir, geçerli çalışmayı temsil ettiğine inanmaktadır, ve yayını onaylamaktadır. Ayrıca yayının editörleri çalışmanın dayandığı verileri talep ederlerse, hazırlamaları gerekir.

**TEKZİP:** Her yazar bu çalışmanın hakaret veya kanunsuz ifadeler içermediğini ve başkalarının haklarını ihlal etmediğini garanti eder. Telif hakkına tabi çalışmalardan alıntılar (metin, rakamlar, tablolar veya şekiller) dahilse, sunumdan önce yazarlar tarafından yazılı bir yayın verilir, ve orijinal yayına kredi uygun şekilde alınıldır. Her yazar çalışmayı takdim etmeden önce, isimleri veya fotoğrafları çalışmanın bir parçası olarak kullanılan hastalardan yazılı ibralarını aldığını garanti eder. Yayın Kurulu bu yazılı ibraların kopyalarını isterse yazarlar bunları sunmalıdır.

### **TELİF HAKKININ TRANSFERİ**

**YAZARLARIN KENDİ ÇALIŞMALARI:** Türk Omurga Cerrahisi Dergisi çalışmayı yayınlaması halinde, yazarlar burada tüm dünyada, tüm dillerde ve CD-ROM, internet ve intranet gibi elektronik medya dahil tüm medya formlarında tüm telif hakkını Türk Omurga Cerrahisi Dergisi'ne transfer eder, devreder ve nakleder. Eğer Türk Omurga Cerrahisi Dergisi herhangi bir sebepten dolayı, bir yazarın çalışmaya takdimini yayınlamamaya karar verirse, yazıyı yürüten yazara kararını bildiren notu hemen gönderir, bu anlaşma feshedilir, ne yazar ne de Türk Omurga Cerrahisi Dergisi başka sorumluluk veya yükümlülük altında olmaz. Yazarlar

Türk Omurga Cerrahisi Dergisi'ne çalışmada ve çalışmanın veya yayının promosyonunda isimlerini ve biyografik verileri (profesyonel bağlantı dahil) kullanma haklarını verirler.

**KİRA İÇİN YAPILMIŞ ÇALIŞMALAR:** Eğer bu çalışma bir başka kişi veya kurum tarafından komisyonlandırılmışsa, veya bir çalışanın görevinin parçası olarak yazıldıysa, komisyon kurumunun yetkili bir temsilcisi veya çalışan kişi de kurumdaki unvanını belirterek bu formu imzalamalıdır.

**FİNANSAL İFŞA:** Her yazar, ayrı bir ek olarak ifşa edilmesi haricinde, takdim edilen makale ile ilişkili olarak bir çıkar çatışması olarak görülebilecek ticari bir ilişkisi (örneğin danışmanlık, hisse senedi sahipliği, sermaye ortaklığı, patent/lisans düzenlemeleri, vs) olmadığını doğrular. Çalışmayı destekleyen tüm fon temin kaynakları ve yazarların tüm kurumsal veya tüzel bağlar çalışmada bir dipnotta verilir.

### **KURUMSAL İNCELEME KURULU / HAYVAN**

**GÖZETİM KOMİTESİ ONAYI:** Her yazar kendi kurumunun, hayvan veya insan içeren her türlü inceleme için protokolü kabul ettiğini ve tüm deneylerin etik ve insani araştırma ilkelerine uygun olarak yürütüldüğünü doğrular.

İmza	Basılı İsim	Tarih
İmza	Basılı İsim	Tarih
İmza	Basılı İsim	Tarih

**TABLO-1. KANIT DÜZEYLERİ****DÜZEY- I .**

- 1) İstatistiksel önemlilik testleri yapılan, vakaların randomize seçildiği, çift kör kontrol gruplarının yer aldığı deneysel çalışmalar
- 2) Vakaların % 80'den fazlasının kontrollere riayet ettiği tanı, tedavi ve prognostik kriterleri karşılaştıran vakaların randomize seçildiği, istatistiksel önemlilik testleri yapılan ileriye dönük planlanan (prospektif) klinik çalışmalar
- 3) Ardıl olgular için önceden seçilmiş kriterlerle istatistiksel önemlilik testleri yapılan, evrensel (altın standart) referanslarla mukayese edilen ileriye dönük klinik çalışmalar
- 4) Düzey – I çalışmaların iki veya daha fazlasının verilerini, önceden belirlenen yöntemlerle ve istatistikî olarak önemlilik testleri yapılarak karşılaştırılan sistematik inceleme (meta analiz) çalışmaları
- 5) Çok merkezli, randomize prospektif çalışmalar

**DÜZEY –II.**

- 1) Vakaların % 80'den azının çalışmaya alındığı randomize prospektif çalışmalar
- 2) Randomizasyon yapılmayan tüm Düzey-I çalışmalar
- 3) Randomize retrospektif klinik çalışmalar
- 4) Düzey-II çalışmaların meta- analizi

**DÜZEY- III.**

- 1) Randomizasyon yapılmayan düzey-II çalışmalar (prospektif klinik araştırmalar vb.)
- 2) Ardıl olmayan vakaların karşılaştırıldığı (tutarlı referans aralığı olmaksızın) klinik çalışmalar
- 3) Düzey III çalışmaların meta – analizi

**DÜZEY- IV.**

- 1) Olgu sunumları
- 2) Zayıf referans aralığı olan istatistiksel önemlilik verileri yapılmayan vaka serileri

**DÜZEY – V.**

- 1) Uzman görüşü
- 2) Bir çalışma hakkında kişisel deneyimlerin aktarıldığı bilimsel dayanağı olmaksızın bildiren görüş yazıları

**TABLO-2. KLİNİK ALANLAR**

Makale	Servikal omurga
Anatomi	Servikal miyolopati
Temel Bilimler	Servikal rekonstrüksiyon
Biyomekanik	Servikal disk hastalığı
Deformite	whiplash
Skolyoz	Kraniyoservikal bileşke
Adölesan idiopatik	Atlantoaksiyel
Kifoz	Torasik omurga
Konjenital	Torakolomber omurga
Dejeneratif	Lomber omurga
Tanısal yöntemler	Lumbosakral bileşke
Epidemioloji	Psikoloji
Fizik Tedavi	Sinir
Fonksiyon	Sinir kökü
Halk sağlığı	Siyatik
Literatür gözden geçirme	Enjeksiyon
Meta-Analiz	Epidural
İş sağlığı	Diğer Hastalık
Sonuçlar	Metabolik kemik hastalıkları
Tedavi	Epilepsi
Konservatif tedavi	Lupus
Primer tedavi	Kanser
Yaşam kalitesi	Parkinson
Tedavi etkinliği	Tüberküloz
Pediyatrik	Romatoloji
Rehabilitasyon	Artrit
Cerrahi	Osteoporoz
Klinik cerrahi	Kemik
Disk cerrahisi	Kemik dansitesi
Nöroşirurji	Kemik biyomekaniği
Rekonstrüksiyon cerrahisi	Kemik rejenerasyonu
görüntüleme rehberliğinde cerrahi endoskopi	Kemik grefti
Başarısız omurga cerrahisi	Greft ürünleri
Mikrocerrahi	Kırık
BT yardımıyla	Disk
Minimal invazif	Disk dejenerasyonu
Görüntüleme	Herniye disk
Radyoloji	Disk patolojisi
MRI	Disk replasmanı
BT	Artifisial disk
Füzyon	IDET
Füzyon kafesleri	Travma
Enstrümantasyon	Spinal kord
Pedikül vidası	Spinal kord yaralanması
Fiksasyon	Klinik eğilimler
Ağrı	Randomize çalışmalar
Kronik ağrı	Biyoloji
Bel ağrısı	Biyokimya
Postoperatif ağrı	Moleküler biyoloji
Ağrı ölçülü	Tümör
Boyun ağrısı	Genetik
Diskojenik ağrı	Stenoz
Nöroloji	Enfeksiyon
Nörofizyoloji	Non-Operatif Tedavi
Nörolojik muayene	Hareket Analizi
Nörokimya	Fizik Tedavi
Nöropatoloji	Manüplasyon
Kognitif nöroloji	Anestezi
Nöromusküler omurga hastalıkları	

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## INSTRUCTIONS TO AUTHORS

**The Journal of Turkish Spinal Surgery (www.jtss.org),** is the official publication of the Turkish Spinal Surgery Society. It is a peer-reviewed multidisciplinary journal for the physicians who deal with spinal diseases and publishes original studies which offer significant contributions to the development of the spinal knowledge. The journal publishes original scientific research articles, invited reviews and case reports that are accepted by the Editorial Board, in English or Turkish. The articles can only be published after being reviewed by at least two referees and Editorial Board has the right to accept, revise or reject a manuscript. The journal is published once in every three months and a volume consists of four issues.

The Journal of Turkish Spinal Surgery is published four times a year: on March, June, September, and December.

- Following types of manuscripts related to the field of "Spinal Surgery" with English Summary and Keywords are accepted for publication:

I- Original clinical and experimental research studies;

II- Case presentations; and

III- Reviews.

The manuscript submitted to the journal should not be previously published (except as an abstract or a preliminary report) or should not be under consideration for publication elsewhere. Every person listed as an author is expected to have been participated in the study to a significant extent. All authors should confirm that they have read the study and agreed to the submission to the Journal of Turkish Spinal Surgery for publication. This should be notified with a separate document as shown in the "Cover Letter" in the appendix. Although the editors and referees make every effort to ensure the validity of published manuscripts,

the final responsibility rests with the authors,

not with the Journal, its editors, or the publisher. The source of any financial support for the study should be clearly indicated in the Cover Letter.

It is the author's responsibility to ensure that a patient's anonymity be carefully protected and to verify that any experimental investigation with human subjects reported in the manuscript was performed upon the informed consent of the patients and in accordance with all guidelines for experimental investigation on human subjects applicable at the institution(s) of all authors. Authors should mask patients' eyes and remove patients' names from figures unless they obtain written consent to do so from the patients; and this consent should be submitted along with the manuscript.

Clinically relevant scientific advances during recent years include use of contemporary outcome measures, more sophisticated statistical approaches, and increasing use and reporting of well-formulated research plans (particularly in clinical research).

Scientific writing, no less than any other form of writing, reflects a demanding creative process, not merely an act: the process of writing changes thought. The quality of a report depends on the quality of thought in the design and the rigor of conduct of the research. Well-posed questions or hypotheses interrelate with the design. Well-posed hypotheses imply design and design implies the hypotheses. The effectiveness of a report relates to brevity and focus. Drawing the attention to a few points will allow authors to focus on critical issues. Brevity is achieved in part by avoiding repetition (with a few exceptions to be noted), clear style, and proper grammar. Few original scientific articles need to be longer than 3000 words. Longer articles may be accepted if substantially novel methods are reported, or if the article reflects a comprehensive review of the literature. Although authors should avoid redundancy, effectively communicating critical information often requires repetition of the questions (or hypotheses/key issues) and answers. The questions should appear in the Abstract, Introduction, and Discussion, and the answers should appear in the Abstract, Results, and Discussion sections.

Although most journals publish guidelines for formatting a manuscript and many have more or less established writing styles (e.g., the American Medical Association Manual of Style), styles of writing are as numerous as authors. The Journal of Turkish Spinal Surgery traditionally has used the AMA style as a general guideline. However, few scientific and medical authors have the time to learn these styles. Therefore, within the limits of proper grammar and clear, effective communication, we will allow individual styles.

- **Permissions:** As shown in the example in the appendix (Letter of Copyright Transfer) the authors should declare in a separate statement that the study has not been previously published and is not under consideration for publication elsewhere. Also, the authors should state in the same statement that they transfer copyrights of their manuscript to our Journal. Quoted material and borrowed illustrations: if the authors have used any material that had appeared in a copyrighted publication, they are expected to obtain written permission letter and it should be submitted along with the manuscript.

- **Review articles:** The format for reviews substantially differs from those reporting original data. However, many of the principles noted above apply. A review still requires an Abstract, an Introduction, and a Discussion. The Introduction still requires focused issues and a rationale for the

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study. Authors should convey to readers the unique aspects of their reviews which distinguish them from other available material (e.g., monographs, book chapters). The main subject should be emphasized in the final paragraph of the Introduction. As for an original research article, the Introduction section of a review typically need not to be longer than four paragraphs. Longer Introductions tend to lose focus, so that the reader may not be sure what novel information will be presented. The sections after the Introduction are almost always unique to the particular review, but need to be organized in a coherent fashion. Headings (and subheadings when appropriate) should follow parallel construction and reflect analogous topics (e.g., diagnostic categories, alternative methods, alternative surgical interventions). If the reader considers only the headings, the logic of the review (as reflected in the Introduction) should be clear. Discussion synthesizes the reviewed literature as a whole coherently and within the context of the novel issues stated in the Introduction.

The limitations should reflect those of the literature, however, rather than a given study. Those limitations will relate to gaps in the literature which preclude more or less definitive assessment of diagnosis or selection of treatment, for example. Controversies in the literature should be briefly explored. Only by exploring limitations will the reader appropriately place the literature in perspective. Authors should end the Discussion by summary statements similar to those which will appear at the end of the Abstract in abbreviated form.

In general, a review requires a more extensive literature review than an original research article, although this will depend on the topic. Some topics (e.g., osteoporosis) could not be comprehensively referenced, even in an entire monograph. However, authors need to ensure that a review is representative of the entire body of literature, and when that body is large, many references are required.

- Original articles should contain the following sections: "Title Page", "Summary", "Keywords", "Introduction", "Materials and Methods", "Results", "Discussion", "Conclusions", and "References". Turkish "Summary" and "Keywords" sections should also be added if the original article is in English.

- Title (80 characters, including spaces): Just as the Abstract is important in capturing a reader's attention, so is the title. Titles rising or answering questions in a few brief words will far more likely do this than titles merely pointing to the topic. Furthermore, such titles as "Bisphosphonates reduce bone loss" effectively convey the main message and readers will more likely remember them. Manuscripts that do not follow the protocol described here will be returned to the corresponding author for technical revision before undergoing peer review. All manuscripts, either in English

or Turkish, should be typed double-spaced on one side of a standard typewriter paper, leaving at least 2.5 cm. margin on all sides. All pages should be numbered beginning from the title page.

- Title page should include: a) informative title of the paper, b) complete names of each author with their institutional affiliations, c) name, address, fax and telephone number, e-mail of the corresponding author, d) address for the reprints if different from that of the corresponding author. It should also be stated in the title page that informed consent was obtained from patients and that the study was approved by the ethics committee. The "Level of Evidence" should certainly be indicated in the title page (see Table 1 in the appendix). Also, the field of study should be pointed out as outlined in Table 2 (maximum three fields).

- **Summary:** A150 to 250 word summary should be included at the second page. The summary should be in Turkish for articles written in English and in Turkish for English articles. The main topics to be included in Summary section are as follows: Background Data, Purpose, Materials-Methods, Results and Conclusion. The English and Turkish versions of the Summary should be identical in meaning. Generally, an Abstract should be written after the entire manuscript is completed. The reason relates to how the process of writing changes thought and perhaps even purpose. Only after careful consideration of the data and a synthesis of the literature can author(s) write an effective abstract. Many readers now access medical and scientific information via Web-based databases rather than browsing hard copy material. Since the reader's introduction occurs through titles and abstracts, substantive titles and abstracts more effectively capture a reader's attention regardless of the method of access. Whether reader will examine an entire article often will depend on an abstract with compelling information. A compelling Abstract contains the questions or purposes, the methods, the results (most often quantitative data), and the conclusions. Each of these may be conveyed in one or two statements. Comments such as "this report describes..." convey little useful information.

- **Key Words :** Standard wording used in scientific indexes and search engines should be preferred. The minimum number for keywords is three and the maximum is five.

- **Introduction (250 – 750 words):** It should contain information on historical literature data on the relevant issue; the problem should be defined; and the objective of the study along with the problem solving methods should be mentioned.

The Introduction, although typically is the shortest of sections, perhaps the most critical. The Introduction must effectively state the issues and formulate the rationale for tho-

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se issues or questions. Its organization might differ somewhat for a clinical report, a study of new scientific data, or a description of a new method. Most studies, however, are published to: (1) report entirely novel findings (frequently case reports, but sometimes substantive basic or clinical studies); (2) confirm previously reported work (eg, case reports, small preliminary series) when such confirmation remains questionable; and (3) introduce or address controversies in the literature when data and/or conclusions conflict. Apart from reviews and other special articles, one of these three purposes generally should be apparent (and often explicit) in the Introduction.

The first paragraph should introduce the general topic or problem and emphasize its importance, a second and perhaps a third paragraph should provide the rationale of the study, and a final paragraph should state the questions, hypotheses, or purposes.

One may think of formulating rationale and hypotheses as Aristotelian logic (a modal syllogism) taking the form: If A, B, and C, then D, E, or F. The premises A, B, and C, reflect accepted facts whereas D, E, or F reflect logical outcomes or predictions. The premises best come from published data, but when data are not available, published observations (typically qualitative), logical arguments or consensus of opinion can be used. The strength of these premises is roughly in descending order from data to observations or argument to opinion. D, E, or F reflects logical consequences. For any set of observations, any number of explanations (D, E, or F) logically follows. Therefore, when formulating hypotheses (explanations), researchers designing experiments and reporting results should not rely on a single explanation.

With the rare exception of truly novel material, when establishing rationale authors should generously reference representative (although not necessarily exhaustive) literature. This rationale establishes novelty and validity of the questions and places it within the body of literature. Writers should merely state the premises with relevant citations (superscripted) and avoid describing cited works and authors' names. The exceptions to this approach include a description of past methods when essential to developing rationale for a new method, or a mention of authors' names when important to establish historic precedent. Amplification of the citations may follow in the Discussion when appropriate. In establishing a rationale, new interventions of any sort are intended to solve certain problems. For example, new implants (unless conceptually novel) typically will be designed according to certain criteria to eliminate problems with previous implants. If the purpose is to report a new treatment, the premises of the study should include those explicitly stated problems

(with quantitative frequencies when possible) and they should be referenced generously.

The final paragraph logically flows from the earlier ones, and should explicitly state the questions or hypotheses to be addressed in terms of the study (independent, dependent) variables. Any issue not posed in terms of study variables cannot be addressed meaningfully. Focus of the report relates to focus of these questions, and the report should avoid questions for which answers are well described in the literature (e.g., dislocation rates for an implant designed to minimize stress shielding). Only if there are new and unexpected information should data reported apart from that essential to answer the stated questions.

**- Materials - Methods (1000-1500 words):** Epidemiological/ demographic data regarding the study subjects; clinical and radiological investigations; surgical technique applied; evaluation methods; and statistical analyses should be described in detail.

In principle, the Materials and Methods should contain adequate detail for another investigator to replicate the study. In practice, such detail is neither practical nor desirable because many methods will have been published previously (and in greater detail), and because long descriptions make reading difficult. Nonetheless, the Materials and Methods section typically will be the longest section. When reporting clinical studies authors must state approval of the institutional review board or ethics committees according to the laws and regulations of their countries. Informed consent must be stated where appropriate. Such approval should be stated in the first paragraph of Materials and Methods. At the outset the reader should grasp the basic study design. Authors should only briefly describe and reference previously reported methods. When authors modify those methods, the modifications require additional description.

In clinical studies, the patient population and demographics should be outlined at the outset. Clinical reports must state inclusion and exclusion criteria and whether the series is consecutive or selected; if selected, criteria for selection should be stated. The reader should understand from this description all potential sources of bias such as referral, diagnosis, exclusion, recall, or treatment bias. Given the expense and effort for substantial prospective studies, it is not surprising that most published clinical studies are retrospective.

Such studies often are criticized unfairly for being retrospective, but that does not negate the validity or value of a study. Carefully designed retrospective studies provide most of the information available to clinicians. However, authors should describe potential problems such as loss to follow-up, difficulty in matching, missing data,

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and the various forms of bias more common with retrospective studies.

If authors use statistical analysis, a paragraph should appear at the end of Materials and Methods stating all statistical tests used. When multiple tests are used, authors should state which tests are used for which sets of data. All statistical tests are associated with assumptions, and when it is not obvious the data would meet those assumptions, the authors either should provide the supporting data (e.g., data are normally distributed, variances in groups are similar) or use alternative tests. Choice of level of significance should be justified. Although it is common to choose a level of alpha of 0.05 and a beta of 0.80, these levels are somewhat arbitrary and not always appropriate. In the case where the implications of an error are very serious (e.g., missing the diagnosis of a cancer), different alpha and beta levels might be chosen in the study design to assess clinical or biological significance.

- **Results (250-750 words):** "Results" section should be written in an explicit manner, and the details should be described in the tables. The results section can be divided into sub-sections for a more clear understanding.

If the questions or issues are adequately focused in the Introduction section, the Results section needs not to be long. Generally, one may need a paragraph or two to persuade the reader of the validity of the methods, one paragraph addressing each explicitly raised question or hypothesis, and finally, any paragraphs to report new and unexpected findings. The first (topic) sentence of each paragraph should state the point or answer the question. When the reader considers only the first sentence in each paragraph in Results, the logic of the authors' interpretations should be clear. Parenthetical reference to all figures and tables forces the author to textually state the interpretation of the data; the important material is the authors' interpretation of the data, not the data.

Statistical reporting of data deserves special consideration. Stating some outcome is increased or decreased (or greater or lesser) and parenthetically stating the p (or other statistical) value immediately after the comparative terms more effectively conveys information than stating something is or is not statistically significantly different from something else (different in what way? the reader may ask). Additionally, avoiding the terms 'statistically different' or 'significantly different' lets the reader determine whether they will consider the statistical value biologically or clinically significant, regardless of statistical significance.

Although a matter of philosophy and style, actual p values convey more information than stating a value less than some preset level. Furthermore, as Motulsky notes,

"When you read that a result is not significant, don't stop thinking... First, look at the confidence interval... Second, ask about the power of the study to find a significant difference if it were there." This approach will give the reader a much greater sense of biological or clinical significance.

- **Discussion (750 - 1250 words):** The Discussion section should contain specific elements: a restatement of the problem or question, an exploration of limitations and assumptions, a comparison and/or contrast with information (data, opinion) in the literature, and a synthesis of the comparison and the author's new data to arrive at conclusions. The restatement of the problem or questions should only be a brief emphasis. Exploration of assumptions and limitations are preferred to be next rather than at the end of the manuscript, because interpretation of what will follow depends on these limitations. Failure to explore limitations suggests the author(s) either do not know or choose to ignore them, potentially misleading the reader. Exploration of these limitations should be brief, but all critical issues must be discussed, and the reader should be persuaded they do not jeopardize the conclusions.

Next the authors should compare and/or contrast their data with data reported in the literature. Generally, many of these reports will include those cited as rationale in the Introduction. Because of the peculiarities of a given study the data or observations might not be strictly comparable to that in the literature, it is unusual that the literature (including that cited in the Introduction as rationale) would not contain at least trends. Quantitative comparisons most effectively persuade the reader that the data in the study are "in the ballpark," and tables or figures efficiently convey that information. Discrepancies should be stated and explained when possible; when an explanation of a discrepancy is not clear that also should be stated. Conclusions based solely on data in the paper seldom are warranted because the literature almost always contains previous information. The quality of any re parisons.

Finally, the author(s) should interpret their data in the light of the literature. No critical data should be overlooked, because contrary data might effectively refute an argument. That is, the final conclusions must be consistent not only with the new data presented, but also that in the literature.

- **Conclusion:** The conclusions and recommendations by the authors should be described briefly. Sentences containing personal opinions or hypotheses that are not based on the scientific data obtained from the study should be avoided.

- **References:** Care must be exercised to include references that are available in indexes. Data based on personal communication should not be included in the reference list. References should be arranged in alphabetical order and

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be cited within the text; references that are not cited should not be included in the reference list. The summary of the presentations made at Symposia or Congresses should be submitted together with the manuscript. The following listing method should be used.

References should derive primarily from peer-reviewed journals, standard textbooks or monographs, or well-accepted and stable electronic sources. For citations dependent on interpretation of data, authors generally should use only high quality peer-reviewed sources. Abstracts and submitted articles should not be used because many in both categories ultimately do not pass peer review.

They should be listed at the end of the paper in alphabetical order under the first author's last name and numbered accordingly. If needed, the authors may be asked to provide and send full text of any reference. If the authors refer to an unpublished data, they should state the name and institution of the study, Unpublished papers and personal communications must be cited in the text. For the abbreviations of the journal names, the authors can apply to "list of Journals" in Index Medicus or to the address "<http://www.nlm.nih.gov/tsd/serials/lji.html>".

**Please note the following examples of journal, book and other reference styles:**

**Journal article:**

1. Berk H, Akçali Ö, Kiter E, Alıcı E. Does anterior spinal instrument rotation cause rethrolisthesis of the lower instrumented vertebra? *J Turk Spin Surg* 1997; 8 (1): 5-9.

**Book chapter:**

2. Wedge IH, Kirkaldy-Willis WH, Kinnard P. Lumbar spinal stenosis. Chapter 5. In: *Disorders of the lumbar spine*. Eds.: Helfet A, Grubel DM. JB Lippincott, Philadelphia 1978, pp: 61-68.

**Entire book:**

3. Paul LW, Juhl IH. *The essentials of Roentgen interpretation*. Second Edition, Harper and Row, New York 1965, pp: 294-311.

**Book with volume number:**

4. Stauffer ES, Kaufer H, Kling THF. Fractures and dislocations of the spine. In: *Fractures in Adults*. Vol 2. Eds.: Rockwood CA, Green DP, JB Lippincott, Philadelphia 1984, pp: 987-1092.

**Journal article in press:**

5. Arslantaş A, Durmaz R, Coşan E, Tel E. Aneurysmal bone cysts of the cervical spine. *J Turk Spin Surg* (In press).

**Book in press:**

6. Condon RH. Modalities in the treatment of acute and chronic low back pain. *Low back pain*. Ed.: Finnison BE, JB Lippincott (In press).

**Symposium:**

7. Raycroft IF, Curtis BH. Spinal curvature in myelomeningocele: Natural history and etiology. *Proceedings of the American Academy of Orthopaedic Surgeons Symposium on Myelomeningocele*, Hartford, Connecticut, November 1970, CV Mosby, St. Louis 1972, pp: 186- 201.

**Papers presented at the meeting:**

8. Rhoton AL. Microsurgery of the Arnold-Chiari malformation with and without hydromyelia in adults. Presented at the annual meeting of the American Association of Neurological Surgeons, Miami, Florida, April 7, 1975.

- **Tables:** They should be numbered consecutively in the text with Arabic numbers. Each table with its number and title should be typed on a separate sheet of paper. Each table must be able to stand alone; all necessary information must be contained in the caption and the table itself so that it can be understood independent from the text. Information should be presented explicitly in "Tables" so that the reader can obtain a clear idea about its content. Information presented in "Tables" should not be repeated within the text. If possible, information in "Tables" should contain statistical means, standard deviations, and t and p values for possibility. Abbreviations used in the table should be explained as a footnote.

Tables should complement not duplicate material in the text. They compactly present information, which would be difficult to describe in text form. (Material which may be succinctly described in text should rarely be placed in tables or figures.) Clinical studies for example, of ten contain complementary tables of demographic data, which although important for interpreting the results, are not critical for the questions raised in the paper. Well focused papers contain only one or two tables or figures for every question or hypothesis explicitly posed in the Introduction section. Additional material may be used for unexpected results. Well constructed tables are self-explanatory and require only a title. Every column contains a header with units when appropriate.

- **Figures:** All figures should be numbered consecutively throughout the text. Each figure should have a label pasted on its back indicating the number of the figure, an arrow to show the top edge of the figure and the name of

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the first author. Black-and-white illustrations should be in the form of glossy prints (9x13 cm). The letter size on the figure should be large enough to be readable after the figure is reduced to its actual printing size. Unprofessional typewritten characters are not accepted. Legends to figures should be written on a separate sheet of paper after the references.

The journal accepts color figures for publication if they enhance the article. Authors who submit color figures will receive an estimate of the cost for color reproduction. If they decide not to pay for color reproduction, they can request that the figures be converted to black and white at no charge. For studies submitted by electronic means, the figures should be in jpeg and tiff formats with a resolution greater than 300 dpi. Figures should be numbered and must be cited in the text.

- **Style:** For manuscript style, American Medical Association Manual of Style (9th edition), Stedman's Medical Dictionary (27th edition) and Merriam Webster's Collegiate Dictionary (10th edition) should be used as standard references. The drugs and therapeutic agents must be referred by their accepted generic or chemical names, without abbreviations. Code numbers must be used only when a generic name is not yet available. In that case, the chemical name and a figure giving the chemical structure of the drug should be given. The trade names of drugs should be capitalized and placed in parentheses after the generic names. To comply with trademark law, the name and location (city and state/country) of the manufacturer of any drug, supply, or equipment mentioned in the manuscript should be included. The metric system must be used to express the units of measure and degrees Celsius to express temperatures, and SI units rather than conventional units should be preferred.

The abbreviations should be defined when they first appear in the text and in each table and figure. If a brand name is cited, the manufacturer's name and address (city and state/country) must be supplied.

The address, "Council of Biology Editors Style Guide" (Council of Science Editors, 9650 Rockville Pike, Bethesda, MD 20814) can be consulted for the standard list of abbreviations.

- **Acknowledgments:** Note any non-financial acknowledgments.

Begin with, "The Authors wish to thank..." All forms of support, including pharmaceutical industry support should also be stated in Acknowledgments section.

Authors are requested to send an electronic diskette including the last version of their manuscript. The electronic file must be in Word format (Microsoft Word or Corel Word

Perfect). Each submitted disk must be clearly labeled with the name of the author, item title, journal title, word processing program and version, and file name used. The disk should contain only one file-the final version of the accepted manuscript. Authors can submit their articles for publication via internet using the guidelines in the following address: [www.jtss.org](http://www.jtss.org).

- **Practical Tips:**

1. Read only the first sentence in each paragraph throughout the text to ascertain whether those statements contain all critical material and the logical flow is clear.
2. Avoid in the Abstract comments such as, "... this report describes..." Such statements convey no substantive information for the reader.
3. Avoid references and statistical values in the Abstract.
4. Avoid using the names of cited authors except to establish historical precedent. Instead, indicate the point in the manuscript by providing citation by superscripting.
5. Avoid in the final paragraph of the Introduction purposes such as, "... we report our data..." Such statements fail to focus the reader's (and author's!) attention on the critical issues (and do not mention study variables).
6. Parenthetically refer to tables and figures and avoid statements in which a table or figure is either subject or object of a sentence. Parenthetical reference places emphasis on interpretation of the information in the table or figure, and not the table or figure.
7. Regularly count words from the Introduction through Discussion.

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## Application Letter Example:

**Editor-in-Chief**

**The Journal of Turkish Spinal Surgery**

**Dear Editor:**

We enclose the manuscript titled '....' for consideration to publish in The Journal of Turkish Spinal Surgery.

The following authors have designed the study (AU: Parenthetically insert names of the appropriate authors), gathered the data (AU: Parenthetically insert names of the appropriate authors), analyzed the data (AU: Parenthetically insert names of the appropriate authors), wrote the initial drafts (AU: Parenthetically insert initials of the appropriate authors), and ensure the accuracy of the data and analysis (AU: Parenthetically insert names of the appropriate authors).

I confirm that all authors have seen and agree with the contents of the manuscript and agree that the work has not been submitted or published elsewhere in whole or in part.

As the Corresponding Author, I (and any other authors) understand that The Journal of Turkish Spinal Surgery requires all authors to specify any contracts or agreements they might have signed with commercial third parties supporting any portion of the work. I further understand such information will be held in confidence while the paper is under review and will not influence the editorial decision, but that if the article is accepted for publication, a disclosure statement will appear with the article. I have selected the following statement(s) to reflect the relationships of myself and any other author with a commercial third party related to the study:

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Sincerely,

Corresponding Author

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Financial Disclosure, and  
Copyright Transfer**

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CORRESPONDING AUTHOR :

MAILING ADDRESS :

TELEPHONE / FAX NUMBERS :

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**INSTITUTIONAL REVIEW BOARD/ANIMAL CARE COMMITTEE**

**APPROVAL:** Each author certifies that his or her institution has approved the protocol for any investigation involving humans or animals and that all experimentation was conducted in conformity with ethical and humane principles of research.

Signature Printed Name      Date

Signature Printed Name      Date

Signature Printed Name      Date

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**TABLE-1. LEVELS OF EVIDENCE****LEVEL- I .**

- 1) Randomized, double-blind, controlled trials for which tests of statistical significance have been performed
- 2) Prospective clinical trials comparing criteria for diagnosis, treatment and prognosis with tests of statistical significance where compliance rate to study exceeds 80%
- 3) Prospective clinical trials where tests of statistical significance for consecutive subjects are based on predefined criteria and a comparison with universal (gold standard) reference is performed
- 4) Systematic meta-analyses which compare two or more studies with Level I evidence using pre-defined methods and statistical comparisons.
- 5) Multi-center, randomized, prospective studies

**LEVEL –II.**

- 1) Randomized, prospective studies where compliance rate is less than 80%
- 2) All Level-I studies with no randomization
- 3) Randomized retrospective clinical studies
- 4) Meta-analysis of Level-II studies

**LEVEL– III.**

- 1) Level-II studies with no randomization (prospective clinical studies etc.)
- 2) Clinical studies comparing non-consecutive cases (without a consistent reference range)
- 3) Meta-analysis of Level III studies

**LEVEL- IV.**

- 1) Case presentations
- 2) Case series with weak reference range and with no statistical tests of significance

**LEVEL – V.**

- 1) Expert opinion
- 2) Anecdotal reports of personal experience regarding a study, with no scientific basis

**TABLE-2. CLINICAL AREAS**

Article  
Anatomy  
Basic Science  
Biomechanics  
Deformity  
    Scoliosis  
    Adolescent idiopathic  
        Kyphosis  
    Congenital spine  
    Degenerative spine conditions  
Diagnostics  
Epidemiology  
Exercise Physiology and  
Physical Exam  
Functional Restoration  
Health Services Research  
Literature Review  
Meta-Analysis  
Occupational Health  
Outcomes  
Patient Care  
    Conservative care  
    primary care  
    quality of life research  
    treatment efficacy  
    pediatric  
    rehabilitation  
Surgery  
    clinical surgery  
    intradiscal surgery  
    neurosurgery  
    reconstructive surgery  
    image guided surgery  
    endoscopy  
    failed spine surgery  
    microsurgery  
    computer-assisted  
    minimally-invasive  
Imaging  
    radiology

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MRI	Parkinson's
CT scan	tuberculosis
Fusion	Rheumatology
fusion cages	arthritis
instrumentation	osteoporosis
pedicle screws	Bone
fixation	bone density
Pain	bone mechanics
chronic pain	bone regeneration
low back pain	bone graft
postoperative pain	bone graft substitutes
pain measurement	fracture
neck pain	Disc
discogenic pain	disc degeneration
Neurology	herniated disc
neurophysiology	disc pathology
neurological examination	disc replacement
neurochemistry	artificial disc
neuropathology	IDET
cognitive neuroscience	Trauma
neuromuscular spine	Spinal cord
Cervical Spine	spinal cord injury
cervical myelopathy	Clinical trials
cervical reconstruction	Randomized trials
cervical disc disease	Biology
whiplash	biochemistry
craniocervical junction	biomaterials
atlantoaxial	molecular biology
Thoracic Spine	Tumor
thoracolumbar spine	Genetics
Lumbar Spine	Stenosis
lumbosacral spine	Infection
Psychology	Non-Operative Treatment
Nerve	Motion Analysis
nerve root	Physical Therapy
sciatica	Manipulation
Injection	Anesthesiology
epidural	
Disease/Disorder	
metabolic bone disease	
epilepsy	
lupus	
cancer	

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## EDITORIAL / EDITÖRDEN

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## ORIGINAL ARTICLE / ORJİNAL MAKALE

## BIOMECHANICS / BİYOMEKANİK

- 1- **BIOMECHANICAL COMPARISON OF INTACT AND HEMILAMINECTOMIZED DISCECTOMIZED SPINE / NORMAL VE HEMİLAMİNEKTOMİ DİSEKTOMİ UYGULANMIŞ OMURGANIN BİYOMEKANİK KARŞILAŞTIRILMASI** 95

Ahmet KARAKAŞLI, İsmail Safa SATOĞLU, Ceren KIZMAZOĞLU, Eyad SEKİK, Didem Venüs YILDIZ, Erdem KUMTEPE

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**EDITORIAL / EDITÖRDEN**

**Dear Colleagues,**

We sincerely wish the year 2015 brings peace, happiness and health to all my colleagues and their families. We are happy to accomplish the second issue of 2015.

There are 8 research articles in this issue. The first one is a biomechanics study analyzing for effect of axial loading on lamp spine without disc on the biomechanical test machine. The second, third and fourth studies are morphometric investigations which were about length and diameter of the lumbar pedicle and lumbosacral sagittal angles and basion-axis interval (BAI), cervical - cranial measurements as basion-dens interval (BDI), Powers ratio, atlanto-occipital interval (AOI), atlantodental interval (ADI) and posterior atlantodental interval (PADI) in the patients with congenital spinal deformity. Fifth study is about the kyphosis. Multiple level posterior osteotomies were discussed in this article for Scheuermann's kyphosis. In the sixth study, the results of the fluoroscopy guided transforaminal steroid injection for cervical radicular pain were presented. The seventh study is about pain management for the failed back syndrome. The last one is a study analyzing the total health expenditure and total spine related procedure expenditure in a five-year period (2008-2012) in Turkey. We believe that all those studies will quietly interest the readers.

There are also three case reports in this issue: the first one is spontaneous intradural herniation of the lumbar vertebra which is seen quiet rarely. The second case has cervical epidural abscess due to nasal septal perforation. In the third case report, validity of the cuff leak test for difficult extubation after cervical fusion was presented.

There are two reviews in this issue. The first one is a review presenting the studies about the cross laminar screw fixation of the axis, and the second one presents the anesthesia for the patient spinal cord injury. Both of those are quiet comprehensive and informative reviews.

In this issue, in the "Frontiers of the Spinal Surgery" section, the bibliographic study for Turkish scientific books about the spine and spinal surgery was presented. The author of the this article is Prof. Sait Naderi.

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The “Marmara Spinal Group Meetings”, which includes İstanbul and neighboring cities and which is conducted to increase the interests of especially assistants and new specialist on spinal surgery and to contribute to their trainings and to transfer the experiences of experienced colleagues and will be organized each month regularly by the regulatory board, and which Prof. Dr. Cüneyt Şar will perform the headship this year and Surgeon Yunus Atıcı performs the secretariat, will be continued. You can find the other meeting contents from the announcements section.

We respond to answer the STE questions that we publish in accordance with the request from TOTBİD TOTEK for recertification in this issue. The answers of the questions included in this issue should be sent to [cutku@ada.net.tr](mailto:cutku@ada.net.tr) or [admin@jtss.org.tr](mailto:admin@jtss.org.tr) addresses as also indicated in the page including the questions. The sent answers will be sent to the secretariat working relevantly in TOTBİD TOTEK by us.

We wish healthy, successful and peaceful days to Turkish Spinal Surgery family and we present our deepest respects.

**Prof. Dr. İ. Teoman BENLİ**  
**JTSS Editor**

## ORIGINAL ARTICLE / ORJİNAL MAKALE

## BIOMECHANICAL COMPARISON OF INTACT AND HEMILAMINECTOMIZED DISCECTOMIZED SPINE

NORMAL VE HEMİLAMİNEKTOMİ DİSEKTOMİ UYGULANMIŞ OMURGANIN  
BİYOMEKANİK KARŞILAŞTIRILMASIAhmet KARAKAŞLI<sup>1</sup>, İsmail Safa SATOĞLU<sup>1</sup>,  
Ceren KIZMAZOĞLU<sup>2</sup>, Eyad SEKİK<sup>3</sup>, Didem Venüs YILDIZ<sup>4</sup>, Erdem KUMTEPE<sup>4</sup>

## SUMMARY

**Objective:** This study aims to investigate the effects of hemilaminectomy and discectomy on the lumbar spine of the lamb by biomechanically comparing changes on motion segments between intact and hemilaminectomy discectomized spine.

**Materials and methods:** Ten fresh-frozen lamb spines were used in this study. Hemilaminectomy and discectomy was performed on each spine at L4-L5 level on the left side. The biomechanical tests for both intact spine and hemilaminectomy discectomized spine were performed by using axial compression testing machine. The axial compression was applied to all specimens with a loading speed of 5 mm/min. 8400 N/mm moment was applied to each specimen to achieve flexion and extension motions, right and left bending through a specially designed fixture.

**Results:** In axial compression test, compression test in flexion motion and the right bending position the specimens were more stable based on displacement values. The displacement values of hemilaminectomy discectomized spines were closer to the values of intact specimens. Comparing both groups, displacement values of extension and left-bending positions were significant ( $p \leq 0.05$ ).

**Conclusion:** The displacement values of hemilaminectomy and total discectomized spine specimens were similar to studies in the literature. Biomechanical instability has been achieved in a hemilaminectomy and total discectomy spine during extension and partial laminectomy side-bending movements. After a total discectomy, a reduction in annulus fibrosis tension caused laxity at the mobile spine segment. Increased mobilization caused instability at the spine mobile segment.

**Keywords:** Biomechanics, spine, hemilaminectomy, discectomy

**Level of Evidence:** Biomechanical experimental study, Level II

## ÖZET

**Amaç:** Bu çalışmanın amacı koyun lomber omurgasında hemilaminektomi ve diskektominin etkilerini incelemek ve hareketli segmentte meydana gelen değişiklikleri biyomekanik olarak sağlam omurga ile karşılaştırmaktır.

**Materyal-Metod:** Bu çalışmada 10 adet taze kuzu omurgası kullanılmıştır. Her omurgada L4-L5 seviyesinde sol taraftan hemilaminektomi ve diskektomi uygulanmıştır. Tüm örnekler için biyomekanik testler aksiyel kompresyon test cihazı kullanılarak gerçekleştirildi. Numunelere 5mm/dk hızda aksiyel kompresyon yüklenme uygulandı. Özel yapım bir cihaz yardımıyla her numuneye 8400N/mm moment oluşacak şekilde fleksiyon, ekstansiyon, sağ ve sol eğilme yüklenmeleri uygulandı.

**Bulgular:** Aksiyel kompresyon testinde, deplasman hareketi açısından fleksiyon hareketi ve sağa eğilme pozisyonunda numunelerin daha stabil olduğu görülmüş, hemilaminektomi ve diskektomi yapılan omurların deplasman değerleri sağlam omurga sonuçlarıyla yakın değerler vermiştir. Gruplar karşılaştırıldığında; ekstansiyon ve sola eğilme pozisyonundaki deplasman değerleri açısından istatistiksel olarak anlamlı fark bulunmuştur ( $P=0.034$ ).

**Sonuç:** Hemilaminektomi ve total diskektomi uygulanan omurlardaki deplasman değerleri literatürdeki çalışmalarla benzer sonuçlar vermiştir. Hemilaminektomi ve total diskektomi uygulanan omurgalarda ekstansiyon ve ameliyatlı tarafa eğilme hareketlerinde instabilite saptanmıştır. Total diskektomi sonrasında, anulus fibrosis gerginliğindeki azalma ve omurga hareketlilikteki artış meydana gelmekte, bu durum hareketli omurga segmentinde instabiliteye yol açmaktadır.

**Anahtar Sözcükler:** Biyomekanik, omurga, hemilaminektomi, diskektomi

**Kanıt Düzeyi:** Biyomekanik deneysel çalışma, Düzey II

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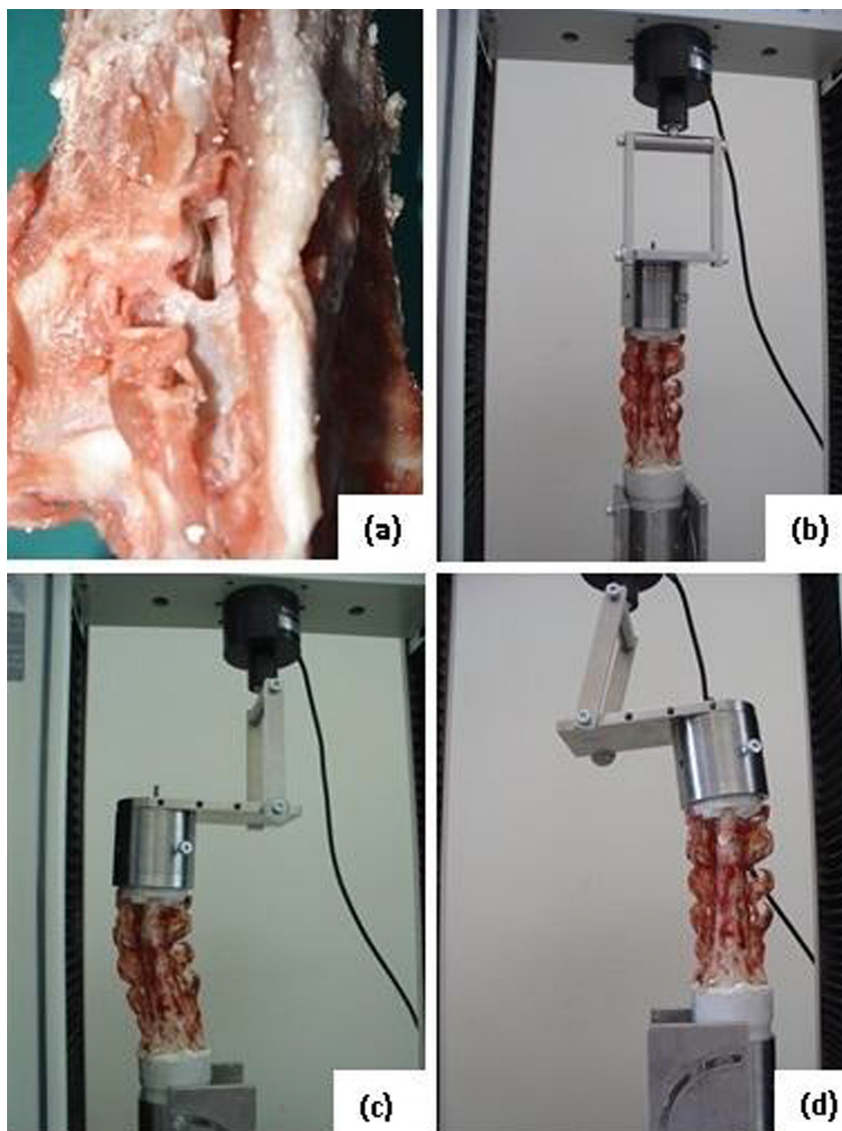
## INTRODUCTION:

Low back pain has become the most common and expensive cause of chronic disability in adults under 45 years of age. Further, lumbar disc prolapsus accounts for less than 5% of all low-back problems but is the most common cause of nerve root pain (1,12). L4-5 is the most frequently involved level, followed closely by L5-S1, then L3-4. Disc protrusion at other levels or at more than one level at any given time is rare (5,14). Intervertebral discs play a primary and critical role in the biomechanics of the spine. They function in contributing to load bearing, impact absorption, and stress transmission between the vertebrae (10,18-19). Biomechanics still play a major role in spinal pathology and pain (3). After open discectomy, degenerative changes occur at the spinal mo-

tion segment. The exact occurrence mechanism of this degeneration is unknown, but some causes, such as disc height loss and increased segment motion are thought to be responsible for instability. After open discectomy, a few studies about spine instability have been reported. This research aims to investigate what degree of instability occurs within the mobile segment of fresh frozen lamb after open hemilaminectomy and discectomy.

## MATERIALS AND METHOD:

The open spinal discectomy study that was performed at this stage consisted of 10 fresh frozen lamb spines. The lambs were between 6 to 12 months old. The specimens did not have any macroscopic or radiological diseases under inspection and evaluation by x-rays, respectively. The spine of each specimen



**Figure-1.** Various positions in biomechanical test. **(a)** Open discectomized Lumbar Lamb Spine **(b)** Axial compression test. **(c)** Right bending test. **(d)** Left bending test.

was dissected from the sacrum to the T12 level. All of the specimens were frozen and thawed at room temperature the night before the surgery.

The biomechanical measurements of all specimens have been obtained preoperatively. Classical hemilaminectomy and open discectomy on left L4-L5 disc space were performed in all specimens (n=10). Following the surgery, operating measurements were obtained and the values were compared.

### Biomechanical Tests:

The current study was performed in Dokuz Eylül University, Institute of Health Sciences, and Biomechanics Laboratory. The biomechanical tests were performed by the axial compression testing machine (AG-IS 10 kN, Shimadzu Corporation, Kyoto, Japan). In the study, two groups (intact and operated) (Figure-1.a) were biomechanically tested preoperatively and postoperatively in order to observe the original mobility of the spinal segment and to compare the differences after the surgery. The first biomechanical test was conducted pre- and postoperatively in a neutral position with an axial 129 compression of 400 Newtons. After that, the tests were carried out

by 8400 Nmm moments in different positions, such as flexion, extension, and right-left bending positions (Figure-1.b,c,d). A specially designed fixture was used to increase moments up to 8400 Nmm, which was generated through the axial movement of the actuator and applied to each of the specimens to achieve the flexion and extension motions in the form of right and left-bending, respectively (9,17).

During the biomechanical test period, the intervertebral displacement at the subjected levels (L4-L5) was recorded in real time by an extensometer. The displacement value data was evaluated by the Wilcoxon Signed Rank test through software (SPSS 15.0) for Windows.

### RESULTS:

The median displacement values of the biomechanical study are shown in Table I. The median displacement values of the intact spines of 10 specimens for each position of the axial compression test, the compression test in flexion, the extension motions and the right-left bending positions in the intact specimens were 3.70 mm, 3.40 mm, 2.44 mm, 2.72 mm and 3.21 mm, respectively (Figure-2).

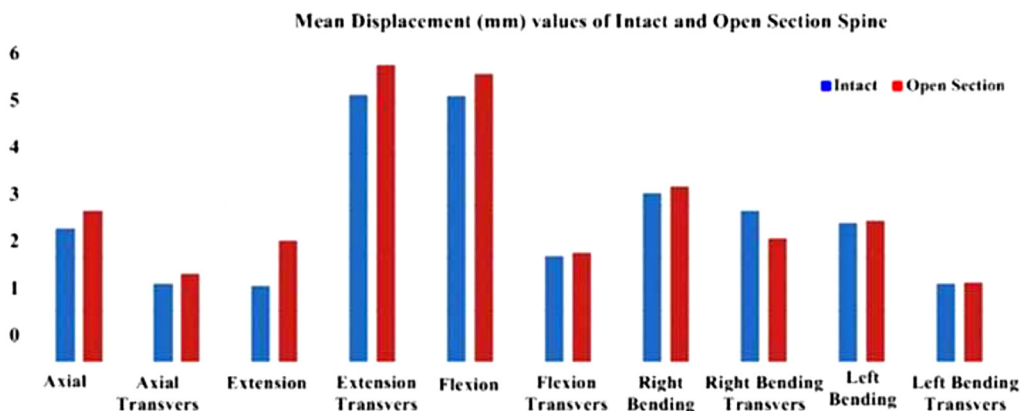


Figure 2: Mean displacement values for both intact and open discectomized lamb spines groups

	Axial	Axial transverse	Extension	Extension transverse	Flexion	Flexion transverse	Right bending	Right bending transverse	Left bending	Left bending transverse
Mean values (n=10) of intact Lumbar Lamb Spine test	3,7022	2,6877	2,4416	6,2273	3,4084	1,4839	2,7230	4,5369	3,2176	4,4491
Mean values (n=10) of open unilateral laminectomy dissectomized Lumbar Lamb Spine test	2,8525	3,1305	2,6825	5,7239	5,4314	1,9112	3,6928	3,0334	4,5392	2,7581

Table-1. Displacement values in mm's in various motional positions

After performing the open left hemilaminectomy discectomy for each lamb spine, the median values of the measurement results of the current biomechanical study were obtained (Table-1). The median displacement values of the discectomy lamb spines of each specimen for each position of axial compression test, compression test in flexion, extension motions and right-left bending positions were 2.85 mm, 5.43 mm, 2.68 mm, 3.69 mm and 4.53 mm, respectively.

The displacement results for the two phases of this study were statistically compared. A significant change was found between the displacement values of specimens under compression in extension ( $P=0.013$ ), and anterior posterior and axial displacement in the left-bending positions respectively ( $P=0.034$ ,  $P=0.010$ ). There were no statistically significant changes under the axial compression test, compression test in flexion motion and the right-bending position for both groups.

## DISCUSSION:

In recent decades, discectomy has become the gold standard technique in symptomatic lumbar herniated disc patients who do not respond to conservative treatment modalities. In our study, we attempted to determine the biomechanical stability of the lumbar spine after unilateral discectomy. Detwiler et al (6) found that, compared with the intact condition, a total laminectomy including bilateral facets in treated human specimens had significantly larger increases in angular motion during flexion, lateral bending, and axial rotation than their facet- sparing laminectomy-treated human specimens. Therefore, a facet-163 sparing laminectomy produces less biomechanical instability than a total laminectomy including bilateral facets (6).

In our study, since hemilaminectomy was only performed on the left side, only a significant change was found between the displacement values of the specimens under compression in extension, and anterior-posterior and axial displacement in the left-bending positions. There were no significant differences between the intact spine and the unilateral laminectomy discectomy spine in other positions. Left-bending displacement is thought to be significant, due to the left-side laminectomy that was performed because ligamentum flavum was removed from the left side but the right side was intact.

Karakaşlı et al. (9) showed that after endoscopic discectomy only the anteroposterior displacement values of the left-bending test were statistically significant. Recent studies indicate that there was instability and mobilization at the laminectomy side. Lu

et al. (13) reported that a 2-level total laminectomy and discectomy affected the flexion instability of the spine. In our study, there was no significant difference in the spine following the partial laminectomy, the discectomy spine and the intact spine at the flexion position. The extension displacement positions were found to be statistically significant because, after the total discectomy, there was laxity at the annulus ligaments. This laxity, which causes instability at the vertebral segment, results in displacement during extension. In our study there was no displacement in flexion because the facet joints were intact and prevented flexion displacement. As a result of this sclerosis occurred at the end plates and movement decreased in the long term.

Schulte et al.(16) reported that, there were increased movements of 26 %, 6 % and 12 % following discectomy at flexion- extension, lateral bending and axial rotation, respectively. Bishop et al. (4) found that the range of motion (ROM) at the level of the laminectomy increased significantly for flexion and extension (7.3 %), lateral bending (7.5 %), and axial rotation (12.2 %), but the ROM of the adjacent segments was only significantly affected in lateral bending. Previous studies showed that an increased range of motion causes instability. In the literature, clinical studies reported that, after a laminectomy discectomy, instability increases in the vertebra segment during the early period and decreases during the late period (7-8).

In our study, during flexion there was no increase in displacement, but during extension, displacement was significantly increased. After a total discectomy, laxity occurred at the mobile segment, but in flexion movements, displacement was limited by facet joints. During extension movements, facet joint limitations were reduced so displacement increased. Lu et al. (13) demonstrated that multilevel fenestrations (bilateral L3-4, L4-5, L5-S1 laminectomy) and (L4-5, L5-S1) discectomies affect lumbar spinal stability in flexion, but they have no effect on the stability of the lumbar spine in lateral bending or axial rotation.

Anasetti et al.( 2) compared the ROM of human cadaver L4-5 segments with or without a resected supraspinous ligament (SSL) after implanting an interspinous device. After resecting the SSL, the authors found a higher ROM during flexion-extension than the intact spine. Tai et al. (17) compared the intervertebral disc displacement of human cadaver L4-5 segments during flexion-extension after two decompression procedures. In one group, a laminotomy with SSL preservation was performed, and a laminectomy with flavectomy and resection of the SSL was

performed in the other. During flexion, the intervertebral disc displacement was higher after resecting the SSL (17).

Jia et al.(8) used 3 sheep models: Group 1, laminectomy only; group 2, laminectomy plus left total facetectomy; and group 3, laminectomy plus bilateral facetectomy and they found that the lumbar stability in flexion/extension and torsion was severely decreased after the three types of surgery. However, in group 1 and 2, each parameter had returned to normal levels by 12 weeks. Lu et al. (13) showed that after open discectomy at L4- L5 and L5-S1, additional signs of movement (3.94 mm anteroposteriorly and 2.5 mm vertically) were found at L4-L5. A notably large increase in vertical motion (2.98 mm) was seen at L5-S1. The motions in the anteroposterior translation showed no statistically significant difference between the intact surgically managed states. In the vertical translation, the motions after different levels of surgery increased significantly at the L4-L5 and L5-S1 segments. Under the combined shear and flexion loads, the translations in the antero-posterior directions ranged from 3 to 4 mm. In the vertical direction, the absolute ROM was always less than 3 mm, even with significant increases after surgery. In addition, it was found that the segmental motion was redistributed after operation. Postoperative motions at L3-L4,

L4-L5 and L5-S1 showed an increase in vertical translation, suggesting a redistribution of motion range within the whole lumbar spine after surgery (13,15).

In our study, the displacement values of partial laminotomy and total discectomy spine specimens were similar to studies in the literature. During flexion of 5mm and extension of 2.6 mm, right bending of 3.7 mm has been found. Extension and left-lateral bending values were statically significant in comparison to an intact spine ( $P=0.013$ ,  $P=0.034$ , respectively).

Lee et al. (11) reported that, in flexion/extension, bilateral laminotomies resulted in an average increase in L2–L5 range of flexion/extension motion of 14.3 %, whereas a full laminectomy resulted in an increase of 32.0 %. These results suggest that laminectomy can cause more instability than bilateral laminotomy. Tai et al. (17) found in the porcine model that instability of the lumbar spine following laminectomy was significantly greater than that of the lumbar spine in intact form or following a bilateral laminotomy.

In conclusion, biomechanical instability has been shown in a partial laminectomy and total discectomy spine during extension and partial laminectomy side-bending movements. After a total discectomy, a reduction in annulus fibrosis tension caused laxity at the mobile spine segment. Increased mobilization caused instability at the spinal mobile segment.

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## ORIGINAL ARTICLE / ORJİNAL MAKALE

## MORPHOMETRIC STUDY OF LUMBAR VERTEBRA PEDICLES

## LUMBER VERTEBRA PEDİKÜLLERİNİN MORFOMETRİK ÇALIŞMASI

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## SUMMARY

**Purpose:** The aim of this study is to investigate the anatomic morphometry of the lumbar pedicles and support to calculate the best diameter and length of screws used in lumbar instrumentation.

**Materials-Method:** We inspected 86 patients' data retrospectively from the patient files. We measured the lumbar vertebrae pedicles diameters from the thickest pedicle image shown in axial bone images of computed tomography (CT) and length of the pedicle-corpus distance from the beginning of posterior pedicle to the end of the corpus vertebra with the line passes through the middle of the pedicle. All of the lumbar vertebrae were measured bilaterally from L1 to L5.

**Results:** Fifty-six patients were male (65.1 %), and 30 were female (34.9 %). Mean age of the patients was 40.8 ± 15.6 (18-60) years. Analyses revealed that only pedicle diameters at L2, L4, and L5 levels were similar between males and females, and all other measurement were significantly different between the sexes. The measurements were significantly higher in males, when compared to females. The results showed that pedicle diameters were significantly increased from L1 through L5, both in left and right sides (p<0.001, for each). The pedicle-corpus diameters were also showed significant differences between lumbar vertebrae (p<0.001, for each), and L4 and L5 values significantly lower than the others at right, and L4 values significantly lower than the others at left side.

**Conclusion:** Preoperative CT based lumbar pedicle morphometric data assessment in preoperative planning of spinal surgery is advisable because of the large variations, so that intra and postoperative complications can be avoided.

**Key Words:** Lumbar vertebra morphometry, Lumbar vertebra pedicle morphometry, Lumbar vertebra pedicle diameter

**Level of evidence:** Retrospective clinical study, Level III

## ÖZET

**Amaç:** Bu çalışmanın amacı lomber omurga pedikül morfometrisini incelemek ve lomber enstrümantasyon ameliyatlarında kullanılan pedikül vidaları için en doğru kalınlığını ve uzunluğunu belirlemeye yardımcı olmaktır.

**Materyal-Metod:** Retrospektif olarak 86 hastanın dosyası incelendi. Lomber vertebra pedikül çapları ince kesit bilgisayarlı tomografi (CT) aksiyel görüntülerinden pediküllerin en kalın olduğu kesitlerden ve pedikül ile vertebra korpusun ön sınırını birleştiren yerden uzunluk olarak ölçüldü. L1 seviyesinden L5 seviyesine kadar tüm vertebra çift taraflı olarak ölçüldü.

**Sonuçlar:** Elli altı erkek hasta (% 65.1) ve 30 kadın hasta (% 34.9) incelemeye alındı. Ortalama hasta yaşı 40.8 ± 15.6 (18-60) olarak hesaplandı. Analiz sonucunda kadın ve erkek hastaların sadece L2, L4 ve L5 vertebra özellikleri benzer görüldü ve diğer ölçümler anlamlı olarak farklı bulundu. Ölçümlerde erkek hastaların değerleri kadın hastalara göre anlamlı derecede büyük çıkmıştır. L1 seviyesinden L5 seviyesine inildikçe pedikül çapları pedikül çapları anlamlı olarak artmaktadır (p<0.001, her taraf için). Pedikül-korpus arası uzunluk L1 seviyesinden L5 seviyesine doğru gidildikçe anlamlı olarak azalmıştır (p<0.001, her biri için), ve L4 - L5 sağ uzunluk değerleri diğerlerinden düşük, L4 sol taraf uzunluk değerleri de diğer uzunluklardan düşük bulunmuştur.

**Çıkarım:** Preoperatif CT kullanılarak lomber pedikül morfometrik veri değerlendirilmesi lomber pedikül anatomisindeki çeşitli varyasyonlar nedeni ile mutlaka önerilmelidir. Böylece ameliyat sırasında ve ameliyat sonrasında karşılaşılabilecek komplikasyonların önüne geçilebilir.

**Anahtar Kelimeler:** Lomber vertebra morfometrisi, lomber vertebra pedikül morfometrisi, lomber vertebra pedikül çapı

**Kanıt Düzeyi:** Retrospektif klinik çalışma, Düzey III

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## INTRODUCTION

Lumbar morphometry is important not only for understanding of biomechanics of lumbar spine but also for surgical techniques aimed to stabilization and correction of deformities. First application of the pedicle screw plating system for the lumbar spine had been made by Roy-Camille et al (20). Since then pedicle screw fixation has become an increasingly popular technique of instrumentation to treat spinal disorders by providing stable fixation and correcting spinal deformities (16).

To prevent impingement of the neural structures, accurate and safe pathway of the pedicle is important and requires precise and accurate knowledge of bony and neural structures (4). There are complications associated with oversized pedicle screw such as dural tears, leakage of cerebrospinal fluid and injuries to nerve roots from the medial wall (13).

The purpose of this study was to investigate the anatomic morphometry of the lumbar pedicles and support to calculate the best diameter and length of screws used in lumbar instrumentation.

## MATERIALS AND METHOD:

We inspected 86 patients' data retrospectively from the patient files. The patients between the ages of 18 to 60 who had been imaged with lumbar vertebral multi-sliced computed tomography were included. The exclusion criteria were emergency patients, having degenerative spinal disease, fractures,

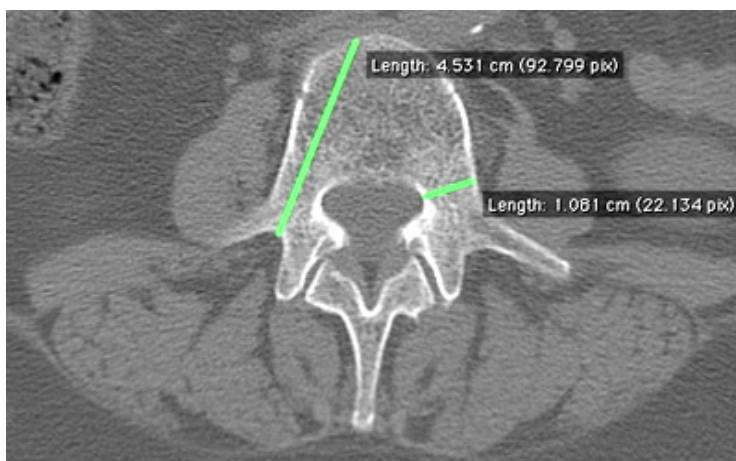
spondylolysis and spondylolisthesis. We measured the lumbar vertebrae pedicles diameters from the thickest pedicle image shown in axial bone images of CT and length of the pedicle-corpus distance from the beginning of posterior pedicle to the end of the corpus vertebra with the line passes through the middle of the pedicle (Figure-1). All of the lumbar vertebrae were measured bilaterally from L1 to L5 by Osirix® software.

### Statistical Analysis:

Descriptive statistics of numerical data were presented as mean, standard deviation, minimum and maximum. The categorical variable gender was presented as frequency and percent. The comparisons between independent two groups were conducted by Mann-Whitney U test. The changes between vertebra levels were compared by using Friedman test, and when a statistically significant difference was observed, post-hoc analyses were performed by Wilcoxon test. SPSS software version 21 (IBM Inc., USA) was used for the statistical analyses. Statistical significance level was considered as 0.05 in the analyses of this study.

## RESULTS:

Fifty-six patients were male (65.1%), and 30 were female (34.9%). Mean age of the patients was  $40.8 \pm 15.6$  (18-60) years. Mean age of the males and females were statistically similar ( $p=0.664$ ), and  $39.7 \pm 15.6$  years and  $42.9 \pm 15.7$  years, respectively.



**Figure-1.** Measurement example of pedicle diameter and pedicle-corpus length prepared with Osirix®

The comparisons of pedicle diameters and pedicle-corpus lengths according to gender are presented in Table-1. Analyses revealed that only pedicle diameters at L2, L4, and L5 levels were similar between males and females, and all other measurement was significantly different between the sexes. The measurements were significantly higher in males, when compared to females.

Table-2 shows the comparisons of pedicle diam-

eters, and pedicle-corpus lengths according to sides. The results showed that pedicle diameters were significantly increased from L1 through L5, both in left and right sides ( $p < 0.001$ , for each). The pedicle-corpus diameters were also showed significant differences between lumbar vertebrae ( $p < 0.001$ , for each), and L4 and L5 values significantly lower than the others at right, and L4 values significantly lower than the others at left side.

**Table-1.** Comparisons of pedicle, and pedicle-corpus lengths according to gender. P: pedicle diameter; PC: pedicle-corpus length. \*: Statistically significant results in comparisons between males and females (Mann-Whitney U test).

	Male				Female				p
	Mean	SD	Min	Max	Mean	SD	Min	Max	
L1-Right-P	6,71	1,01	5	9,2	5,8	0,83	4,6	7	0,009*
L1-Left-P	6,78	1,1	5,1	9,4	6,05	0,89	4,7	7,8	0,030*
L1- Right -PC	55,6	3,91	47,7	66,7	51,83	2,48	47,7	56,1	0,002*
L1- Left - PC	55,89	3,68	48,3	66,8	52,15	2,33	48,2	55,8	0,001*
L2- Right -P	7,07	1,13	5,2	9,6	6,37	0,8	5,2	8	0,054
L2- Left -P	6,54	2,16	0	9,5	6,48	0,82	5,2	8,2	0,236
L2- Right - PC	55,03	3,78	46,6	66,1	51,19	3,09	46,6	59,1	<0.001*
L2- Left - PC	55,3	3,78	46,8	65,9	51,55	2,93	46,8	57,1	0,001*
L3- Right -P	8,63	1,29	6,1	11,1	7,71	1,13	6,1	10,3	0,026*
L3- Left -P	8,71	1,4	5,7	12,1	7,85	1,42	6,1	10,8	0,036*
L3- Right - PC	55,06	4,36	45,8	63,2	52,25	3,35	45,8	58,5	0,029*
L3- Left - PC	54,91	3,9	46,3	62,5	52,31	3,57	46,3	57,8	0,035*
L4- Right -P	10,37	1,43	7,5	14	9,57	1,58	7,3	12,3	0,143
L4- Left -P	10,5	1,44	8,1	13,4	9,84	1,69	7,8	13,8	0,172
L4- Right - PC	53,05	3,65	44,7	59,5	50,09	3,56	44,6	56,4	0,009*
L4- Left - PC	53,01	3,8	44,9	60,7	49,95	3,26	44,9	56,8	0,007*
L5- Right -P	13,33	1,75	9,6	16,9	12,83	1,57	10,8	16	0,320
L5- Left -P	13,41	1,93	9,8	17,4	12,78	1,96	9,9	17,1	0,284
L5- Right - PC	54	3,85	47,6	63,9	49,8	3,46	42,4	57,8	<0.001*
L5- Left - PC	54,17	3,91	46,5	65,1	50,5	3,07	45,4	57,2	0,003*

**Table-2.** Pedicle diameters and pedicle-corpus lengths according to the sides.\*: Pedicle diameters were significantly increased from L1 through L5, both in left and right sides (Friedman Test). \*\*: Pedicle-corpus lengths on right side showed significant difference in overall comparisons (Friedman Test), and post-hoc analyses revealed that L4 and L5 values significantly lower than the others (Wilcoxon test). \*\*\*: Pedicle-corpus lengths on left side showed significant difference in overall comparisons (Friedman Test), and post-hoc analyses revealed that L4 values significantly lower than the others (Wilcoxon test).

	Right					Left				
Pedicle diameter	Mean	SD	Min	Max	p	Mean	SD	Min	Max	p
L1	6,39	1,04	4,6	9,2	<0.001*	6,53	1,08	4,7	9,4	<0.001*
L2	6,83	1,07	5,2	9,6		6,52	1,79	0	9,5	
L3	8,31	1,3	6,1	11,1		8,41	1,45	5,7	12,1	
L4	10,09	1,52	7,3	14		10,27	1,55	7,8	13,8	
L5	13,15	1,69	9,6	16,9		13,19	1,94	9,8	17,4	
Pedicle-corpus length										
L1	54,29	3,9	47,7	66,7	<0.001**	54,58	3,71	48,2	66,8	<0.001***
L2	53,69	3,97	46,6	66,1		53,99	3,91	46,8	65,9	
L3	54,08	4,22	45,8	63,2		54	3,95	46,3	62,5	
L4	52,02	3,85	44,6	59,5		51,94	3,87	44,9	60,7	
L5	52,54	4,2	42,4	63,9		52,89	4,01	45,4	65,1	

## DISCUSSION:

Detailed anatomical descriptions of the morphology and orientation of lumbar vertebrae are necessary for the development and use of implantable devices and spinal instrumentation (3). The goal of internal fixation for fusion is to reconstruct the compromised columns within a spinal motion segment with non-biologic materials, affording temporary immobilization and stabilization until bony fusion can develop (1).

Fixation is successful when a construct can withstand the wear and tear of stresses and strains until fusion occurs. In the lumbar area, detailed anatomical knowledge is critical for performing a safe operation (22). It is a common clinical finding that most of the pedicle fractures related to pedicle screws occur at the lateral wall of the pedicle. Misenheimer et al. inserted screws of the different diameters into thoracic and lumbar pedicles (17). After the use of increased screw diameter, they found changes on the pedicle structure. Although there were as many lateral cut-outs as there were medial, they have found that the entrance points for the screws were in the center of the pedicle, they saw 72 % pedicle fractures laterally

and only 28 % medially. The medial wall of the pedicle must be preserved during screw placement into the pedicle to avoid nerve root or dural damage and to preserve biomechanical stability (13). The definition of the appropriate screw length and diameter usage will decrease the complication risks like anterior corpus and pedicle perforation, dural tear, cerebrospinal fluid leakage, nerve and major vascular injury.

Cansever et al. and Zindrick et al. reported similarly in their studies that pedicle diameter is increasing but length of pedicle is decreasing from L1 to L5 (6,22). Our results are supporting these reports. Acharya et al. and Chadha et al. reported Indian populations' lumbar vertebrae morphology have variations (2,7). That supports the opinion of morphological characteristics may be varied between different populations. This aspect was also evident in various other ethnic population groups studied by Cheung et al., Hou et al., and Kim et al., for Chinese, Asian and Koreans, respectively (8,10,12).

Many literature have described the morphometric aspects of the lumbar spine and the details of the pedicle sizes and dimensions by means of CT scan, plain image, direct specimen measurement and

quantitative 3D anatomic technique (9,11,14-15,18). Panjabi et al. provided the most detailed collection of quantitative 3D surface anatomy of the main vertebral parameters for the thoracic and lumbar human spine (19). The parameters corresponding to the vertebra L5 were not included in the analyses because L5 shows remarkable morphological differences for some parameters when compared with the other lumbar vertebrae as reported by Berry et al., Zindrick

et al., Scoles et al. before (5,21-22). This is probably due to the position of L5 being localized in the final transition zone from lumbar to sacral region (19).

Preoperative computer aided CT based lumbar pedicle morphometric data assessment in preoperative planning of spinal surgery is advisable because of the large variations, so that intra and postoperative complications can be avoided.

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## ORIGINAL ARTICLE / ORJİNAL MAKALE

# LUMBAR LORDOSIS AND SACRAL SLOPE ANGLE MEASUREMENTS ACCORDING TO ADULT AGE GROUPS: A MORPHOMETRIC STUDY

ERİŞKİN YAŞ GRUPLARINA GÖRE LOMBER LORDOZ VE SAKRAL SLOP AÇILARININ  
ÖLÇÜMÜ: MORFOMETRİK ÇALIŞMA

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## SUMMARY

**Purpose:** The aim of the study is to evaluate lumbar lordosis (LL) and sacral slope (SS) angle values according to healthy adult age groups, gender and correlations with each other.

**Materials-Methods:** We inspected 132 patients' datas retrospectively from the patient files. The patients were divided into 3 age groups as 18-40, 41-60 and 61-80. Patients who had been imaged with lumbar vertebral multi-sliced computed tomography were included.

**Results:** Forty-six participants (34.8 %) were between 18-40 years, 46 cases (34.8 %) between 41-60 years, and 40 cases (30.3 %) between 61-80 years. There was no significant difference between the age groups regarding gender. The comparisons revealed that both LL, and SS values were significantly higher in 61-80 years ( $p<0.001$  for both). According to the analyses, age ( $p<0.001$ ), LL ( $p<0.001$ ), and SS ( $p<0.001$ ) values were significantly higher in females when compared to males. LL and SS values showed statistically significant and strong positive correlation with each other.

**Conclusion:** LL and SS values showed statistically significant and strong positive correlation with each other through all age groups additionally significantly higher in 61-80 years.

**Key Words:** Lumbar lordosis, sacral slope, morphometric angles of lumbosacral region

**Level of evidence:** Retrospective clinical study, Level III

## ÖZET

**Amaç:** Bu çalışmanın amacı sağlıklı erişkin yaş gruplarına ve cinsiyete göre lomber lordoz (LL) ve sakral slop (SS) açılarını ve birbirleri ile olan ilişkiyi incelemektir.

**Materyal-Metod:** Retrospektif olarak 132 hasta dosyası incelendi. Hastalar yaş gruplarına göre 3 gruba 18-40, 41-60 ve 61-80 olarak ayrıldı. İnce kesit lomber vertebral bilgisayarlı tomografi çekilen hastalar çalışmaya alındı.

**Sonuçlar:** 46 hasta (% 34.8) 18-40 yaş arasında, 46 hasta (% 34.8) 41-60 yaş arasında ve 40 hasta (30.3%) 61-80 yaş arasında idi. Cinsiyetler arası yaş farkı istatistiksel olarak anlamlı değildi. Karşılaştırma sonucunda LL ve SS değerleri anlamlı olarak 61-80 yaş aralığında yüksek olarak bulundu ( $p<0.001$ ). Analizlere göre yaş ( $p<0.001$ ), LL ( $p<0.001$ ) ve SS ( $p<0.001$ ) değerleri kadınlarda erkeklere göre daha büyük olarak bulundu. LL ve SS değerleri birbirleri ile doğru orantıda hareket ettikleri anlaşıldı.

**Çıkarım:** LL ve SS değerleri tüm yaş gruplarında birbirleri ile anlamlı ve güçlü pozitif birliktelik göstermekte ve 61-80 yaş grubunda anlamlı olarak daha yüksek değerlere çıkmaktadır.

**Anahtar Kelimeler:** Lomber lordoz, sakral slop, lumbosakral bölgenin morfometrik açıları

**Kanıt Düzeyi:** Retrospektif klinik çalışma, Düzey III

## INTRODUCTION:

The sagittal balance of the spine is determined by the pelvic shape which is set by the pelvic incidence (PI) (8). The PI was initially described by Duval-Beaupère et al (4). PI is defined as the angle between the perpendicular to the upper sacral end plate at its midpoint and the line connecting this point to the femoral head axis.

Sacral slope (SS) is defined as the angle between the horizontal and the upper sacral endplate (15). The pelvic tilt (PT) is defined by the angle between the vertical and the line through the midpoint of the sacral plate to the femoral head axis (11). PI is strongly correlated with the SS and PT, and represents the algebraic sum of the SS and the PT ( $PI=SS+PT$ ). Lumbar lordosis (LL) is defined as the angle between the up-

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per L1 endplate and the upper sacral endplate(11).

The aim of our study is try to investigate the correlations between LL and SS according to gender and different age groups of healthy adults.

## MATERIALS AND METHOD:

We inspected 132 patients' datas retrospectively from the patient files. The patients were divided into 3 age groups as 18-40, 41-60 and 61-80. Patients who had been imaged with lumbar vertebral multi-sliced computed tomography(CT) were included. The exclusion criteria were having degenerative spinal disease, fractures, spondylolisthesis and pathological images on CT. LL and SS angles were measured with Osirix® software(Figure1,2). LL was defined as the angle between the upper endplates of L1 and S1. SS corresponds to the angle between the upper sacral endplate and the horizontal plane. All measurement values included for statistical analyse.

### Statistical Analysis:

Descriptive data of VAS scores were presented as mean, standard deviation, minimum and maximum. The categorical variable, gender, was presented as frequency and percent. The comparisons between independent two groups were conducted by Mann-Whitney U test. Comparison of distribution of sexes among age groups was conducted by Chi-square test. Spearman non-parametric correlation analysis was performed to evaluate the correlations between lumbar lordosis and sacral slope values. SPSS software

version 21 (IBM Inc., USA) was used for the statistical analyses. Statistical significance level was considered as 0.05 in the analyses of this study.

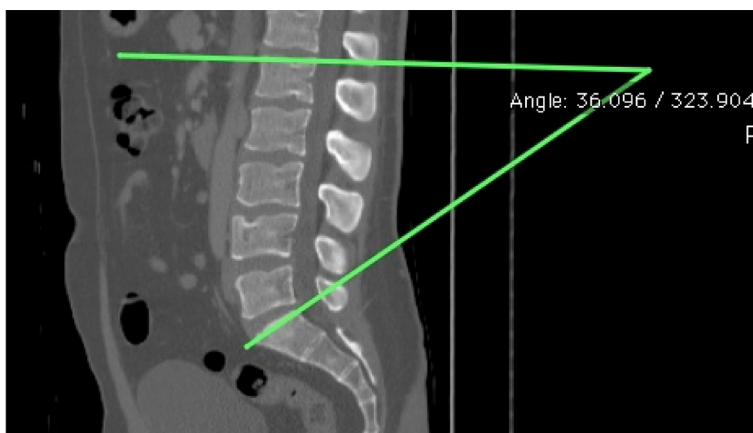
## RESULTS:

Fifty-five participants were female (41.7 %), and 77 were male (58.3 %). Mean age of the females and males were  $50.82 \pm 15.40$  years and  $46.73 \pm 18.18$  years, respectively ( $p=0.154$ , Mann-Whitney U test). Forty-six participants (34.8 %) were between 18-40 years, 46 cases (34.8 %) between 41-60 years, and 40 cases (30.3 %) between 61-80 years. The distribution of the sexes according to age groups is presented in Table-1. There was no significant difference between the age groups regarding gender ( $p=0.147$ , Chi-square test).

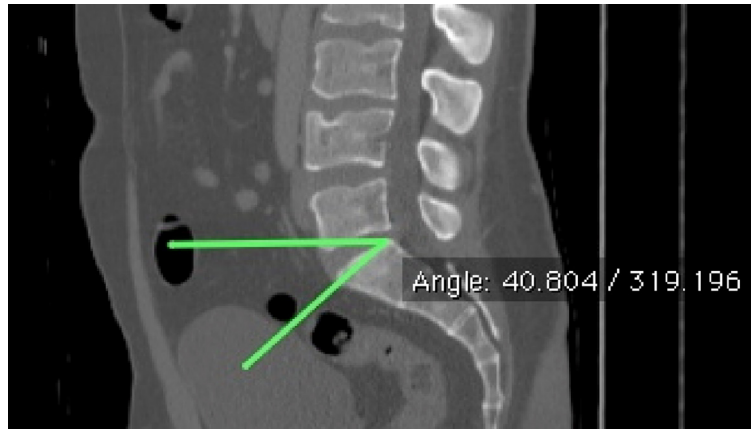
Table-2 shows the LL and SS according to age groups. The comparisons revealed that both LL, and SS values were significantly higher in 61-80 years ( $p<0.001$  for both).

The comparisons of age, LL and SS values between males and females are presented in Table 3. According to the analyses, age ( $p<0.001$ ), LL ( $p<0.001$ ), and SS ( $p<0.001$ ) values were significantly higher in females when compared to males.

LL and SS values showed statistically significant and strong positive correlation with each other ( $r=0.909$ ,  $p<0.001$ , Spearman correlation analysis). The correlations were consistent through all age groups (18-40:  $r=0.906$ ,  $p<0.001$ ; 41-60:  $r=0.922$ ,  $p<0.001$ ; 61-80:  $r=0.861$ ,  $p<0.001$ ).



**Figure-1.** Lumbar lordosis angle measurement with Osirix®



**Figure-2.** Sacral slope angle measurement with Osirix®

**Table-1.** Distribution of gender in age groups

	18-40		41-60		61-80		p
	n	%	n	%	n	%	
Female	14	30,40%	21	45,70%	20	50,00%	0,147
Male	32	69,60%	25	54,30%	20	50,00%	

**Table-2.** Lumbar Lordosis and Sacral Slope according to age groups

	18-40				41-60				61-80				p
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	
LL	44,54	11,16	18,1	64,2	47	10,32	24,5	64,2	59,79	10,52	42,1	77,1	<0.001
SS	37,23	8,78	16	52,4	38,49	7,32	23,1	51,2	45,05	5,92	34	56,6	<0.001

**Table-3.** Age, Lumbar Lordosis and Sacral Slope according to gender

	Female				Male				p
	Mean	SD	Min	Max	Mean	SD	Min	Max	
Age	50,82	15,4	18	74	46,73	18,18	18	80	<0.001
LL	52,33	12,05	18,1	65,3	48,36	12,56	26,5	77,1	<0.001
SS	40,62	8,35	16	52,4	39,62	8,05	20,1	56,6	<0.001

## DISCUSSION:

The analysis of sagittal balance seems to be important in the management of lumbar degenerative pathologies. Clinical importance of LL and SS is being recognized increasingly. Lumbar lordosis is formed by the wedging of the lumbar vertebral bodies and intervertebral discs (15). Abnormal lordotic alignment may lead pathologic changes in the spine from load bearing and accelerate degeneration of the functional motion units (7). Overall, the degree of lumbar lordosis decreases with advanced age (14). LL and SS value range means in asymptomatic adults is 43-61 and 36-42 degrees (11).

Spinopelvic parameters have been studied extensively in the literature. The relationship SS and LL in healthy patients has been documented (8-9,12,13). Roussouly et al. reported the standard sagittal parameters in a normal population (12). The average value for LL was 61.4 with a range from 41.2 to 81.9. The sacral slope averaged 39.9 (SD 8.2, range 21.2–65.9). The correlation between SS and LL with a Pearson's  $r$  of 0.86 indicates that the total amount of lordosis is determined by the relationship of the superior endplate of S1 with the horizontal axis (2,12).

Oh et al. reported the spinopelvic parameters of Korean normal population as followings, the PI was 49°; the SS was 38°; the PT was 11°, the LL was 48° (10). Legaye et al. and Vaz et al. have demonstrated a correlation between PI and LL in the general population; a low PI is usually associated with a low lumbar lordosis, whereas a high PI is usually associated with a high lumbar lordosis (8,13). Also, the correlation between LL and SS has been reported in normal populations; LL increases linearly with SS.

Abnormal spinal sagittal alignment can cause persistent low back pain (LBP) and the association of acute LBP with hyperlordosis, and the relationship

of chronic LBP with hypolordosis have been demonstrated also (5).

All measurements were performed in supine position. Although both groups had identical positions during imaging and some former studies had demonstrated that sagittal alignment measured in supine position is reliable for investigational analyses (1-2,5-6).

The comparisons revealed that age, LL and SS angle values were significantly higher in females when compared to males. LL and SS values showed statistically significant and strong positive correlation with each other through all age groups additionally significantly higher in 61-80 years.

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## ORIGINAL ARTICLE / ORJİNAL MAKALE

# EVALUATION OF THE CRANIOCERVICAL JUNCTION OF THE ADOLESCENT PATIENTS WITH CONGENITAL SPINAL DEFORMITY VIA COMPUTERIZED TOMOGRAPHY

## KONJENİTAL OMURGA DEFORMİTELİ ADÖLESAN HASTALARDA BİLGİSAYARLI TOMOGRAFİ İLE KRANİOSERVİKAL BİLEŞKENİN DEĞERLENDİRİLMESİ

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### SUMMARY

**Aim:** Analysis of the craniocervical junction of adolescent patients with congenital spine deformities with computed tomography (CT) was planned.

**Materials and Methods:** 23 adolescent patients (15 females and 8 males) with congenital spine pathology and CT of the cervical region were evaluated retrospectively. The mean age was 18.4 years (10-19 years). Basion-axis interval (BAI), basion-dens interval (BDI), Powers ratio, atlanto-occipital interval (AOI), atlantodental interval (ADI) and posterior atlantodental interval (PADI) were measured in CT. Results were compared according to gender, presence or absence of atlantoaxial anomalies and inraspinal anomalies. Mann-Whitney U test was used for comparisons between groups.

**Results:** The median, minimum and maximum values measured by CT were calculated in all patients. In CT, BAI was found as 2.5 mm (0-7.4 mm), BDI was found as 4.0 mm (2-7.5 mm), Powers ratio was found as 0.76 (0.63-0.88), AOI was found as 1.2 mm (0-2.8 mm), ADI was found as 1.5 mm (0-3.1 mm) and PADI was found as 17.5 (14.6-23 mm). AOI was found to be significantly different in the patients with congenital anomalies in atlantoaxial junction when compared to the patients without congenital anomalies (P=0.015). In patients with inraspinal anomalies, BDI showed statistically significant differences (P = 0.008).

**Conclusion:** Being high values of BDI in the patients with AOI and inraspinal anomalies in the presence of atlantoaxial pathology compared to those without could be important when a treatment for craniocervical junction in the adolescent cases accompanied by congenital spinal deformity. The larger number of patients for craniocervical junction is needed for comprehensive detailed studies.

**Keywords:** Congenital spinal deformity, craniocervical junction, computed tomography, atlantoaxial interval

**Level of evidence:** Retrospective clinical study, Level III

### ÖZET

**Amaç:** Konjenital omurga deformiteli adölesan hastalarda bilgisayarlı tomografi (BT) ile kranioservikal bileşkenin analizi planlandı.

**Materyal ve Metod:** Konjenital omurga patolojisi olan ve servikal bölgesine BT çekilen, 23 adölesan hasta (15 kadın, 8 erkek) retrospektif olarak değerlendirildi. Yaş ortalaması 18.4 yıl (10-19 yıl) idi. BT de basion-aksis mesafesi (BAM), basion-dens mesafesi (BDM), Powers ratio, atlanto-oksipital mesafe (AOM), atlantodental mesafe (ADM) ve posterior atlantodental mesafe (PADM) ölçüldü. Sonuçlar cinsiyetlere, atlantoaksiyel anomali ve inraspinal anomali olup olmamasına göre karşılaştırıldı. Gruplar arası karşılaştırma için Mann Whitney U testi kullanıldı.

**Sonuçlar:** Tüm hastalarda BT ile ölçülen ortalama, en küçük ve en yüksek değerler hesaplandı. BT de BAM 2.5 mm (0-7.4 mm), BDM 4.0 mm (2-7.5 mm), Powers ratio 0.76 (0.63-0.88), AOM 1,2 mm (0-2.8 mm), ADM 1.5 mm (0-3.1 mm) ve PADM 17.5 (14.6-23 mm) bulundu. Atlantoaksiyel bileşkede konjenital anomali olan hastalarda olmayanlara göre AOM anlamlı olarak farklı bulundu (P=0.015). İntraspinal anomali olan hastalarda BDM istatistiksel olarak anlamlı farklılık gösterdi (P=0.008).

**Çıkarım:** Atlantoaksiyel patoloji varlığında AOM ve inraspinal anomali olan hastalarda BDM değerlerinin olmayanlara göre yüksek olması konjenital omurga deformitelerinin eşlik ettiği adölesan olgularda kranioservikal bileşkeye yönelik bir tedavi planlanırken önemli olabilir. Kranioservikal bileşkeye yönelik daha fazla hasta sayısı ile kapsamlı detaylı çalışmalara ihtiyaç vardır.

**Anahtar kelimeler:** Konjenital omurga deformitesi, kranioservikal bileşke, bilgisayarlı tomografi, atlantoaksiyel mesafe

**Kanıt düzeyi:** Retrospektif klinik çalışma, Düzey III

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## INTRODUCTION:

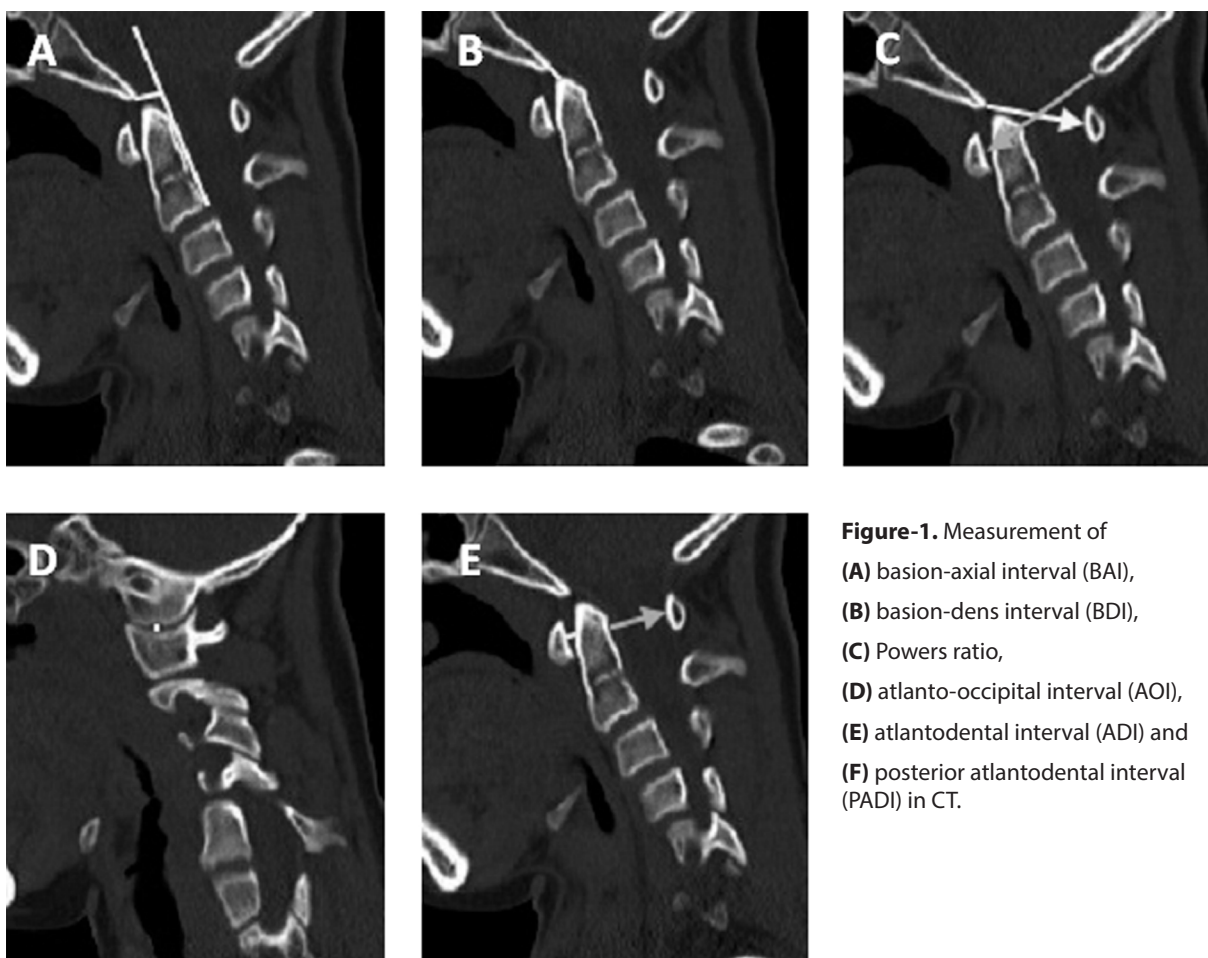
There are difficulties in defining the craniocervical junction pathologies with conventional radiological methods (2,4). In the literature, there are studies using direct radiological and computed tomography (CT) which define the various measurement methods for determining the normal values of craniocervical junction radiologically (5-7,9-11). With congenital spine abnormalities, osseous and intraspinal anomalies can be found together. In our study, investigation of measured values with CT in craniocervical junction of adolescent patients with congenital spinal anomalies was aimed for the analysis of accompanying craniocervical junction and to investigate whether the values is different from the values reported in the literature or not.

## MATERIALS AND METHODS:

Twenty-three patients who were imaged with CT due to congenital anomalies of the spine (such as hemivertebra, butterfly vertebrae, block vertebrae) were evaluated. 15 of the patients were female, 8 of

the patients were male and mean age was 18.4 years (10-19 years). In our study, craniocervical junction was examined with CT; the patients with no history of cervical spine trauma, bone or ligament injury were included. Basion-axis interval (BAI), basion-dens interval (BDI), Powers ratio, atlanto-occipital interval (AOI), atlantodental interval (ADI) and posterior atlantodental interval (PADI) were measured in every patient. All cases were investigated with magnetic resonance imaging (MRI) in terms of intraspinal anomalies.

Cervical spines were examined with CT device with 16 detectors (Somatom Sensation 16, Siemens AG, Erlanger, Germany). Images in axial and sagittal plan in PACs system were analyzed using bone window. BAI, BDI, Power ratio, AOI, ADI and PADI were measured from CT scans of each patient. For BAI measurements, the interval between basion and the posterior cortical edge of axis was measured according to the method described by Harris (5-6,10) (Figure 1A). BDI measurement was calculated by measuring the interval from most inferior part of the basion to the nearest point of dens superior to the basion (11)



**Figure-1.** Measurement of (A) basion-axial interval (BAI), (B) basion-dens interval (BDI), (C) Powers ratio, (D) atlanto-occipital interval (AOI), (E) atlantodental interval (ADI) and (F) posterior atlantodental interval (PADI) in CT.

(Figure-1B). Powers ratio was calculated by dividing basion type to posterior surface of the spinolaminar line of the atlas and anterior arch of C1 from opisthion type (9) (Figure-1C). AOI was calculated by measuring the average of the interval of perpendicular line extended from mid point of occipital condyle articular surface in sagittal and coronal plan to C1 lateral mass (Figure-1D). ADI was calculated by taking the interval between posterior surface of anterior arch of C1 in sagittal plan and anterior surface of dens in the middle of the arch (7) (Figure-1E). PADI calculation was made by measuring the interval between the most posterior edge of dens in middle sagittal plan and anterior surface of posterior arch of C1 (Figure-1E).

Since the data measured by each method showed nonparametric distribution, they were expressed as median, the minimum value and the maximum value. Mann Withney-U test was used in pairwise comparisons. Each measured distance was statistically compared in terms of gender, atlantoaxial pathology and intraspinal anomalies.

## RESULTS:

All parameters measured in the patients were calculated in sequence of median, the minimum and

the maximum. When all patients were evaluated, BAI was found as 2.5 mm (0-7.4 mm), BDI was found as 4.0 mm (2-7.5 mm), Powers ratio was found as 0.76 (0.63-0.88), AOI was found as 1.2 mm (0-2.8 mm), ADI was found as 1.5 mm (0-3.1 mm) and PADI was found as 17.5 (14.6-23 mm) (Table-1).

When the distribution of obtained results according to gender were statistically compared, no significant differences were found between both sexes ( $p < 0.05$ ) (Table -2).

When the patients were compared in terms of atlantoaxial pathology, only AOI was found to be significantly different between the patients with pathology ( $n=5$ ) and the patients with congenital anomalies in other parts of the spine but no cervical pathology ( $n=18$ ) ( $P=0.015$ ). There were no significant differences in other parameters ( $p < 0.05$ ) (Table-3).

When the patients with both detected congenital anomalies of the spine and intraspinal pathology ( $n=15$ ) were compared to the patients without intraspinal pathology ( $n=8$ ), only BDI was found to be significantly different ( $p=0.008$ ); there were no significant differences in other parameters between the two groups ( $p > 0.05$ ) (Table-4).

**Table-1.** Median values (minimum-maximum) of basion-axial interval (BAI), basion-dens interval (BDI), Powers ratio, atlanto-occipital interval (AOI), atlantodental interval (ADI) and posterior atlantodental interval (PADI) in all patients via CT

N=23	Median	Minimum	Maximum
BAI (mm)	2.50	0.00	7.40
BDI (mm)	4.00	2.00	7.50
Powers Ratio	0.76	0.63	0.88
AOI (mm)	1.20	0.00	2.80
ADI (mm)	1.50	0.00	3.10
PADI (mm)	17.50	14.60	23.00

**Table-2.** Distribution of the patients according to gender and comparison of kranioserkal junction angles. Significant difference was not found among both genders ( $P > 0.05$ ).

	Female (n=15)			Male (n=8)			P
	Median	Minimum	Maximum	Median	Minimum	Maximum	
BAI (mm)	1.80	0.00	6.80	3.15	0.00	7.40	0.357
BDI (mm)	4.40	2.00	7.50	3.85	2.00	7.00	0.925
Powers Ratio	0.76	0.63	0.88	0.77	0.65	0.85	>0.05
AOI (mm)	1.20	0.00	1.70	1.55	1.00	2.80	0.115
ADI (mm)	1.50	0.80	2.40	1.60	0.00	3.10	0.925
PADI (mm)	17.50	14.80	23.00	18.25	14.60	22.60	0.548

**Table-3.** According to the presence or absence of craniocervical junction pathology, AOI was found to be significantly different in the patients with atlantoaxial pathology compared to the patients without atlantoaxial pathology ( $P=0.015$ ). There were no significant differences in other parameters ( $P > 0.05$ ).

	Atlantoaxial pathology						P
	Absent (n=18)			Present (n=5)			
	Median	Minimum	Maximum	Median	Minimum	Maximum	
BAI (mm)	2.20	0.00	6.80	2.60	0.00	7.40	0.691
BDI (mm)	3.90	2.00	7.50	5.10	2.00	6.60	0.691
Powers Ratio	.75	.63	.88	.79	.73	.82	0.446
AOI (mm)	1.10	0.00	1.70	1.60	1.30	2.80	<b>0.015</b>
ADI (mm)	1.50	.80	3.10	1.50	0.00	2.60	>0.05
PADI (mm)	17.25	14.60	23.00	19.10	17.00	21.50	0.290

**Table-4.** The patients with detected intraspinal pathology were compared to the patients without intraspinal pathology. BDI displays significant difference ( $P=0.008$ ), while there were no significant differences in other parameters between the two groups ( $P>0.05$ ).

	Intraspinal anomalies						P
	Absent (n=8)			Present (n=15)			
	Median	Minimum	Maximum	Median	Minimum	Maximum	
BAI (mm)	2.95	0.00	6.80	1.90	0.00	7.40	0.357
BDI (mm)	3.50	2.00	4.40	5.50	3.00	7.50	<b>0.008</b>
Powers Ratio	0.73	0.68	0.82	0.76	0.63	0.88	0.392
AOI (mm)	1.30	0.90	1.70	1.10	0.00	2.80	0.681
ADI (mm)	1.65	0.80	2.40	1.40	0.00	3.10	0.506
PADI (mm)	17.50	15.20	23.00	17.50	14.60	22.60	0.975

## DISCUSSION:

The evaluation of the problems of craniocervical region (e.g., trauma or other pathologies) is not always possible with conventional lateral radiological examinations (2,4). It is possible to evaluate craniocervical region particularly with CT (10).

It is recommended to measure from the sections of midline to accurately assess the contour of the posterior cortex, since BAI gives the erroneous results in the different sections of axis (10). In their study, Rojas et al. measured the BAI as 3.4 cm in average with CT (10). In our study, BAI was measured as 2.5 mm.

The normal upper limit of BDI was reported as 12 mm in the literature (5,6). Gonzalez et al. published the average as 4.7 mm and the maximum as 9 mm (3). Rojas et al. showed the maximum as 9.1 mm in 200 patients with the age of 20-40 years with CT, and up to 8.5 mm for  $>95\%$  (10). In our study, we found the median value of BDI as 4.9 mm, the maximum as 7.5 mm in the adolescent patients with congenital spine anomalies. We found our results consistent with the normal values reported in the literature.

In our study, median of BDI value was measured as 4 mm (2-7.5 mm) in all patients with CT. The value was found to be significantly high in patients detected with intraspinal anomalies in MRI compared to ones without intraspinal pathology ( $P=0.008$ ) (Table-4).

Power ratio was shown as  $<0.9$  mm for more than 95 % of normal population (9). In our study, we found the power ratio in our patients as 0.76 which is compatible with the normal values in the literature (Table-1).

The normal values for AOI in 95 % of the adults were reported as 1 mm in average (0.6-1.4 mm) with CT (10). In our study, the median value of AOI measured with CT was found as 1.2 mm (0-2.8 mm). When

the patients with atlantoaxial pathology were compared the ones without atlantoaxial pathology, AOI values of the patients with atlantoaxial pathology was found to be significantly high ( $P = 0.015$ ) (Table-3).

Atlantodental ligament, alar ligaments and transverse Atlanta ligaments were evaluated by measuring the predental interval with ADI. Abnormal enlargement of predental interval shows the injury of craniocervical ligaments, especially transverse atlantal ligament (1). Normal value was shown as 3 mm for males, 2.5 mm for females (7). Rojas et al. reported the normal value as  $\leq 2$  mm for both genders with CT (10). In the study of Ozdogan et al, ADI was found as 1.47 mm for males and 1.51 for females with CT in the study of 50 males and 50 females; if it is measured more than 2 mm, it was emphasized that should be investigated in terms of craniocervical region pathologies (8). In our study, the median value of ADI of adolescent patients was found as 1.5 mm in males ( $\leq 2.4$ ) and 1.6 mm for females ( $\leq 3.1$ ) which were compatible with the normal literature. Median value of PADI in our patients was found as 17.5 mm (14.6-23 mm) (Table 2).

Knowing the distance between each of the anatomical structure of the craniocervical junction can be necessary for the treatment and follow-up of adolescent cases especially accompanied by congenital spinal deformity. In the presence of atlantoaxial pathology, higher value of AOI and BDI in the patients with intraspinal anomalies compared to the patients without intraspinal anomalies can be important in planning the treatment for craniocervical junction in the adolescent cases accompanied by congenital spinal deformity. In the cases with congenital spinal pathology, further studies are needed with more number of patients to better evaluate craniocervical junction.

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## ORIGINAL ARTICLE / ORJİNAL MAKALE

EFFICACY OF MULTIPLE SMITH PETERSEN  
OSTEOTOMY IN ADULTS WITH THORACIC  
HYPERKYPHOSISTORASİK HİPERKİFOZU OLAN ERİŞKİNLERDE ÇOKLU SMİTH PETERSEN  
OSTEOTOMİSİNİN ETKİNLİĞİÖzcan KAYA<sup>1</sup>, Fatih DİKİCİ<sup>2</sup>, Turgut AKGÜL<sup>3</sup>, Ahmet SALDUZ<sup>3</sup>

## SUMMARY

**Introduction:** This is clinical study of adult patients with rigid hyperkyphosis, curve magnitude bigger than 70° who underwent with multiple Smith Petersen osteotomy and segmental pedicle screw. The aim of the study to show efficacy and safety of this surgical procedure for adult's hyperkyphosis

**Material and Method:** Between 2011 and 2012, fifteen patients were operated for thoracic hyperkyphosis. Radiologic parameters were evaluated on standing long cassette anteroposterior (AP) and lateral columna vertebralis. We measured the thoracic and lumbar sagittal curve, pelvic incidence angle (PI), pelvic tilt (PT), sacral slope (SS), thoracic inlet alignment (TIA), T1 slope, relationship of the central sacral line (CSVL) preoperatively and at final follow-up

**Result:** The mean 7 (6-8) level SPO was performed in patients and 5,9° correction was obtained with each level osteotomy. Intraoperative mean bleeding was 980 ± 429 SD ml mean operative time was 342 ± 429 SD minutes. Patients were followed up for an average of 18,5 ± 5 SD months. The mean preoperative thoracic kyphosis was 79° ± 8,2 SD (70°-90°) and improved to 38° ± 8,3 SD (28°-42°) postoperatively and correction rate was 52% (range 39% to 62 %). Lumbar lordosis was 65° ± 3,3 SD (61°-69°) preoperatively and improved to 40° ± 2,4 SD (37°-43°) postoperatively. There were not significant differences between preoperative and postoperative spinopelvic values. T1 vertebra tilt was improved from 38° ± 2,9 SD to 29° ± 3,8 SD and TIA was improved from 80° ± 5,2 SD to 66° ± 3,1 SD. One dural tear was occurred and treated with suture and fibrin clothe.

**Conclusion:** In this small series, using segmental pedicle screw and multiple SPO more than six level, overall correction of the thoracic kyphosis was 52 % and correction was 5,9° per one level osteotomy. SPO is effective and safe treatment method for adults with rigid deformity thoracic hyperkyphosis.

**Key words:** Deformity, adult hyperkyphosis, Smith Petersen osteotomy

**Level of evidence:** Retrospective clinical study, Level III

## ÖZET

**Giriş:** Bu çalışmada erişkinlerde görülen 70° den büyük rijit torakal hiperkifoz tedavisinde çoklu Smith Petersen osteotomisi ve segmental pedikül vida ile tespitin etkinliği gösterilmesi amaçlanmıştır.

**Hastalar ve Yöntem:** 2011 ve 2012 yılları arasında torakal hiperkifoz tanısı ile opere edilen 15 hasta bu çalışmaya alınmıştır. Radyolojik olarak ayakta çekilen AP ve LATERAL ortonörogramlarda sagittal torakolomber eğrilikler, pelvik insidans (PI), torasik inlet alignment (TIA), T1 slope, santral sakral düzey çizgi (CSVL) ameliyat öncesi ve kontrolleri karşılaştırıldı.

**Sonuçlar:** Ortalama olarak 7 seviye (6-8) SPO yapıldı. Her seviye için ortalama 5,9° lik düzeltme sağlandı. Peroperative ortalama kanama miktarı 980 ± 429 ml ve ortalama ameliyat süresi 342 ± 41 dakika olarak tespit edildi. Ortalama takip süresi 18,5 ± 5 aydı. Ortalama torakal hiperkifoz 79° ± 8,2° den (70° -90°) 38° ± 8,3° ye (28° -42°) geriledi. Lumbar lordoz 65° ± 3,3° den (61° -69°) 40° ± 2,4° ye (37° -43°) düştü. T1 vertebra tilt 38° ± 2,9° SD den 29° ± 3,8° ye; TIA 80° ± 5,2 SD den 66° ± 3,1° ye geriledi. Bir hastada durameter yarananması meydana geldi sütür ve fibrin yapıştırıcı ile tedavi edildi.

**Çıkarım:** Çoklu SPO, rijit torakal hiperkifozun tedavisinde etkin ve güvenli tedavi metodu olarak kullanılabilir.

**Anahtar Kelimeler:** Deformite, erişkin kifoz, Smith-Petersen osteotomisi

**Kanıt Düzeyi:** Retrospektif klinik çalışma, Düzey III

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## INTRODUCTION:

The surgical treatment of thoracic kyphosis is indicated in patient with pain and disgusting their cosmetic appearance. Curve magnitude bigger than 75° is an objective criteria for surgery (6,13). Anterior release and posterior instrumentation is basic treatment protocol for hyperkyphosis. Recently, posterior instrumentation with segmental pedicle screw has been popularized and its results were comparable with combined approach (8,12). In rigid deformity, to restore sagittal kyphosis couldn't be possible only posterior approach without osteotomy of bony structure (4,6).

Posterior shortening osteotomy such as Smith Petersen osteotomy (SPO) was described in deformity correction in Scheuermann disease (6,8,14). Generally SPO is localized at apex of kyphosis and adjacent segment that is more rigidity (6,14). In adult patient, correction of deformity with osteotomy just localized apex side is inadequate to restore thoracic kyphosis. That situation can be resolved with combined posterior instrumentation and anterior release or only posterior instrumentation with multiple SPO. In literature, several studies up to seven SPO in adolescent patients have been reported (7,9).

The aim of this study to show efficacy and safety of multiple Smith Peterson osteotomy and segmental pedicle screw via only posterior approach in adults with rigid thoracic hyperkyphosis.

## MATERIAL AND METHOD:

Between 2011 and 2012, fifteen patients were operated for thoracic kyphosis with multiple Ponte osteotomy and segmental pedicle screw, cobalt chrome rod combination by one senior author. Main indications for operation were pain that significantly reduce functional capacity and cosmetic expectations. The patients were analyzed prospectively with minimum two years followed-up after operation.

Radiologic parameters were evaluated on standing long cassette anteroposterior (AP) and lateral vertebral column (Figure-1a,b). We measured the thoracic and lumbar sagittal curve, pelvic incidence

angle (PI), pelvic tilt (PT), sacral slope (SS), thoracic inlet alignment (TIA), T1slope, relationship of the central sacral line (CSVL) preoperatively and at final follow-up (10-11).

Patient were placed prone position and posterior midline incision was performed. Segmental pedicle screw was inserted at every level after wide facetectomy. Upper instrumentation level was T2 at all patients and distal fusion level was determined using distal sagittal vertebra that cross-linked with posterior sacral line. Spinous processes and interspinous ligament were excised with rongeurs. High speed burr and Kerrison rongeurs were used for posterior bony structure excision rectangular (Figure-1.c). Bilateral cobalt chrome 6,0 mm rod were placed beginning at proximal side and tightened. Reduction was performed with two rods simultaneously using cantilever technique and segmental compression was added. 60 cc spongius allograft and spinous process autograft was used for grafting. Cell saver was used in all surgery to reduce allogenic erythrocyte replacement.

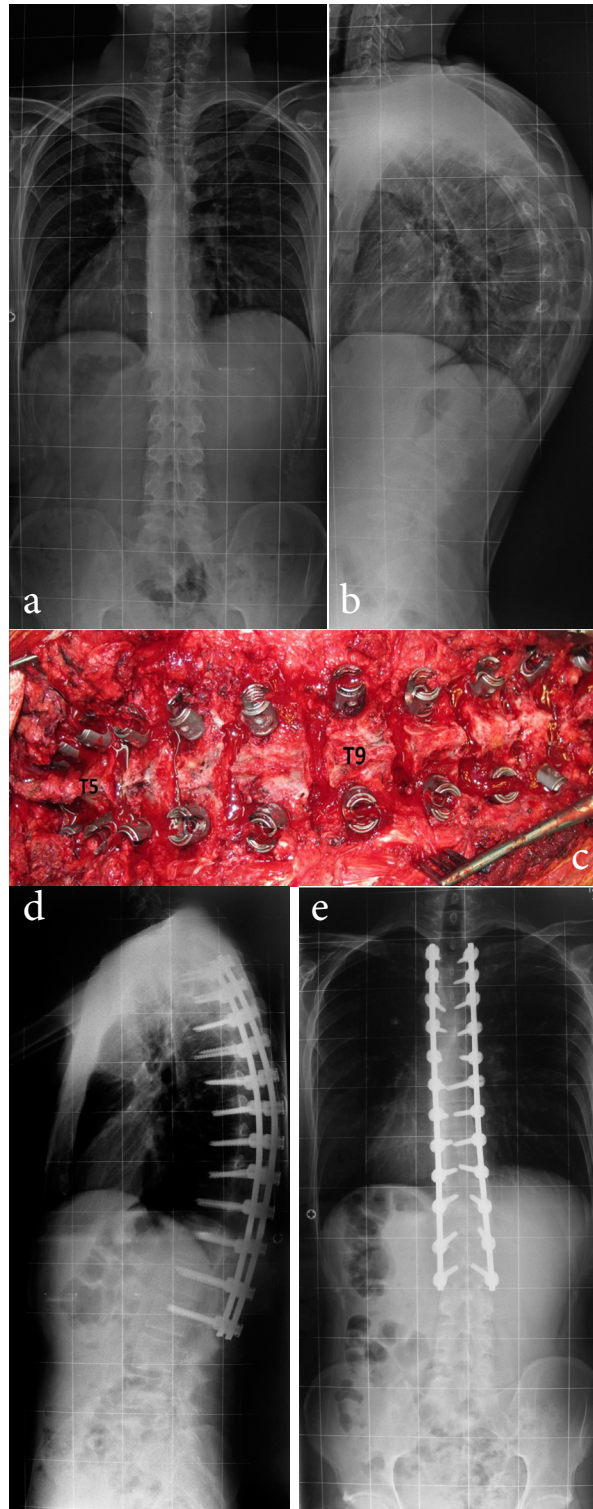
Patients were allowed to sit at the bed side and walk on the first postoperative day. Routine follow-up examinations were performed on the 6<sup>th</sup> week and 3<sup>rd</sup>, 6<sup>th</sup> and 12<sup>th</sup> months and yearly after this. Standard standing long cassette anteroposterior and lateral radiographs were obtained at each visit (Figure-1.d,e).

Statistical analyses were performed using SPSS version 20.0. Comparisons of all preoperative and postoperative measurements were done using a matched-pair t-test and ANOVA. A p value of less than 0.05 was considered to be significant.

## RESULTS:

Fifteen patients were operated on at a mean age of 27 (range 22 to 35) years with hyperkyphosis. Eleven patient was excluded from study because lack of follow-up. Two patients were female (50 %) and two patients were (50 %) male.

The apex of kyphosis was T-8 in three patients and T-9 in one patient. The mean 7 (6-8) level SPO was performed in patients and 5,9° correction was



**Figure-1.** Patient number 2 was 27 years old male diagnosed hyperkyphosis complaint with cosmeses. Pre-operative standing long cassette AP (A) and Lateral (B) radiograph was obtained. His thoracic kyphosis was 79° and lumbar lordosis was 61°. Peroperative picture show SPO level and pedicle screw placement clinically (C). Control X-rays shows thoracic kyphosis was improved 79° to 42° after eight level SPO and pedicle screw placement only posterior approach (D,E).

**Table-1.** Patients Data F: female, M: male, T: thoracic, ml: milliliter

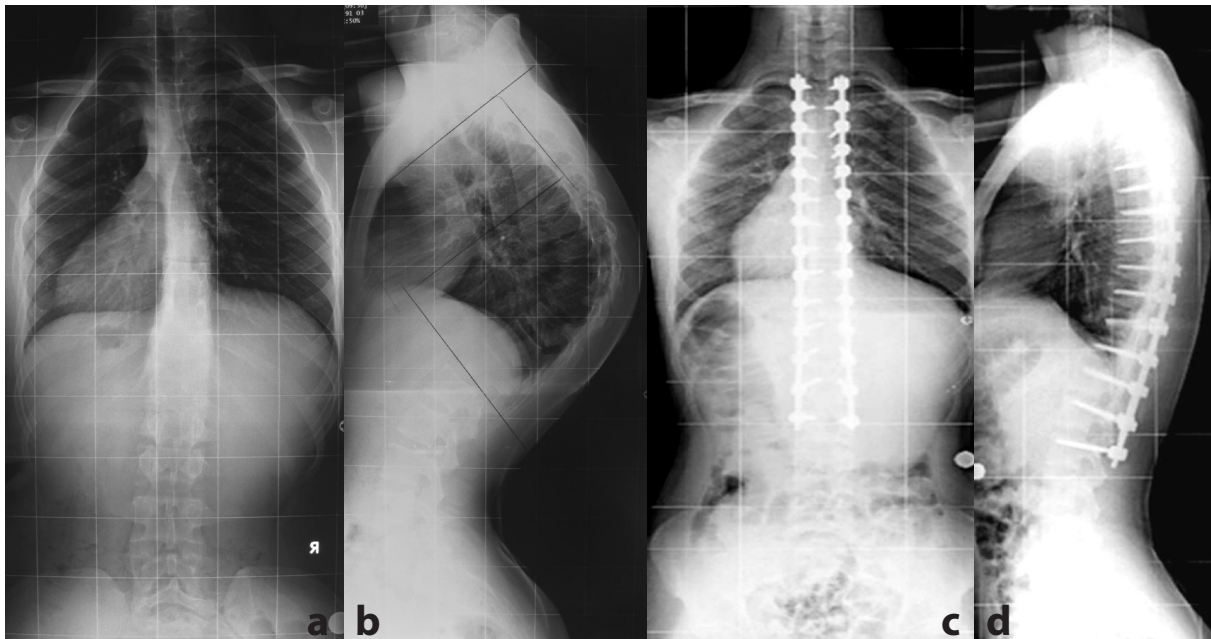
Patient	Sex	Age	Follow-up (months)	Fusion Level proximal	Fusion Level distal	Osteotomy Level	Number osteotomy	Operation time (minutes)	Intraoperative bleeding (ml)	Intraoperative cell saver (ml)
B.K.	F	26	20	T2	L3	T5-T12	7	290	620	260
E.K.	M	27	18	T3	L2	T5-L1	8	380	900	440
Ö.G.	M	22	12	T2	L3	T5-T12	7	390	1600	760
S.T.	F	35	24	T2	L2	T6-T12	6	310	800	360

obtained with each level osteotomy. Intraoperative mean bleeding was  $980 \pm 429$  SD ml and mean salvage cell account was  $455 \pm 216$  SD ml. The mean operative time was  $342 \pm 429$  SD second. Patients were followed up for an average of  $18,5 \pm 5$  SD (range, 12 to 24) months (Table-1).

The mean preoperative thoracic kyphosis was  $79^\circ \pm 8,2^\circ$  SD ( $70^\circ$ - $90^\circ$ ) and improved to  $38^\circ \pm 8,3^\circ$  SD ( $28^\circ$ - $42^\circ$ ) postoperatively. There was a significant difference in the mean thoracic kyphosis values between the last follow-up and preoperative measurements ( $p=0,0002$ ). The mean kyphosis correction rate was 52 % (range 39 % to 62 %). Lumbar lordosis was

$65^\circ \pm 3,3^\circ$  SD ( $61^\circ$ - $69^\circ$ ) preoperatively and improved to  $40^\circ \pm 2,4^\circ$  SD ( $37^\circ$ - $43^\circ$ ) postoperatively and there was significant difference ( $p=0,0001$ ). T12 and L2 sagittal alignment was improved from  $9^\circ$  ( $5^\circ$ - $20^\circ$ ) to  $3,5^\circ$  ( $3^\circ$ - $4^\circ$ ) (Table-2) (Figure-2).

The mean preoperative PI was  $50^\circ \pm 6,3^\circ$  SD and it was measured as  $42^\circ \pm 5,5^\circ$  SD at postoperatively. PT was measured preoperatively as  $14^\circ \pm 4,8^\circ$  SD and postoperatively as  $9,5^\circ \pm 3^\circ$  SD, SS was measured preoperatively as  $32^\circ \pm 4,3^\circ$  SD and postoperatively as  $36^\circ \pm 5,2^\circ$  SD. There was not significant difference between preoperative and postoperative spinopelvic parameters (Table-3).



**Figure-2.** Patient number 3 was 22 years old male diagnosed hyperkyphosis complaint with pain. Preoperative standing long cassette AP (A) and Lateral (B) radiograph was obtained. His thoracic kyphosis was  $90^\circ$  and lumbar lordosis was  $69^\circ$ . Control X-rays shows thoracic kyphosis was improved  $90^\circ$  to  $37^\circ$  after seven level SPO and pedicle screw placement only posterior approach (C,D).

**Table-2.** Sagittal Plane measurement. Preop.: Preoperative, Postop.: Postoperative, TIA: thoracic inlet alignment, T1: Thoracic 1 vertebra.\* statistical comparison of preoperative and postoperative value.

Patient	Thoracic Kyphosis		Lumbar Lordosis		T12-L2 Sagittal		TIA		T1 tilt	
	Preop.	Postop.	Preop.	Postop.	Preop.	Postop.	Preop.	Postop.	Preop.	Postop.
B.K.	78	41	66	43	6	3	80	63	36	31
E.K.	79	42	61	40	5	4	72	64	42	33
Ö.G	90	37	69	40	20	4	83	70	36	24
S.T.	70	28	65	37	5	3	83	65	39	29
P value*	0,0002		0,0001		0,186		0,036		0,009	

**Table-3.** Pelvic parameter Preop.: Preoperative, Postop.: Postoperative, PI: Pelvic incidence angle , PT: Pelvic tilt , SS: Sacral slope, CSVL: Central sacral line. \* statistical comparison of preoperative and postoperative value

Patient	SS		CSVL		PT		PI	
	Preop.	Postop.	Preop.	Postop.	Preop.	Postop.	Preop.	Postop.
B.K.	34	27	-26	-17	10	7	44	34
E.K.	34	34	+32	-12	21	13	55	47
Ö.G	43	37	-30	-11	12	7	55	44
S.T.	31	30	+27	+12	13	11	44	41
P value*	0,34		0,67		0,16		0,10	

T1 vertebra tilt was improved from  $38^\circ \pm 2,9^\circ$  SD to  $29^\circ \pm 3,8^\circ$  SD and TIA was improved from  $80^\circ \pm 5,2^\circ$  SD to  $66^\circ \pm 3,1^\circ$  SD. The difference in the mean T1 slope and TIA values between the preoperative and postoperative measurements was significant ( $p=0.009$  and  $p=0.036$ ) (Table-2).

One dural tear was occurred and treated with primary suture and fibrin cloth as called intraoperative complications. This patient was mobilized lately and healed spontaneously at follow-up.

## DISCUSSION:

Posterior arc osteotomy (SPO) was first described by Smith Peterson as one or two level for ankylosing spondylitis in 1954 (16). Lately multiple chevron posterior arc osteotomy was introduced by Ponte for Scheuermann's kyphosis (14). Those osteotomies based on posterior bony structures shortening and compression with mobile anterior disc space that opens anteriorly acting as hinge. This type osteotomies have lower risk for vascular and neurologic complication when compared with anterior lengthening osteotomies (1,17).

The classical indication is rounded that classified type 1 kyphosis for SPO. The mean correction degree was  $9,3^\circ$ - $10^\circ$  per each level (5-7,14). In our cases the mean correction was  $5,9^\circ$  per each level. This correc-

tion value is lower than reported case series. Geck et al reported their correction value mean  $9,3^\circ$  ( $5,9^\circ$ - $15^\circ$ ) in Scheuermann disease. They noted that SPO is useful for adolescent patient who have flexible curve. In this series the mean age was 16,4 years and one patient over twenty years was reported (6). Also Koptan et al. report 52.2 % correction rate in adolescent patient with mean age 15 years old and the mean 5 level SPO (8). Maida et al reported one case was 45 years with Scheuermann kyphosis. He was treated with seven level Ponte osteotomy and pedicle screw-rod combination. The correction degree per level was  $6,1^\circ$  which was similar as we presented (9). The lost of the correction degree per level can be explained with older age that kyphosis become stiffer. Our correction ratio was 52 % and this was similar with other studies were reported in literature (6,8,12-13). Also this correction rate was similar with combined surgery (7)

Coronal decompensation seems to be the major disadvantage of the technique in reported paper (2,5). In our series, there was no decompensation on coronal balance. That was related with segmental pedicle screw instrumentation.

In thoracic region, SPO can effect T1 vertebra tilt and thoracic inlet alignment positively ( $p=0.009$  and  $p=0.03$ ). This results influence further cervical malalignment because sagittal balance of the cervical spine

could influence by the T1 position (11). Contrary our study showed that The effect of thoracic SPO on the spino-pelvic alignment was statistically not significant also on CSVL (SS  $p=0,34$ , PI  $p=0,10$ , PT  $p=0,16$ , CSVL  $p=0,67$ ). Our finding was supported by Bridwell suggest that SPO not useful for major sagittal imbalance have just indication on minor imbalance (4).

Reported neurological complication rate was 0-3,3 % although overall complication rate was 29-47 % (2,4,6,14). We have one complication as dural tear

was occurred during laminectomy. That was treated with primary suture and fibrin cloth. Although this complication was seen, SPO is safer than other osteotomies (2,3,4,5).

In this small series, using segmental pedicle screw and multiple SPO more than six level, overall correction of the thoracic kyphosis was 52 % and correction was 5,9° per one level osteotomy. SPO is effective and safe treatment method for thoracic hyperkyphosis although adult age with rigid deformity.

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## ORIGINAL ARTICLE / ORJİNAL MAKALE

FLUOROSCOPY GUIDED TRANSFORAMINAL  
STERIOD INJECTION ON CERVICAL RADICULAR PAINSERVİKAL RADİKÜLER AĞRIDA FLOROSKOPİ EŞLİĞİNDE  
TRANSFORAMİNAL STEROİD ENJEKSİYONUHüsnü SÜSLÜ<sup>1</sup>, Hanife Güliden DÜZKALIR<sup>2</sup>, Selçuk ÖZDOĞAN<sup>3</sup>, Özgür ŞENOL<sup>3</sup>,  
Necati TATARLI<sup>3</sup>, Ali Haluk DÜZKALIR<sup>4</sup>, Cumhur Kaan YALTIRIK<sup>5</sup>

## SUMMARY

**Purpose:** The aim of this study is to evaluate the benefit rate of cervical radicular pain from fluoroscopy guided transforaminal cervical steroid injection.

**Materials-Methods:** We collected data of 78 patients retrospectively from patient files. Only adults at least 18 years of age with upper extremity pain of at least 1 month duration at C5-6 or C6-7 levels of cervical spine were included. Each patient underwent a standard physical examination and was asked to complete a 100-mm visual analogue scale (VAS) questionnaire before transforaminal cervical steroid injection and 1, 3, 6 and 12 months after procedure.

**Results:** Mean pre- and post-injection VAS scores at 1st, 3rd, 6th, and 12th months were  $8.34 \pm 0.68$  (7.24-9.64),  $3.88 \pm 1.45$  (2.22-7.35),  $3.95 \pm 1.29$  (2.12-6.87),  $4.35 \pm 1.12$  (2.53-7.12),  $4.43 \pm 1.10$  (2.10-6.15), respectively. The changes in pre- and post-injection VAS scores through follow-ups were statistically significant ( $p < 0.001$ ). Post-hoc tests (Wilcoxon signed-ranks test) revealed that the pre-injection VAS levels were significantly higher than the post-injection VAS scores. The changes in VAS scores at 1st, 3rd, 6th, and 12th months when compared to the pre-injection VAS scores were 53.9 %, 52.9 %, 48.1 %, and 47.1 %, respectively.

**Conclusion:** Fluoroscopy guided transforaminal cervical steroid injection has been postulated to be effective on cervical radicular pain because accurate delivery of medication to the site of pathology is possible.

**Key Words:** Cervical transforaminal steroid injection, cervical radicular pain, fluoroscopy guided injection

**Level of Evidence:** Retrospective clinical study, Level III

## ÖZET

**Amaç:** Bu çalışmanın amacı servikal radiküler ağrının floroskopi eşliğinde transforaminal steroid enjeksiyonundan fayda görme miktarının incelenmesidir.

**Materyal-Metod:** 78 hastanın verileri retrospektif olarak dosyalardan toplandı. Sadece en az 18 yaşında, 1 aydır devam eden C5-6 veya C6-7 seviye kaynaklı üst ekstremité radiküler ağrısı olan hastalar çalışmaya dâhil edildi. Her hasta standart fizik muayeneden geçti ve 100mm'lik vizüel analog skala skorları prosedür öncesi ve prosedürden 1,3,6 ve 12 ay sonra hesaplandı.

**Sonuçlar:** İşlem öncesi ve sonrası 1, 3, 6 ve 12. aylardaki ortalama VAS değerleri  $8.34 \pm 0.68$  (7.24-9.64),  $3.88 \pm 1.45$  (2.22-7.35),  $3.95 \pm 1.29$  (2.12-6.87),  $4.35 \pm 1.12$  (2.53-7.12),  $4.43 \pm 1.10$  (2.10-6.15) olarak hesaplanmıştır. İşlem öncesi ve sonrası değerler arasında istatistiksel olarak anlamlı değişim bulunmuştur ( $p < 0.001$ ). Post-hoc testi (Wilcoxon signed-ranks test) işlem öncesi değerlerin işlem sonrasına göre anlamlı derecede yüksek olduğunu göstermiştir. İşlem sonrası 1., 3., 6. ve 12. aylardaki VAS skorlarının işlem öncesi değerler arasındaki değişim oranı ise % 53.9, % 52.9, % 48.1 ve % 47.1 olarak hesaplanmıştır.

**Çıkarım:** Servikal radikülopati ağrısında floroskopi eşliğinde yapılan transforaminal steroid enjeksiyonu etkilidir çünkü ilacı patolojinin olduğu yere uygulamak mümkündür.

**Anahtar Kelimeler:** Servikal transforaminal steroid enjeksiyonu, servikal radiküler ağrı, floroskopi eşliğinde enjeksiyon

**Kanıt Düzeyi:** Retrospektif klinik çalışma, Düzey III

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## INTRODUCTION:

Neck and cervical radiculitis pain have been shown to be caused by intervertebral discopathies, cervical muscles, facet joints, ligaments, and nerve root dura which are capable of transmitting pain (13). Cervical disc herniation is one of the most common indications for surgical interventions in the spine. Cervical radiculitis affects approximately 83 per 100,000 population per year (27).

The pathogenesis of cervical radicular pain is associated with multiple chemicals including nitric oxide, metalloproteinase, prostaglandin E2 and interleukin-6 of which are irritants of the spinal nerves causing inflammation (12). Corticosteroids have anti-inflammatory affect and also stabilize nerve membranes inhibiting ectopic impulses, inhibits ion conductance, hyperpolarizes spinal neurons, and inhibits C fiber transmission (7,10).

Initial treatment of cervical radiculitis usually consists of activity modification, medical and physical therapy. Narcotic analgesics and analgesic adjuvant may be needed when pain is not adequately controlled. A cervical orthosis may provide comfort for some patients in the acute phase. If there is no improvement in 3–4 weeks of conservative treatment, cervical transforaminal steroid injections (CTSI) may be performed before suggestion of surgery.

Fluoroscopy allowed the development of injection procedures. CTSI have the advantage of being able to place medication directly around the dorsal root ganglion pathologically involved in causing a patient's radicular pain. We investigated 78 patients whom treated with CTSI for cervical radicular pain with the follow-up 1., 3., 6. and 12. months.

## MATERIALS AND METHOD:

We collected data of 78 patients retrospectively from Maltepe University Department of Algology patient files. Only adults at least 18 years of age with upper extremity pain of at least 1 months duration at C5-6 or C6-7 levels of cervical spine were included. All patients had been evaluated with magnetic resonance imaging (MRI). Furthermore inclusion criteria were patients must have failed previous pharmacotherapy and physical therapy, MRI reports do not include sequestered cervical disc herniations but bulging and protrusion at one side. Exclusion criteria were neurological deficit, pregnancy, coagulation disorders and have had an operation for cervical spine. CTSI procedure had been performed for all patients.

### *Transforaminal Injection Technique:*

The patient is placed in the supine-oblique position on the fluoroscopy table. A towel is placed under the head to keep the neck parallel to the table.

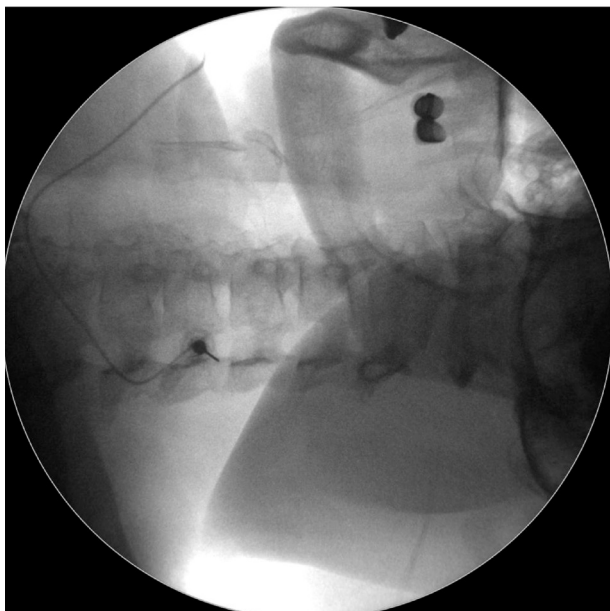
The patient is rolled into the correct position with the foramen perpendicular to the radiographic imager. A bolster is then placed behind the patient to support this position. The patient is prepped in a sterile fashion and sterile technique is utilized throughout the procedure.

Once correctly positioned, a skin wheal is raised with 10:1 mixture of 1 % lidocaine and 8.4 % bicarbonate. A 22 gauge 1.5–2.5 inch (5 cm) spinal needle (10 cm in obesity) is advanced parallel to the radiographic beam to abut upon the mid-portion near the anterior edge of the superior articular process to gauge depth. The needle is slightly withdrawn and then redirected into the posterior aspect of the foramen 1–2 mm. The position is checked in the AP plane, the needle tip should be slightly beyond the lateral border of the cervical pillar. The needle is then advanced 1–2 mm in the AP plane. If nerve is contacted, the patient typically experiences pain or paraesthesia into the scapula or upper extremity. The needle should be slightly withdrawn off the nerve. The needle should not be advanced beyond the mid-sagittal line of the lateral mass.

Oblique and lateral views are checked to ensure the needle is in the posterior aspect of the foramen (Figure-1, 2). A 1cc syringe containing non-ionic contrast (Isovue or Omnipaque) is connected to low volume extension tubing and flushed with contrast. The extension tubing is then connected to the spinal needle hub after first providing a drop of contrast into the spinal needle to flush out any air. The extension tubing minimizes the chance of needle movement with attaching and detaching the various syringes. Furthermore, the tubing keeps the interventionalist's hand away from the fluoroscopic beam. Contrast 0.5–1.0 cc is then infused under live fluoroscopy carefully evaluating not only for outline of the nerve root but also for any vascular flow.



**Figure-1.** Position of the patient and the needle



**Figure-2.** Oblique fluoroscopical view of the needle

Multi-planar fluoroscopic imaging of needle placement is performed before infusion of contrast (Figure-1, 2). Contrast should outline the nerve root with epidural flow and no vascular pattern. Preservative free 1% xylocaine 0.5–1.0 cc is then instilled under live fluoroscopy carefully watching for any vascular flow. After 90s, the patient is queried about perioral numbness, metallic taste, tinnitus, light-headedness, shortness of breath, and agitation. The patient is asked to move the fingers and toes, and pin-prick is tested on the hands and lower legs or feet. If there are no untoward effects, 1.5–2 cc dexamethasone may then be infused slowly. Before injecting, imaging is performed to ensure the needle position has not changed.

#### **Follow-up:**

Each patient underwent a standard physical examination and was asked to complete a 100-mm visual analogue scale (VAS) questionnaire, in which 0 mm represented no pain and 100 mm the worst imaginable pain, for upper extremity radiculopathic pain symptoms on movement during activities of daily living, before CTSI and 1, 3, 6 and 12 months after procedure.

#### **Statistical Analysis:**

Descriptive data of VAS scores were presented as mean, standard deviation, minimum and maximum. The categorical variables gender, level, and side were presented as frequency and percent. The comparisons between independent two groups were conducted by Mann-Whitney U test. The changes during the follow-ups were compared by using Friedman test, and when a statistically significant difference was observed, post-hoc analyses were performed by Wilcoxon test. SPSS software version 21 (IBM Inc., USA) was used for the statistical analyses. Statistical significance level was considered as 0.05 in the analyses of this study.

#### **RESULTS:**

Mean age of the patients was  $58.15 \pm 15.02$  (27–79) years. 42 patients were female (53.8 %), and 36 were male (46.2 %). Mean age of the females and males were  $63.21 \pm 13.05$  years and  $52.25 \pm 15.53$  years, respectively ( $p=0.050$ , Mann-Whitney U test). 42 patients (53.8 %) had injections at C5-6 level, 36 patients (46.2 %) at C6-7 level, 30 patients (38.5 %) on right side, and 48 (61.5 %) on left side.

Mean pre- and post-injection VAS scores at 1<sup>st</sup>, 3<sup>rd</sup>, 6<sup>th</sup>, and 12<sup>th</sup> months were  $8.34 \pm 0.68$  (7.24–9.64),  $3.88 \pm 1.45$  (2.22–7.35),  $3.95 \pm 1.29$  (2.12–6.87),  $4.35 \pm 1.12$  (2.53–7.12),  $4.43 \pm 1.10$  (2.10–6.15), respectively (Table-1). The changes in pre- and post-injection VAS scores through follow-ups were statistically significant ( $p<0.001$ ). Post-hoc tests (Wilcoxon signed-ranks test) revealed that the pre-injection VAS levels were significantly higher than the post-injection VAS scores.

**Table-1.** Pre- and post-injection VAS levels through follow-ups

	Mean	SD	Min	Max	p
Preinjection VAS	8,34	0,68	7,24	9,64	<0.001
1.month VAS	3,88	1,45	2,22	7,35	
3.month VAS	3,95	1,29	2,12	6,87	
6.month VAS	4,35	1,12	2,53	7,12	
12.moth VAS	4,43	1,10	2,10	6,15	

**Table-2.** Pre- and post-injection VAS levels according to gender

	Gender								p
	Female				Male				
	Mean	SD	Min	Max	Mean	SD	Min	Max	
Preinjection VAS	8,38	,76	7,24	9,64	8,29	,60	7,45	9,24	0,738
1.month VAS	4,09	1,59	2,24	7,35	3,62	1,29	2,22	7,15	0,571
3.month VAS	4,05	1,45	2,12	6,87	3,84	1,12	2,29	6,54	0,877
6.month VAS	4,39	1,37	2,53	7,12	4,30	,79	3,14	5,12	0,817
12.moth VAS	4,60	1,19	2,10	6,15	4,24	1,00	2,53	6,12	0,280

**Table-3.** Pre- and post-injection VAS levels according to level

	Level								p
	C5-6				C6-7				
	Mean	SD	Min	Max	Mean	SD	Min	Max	
Preinjection VAS	8,14	,68	7,24	9,64	8,56	,63	7,45	9,24	0,089
1.month VAS	4,13	1,44	2,45	7,35	3,58	1,47	2,22	7,15	0,165
3.month VAS	4,11	1,38	2,12	6,87	3,78	1,20	2,29	6,54	0,662
6.month VAS	4,55	1,28	2,53	7,12	4,11	,89	3,12	5,76	0,367
12.moth VAS	4,31	1,25	2,10	6,15	4,58	,92	3,18	6,12	0,554

**Table-4.** Pre- and post-injection VAS levels according to side

	Side								p
	Right				Left				
	Mean	SD	Min	Max	Mean	SD	Min	Max	
Preinjection VAS	8,59	,64	7,79	9,64	8,18	,68	7,24	9,24	0,170
1.month VAS	4,30	1,60	3,14	7,35	3,61	1,33	2,22	6,39	0,126
3.month VAS	4,26	1,44	2,43	6,87	3,76	1,19	2,12	6,02	0,429
6.month VAS	4,61	1,07	3,25	7,12	4,18	1,14	2,53	6,12	0,444
12.moth VAS	4,73	1,02	2,53	6,12	4,25	1,14	2,10	6,15	0,429

The changes in VAS scores at 1<sup>st</sup>, 3<sup>rd</sup>, 6<sup>th</sup>, and 12<sup>th</sup> months when compared to the pre-injection VAS scores were 53.9 %, 52.9 %, 48.1 %, and 47.1 %, respectively.

The comparisons of pre- and post-injection VAS scores according to gender are presented in Table-2, according to level in Table-3, and according to side in Table-4. The analyses revealed that all VAS scores were similar between males and females, C5-6 and C6-7, and left and right sides ( $p>0.05$  for all).

## DISCUSSION:

The aging process in conjunction with the influence of various mechanical stress factors or injuries to the cervical spine typically results in degenerative changes of the cervical spine. Cervical radicular pain is defined as pain perceived as arising in the upper limb with a sharp, shooting, lancinating quality caused by ectopic activation of the nerve roots or other neuropathic mechanisms (14). Radicular pain follows a segmental-specific pattern. Cervical spine MRI can determine the cause of radicular pain, herniated disk or cervical foraminal stenosis. If not diagnostic, fur-

ther testing may be required like electrodiagnostic studies, diagnostic selective nerve root injections and brachial plexus MRI (2,11,25).

Cervical herniated disk specimens have demonstrated increased levels of matrix metalloproteinase activity, nitric oxide, prostaglandin E2 and interleukin-6 (16). Phospholipase A2 also plays a role in the inflammation of the nerve root and can be neurotoxic (10). Epidural steroids have been shown to inhibit phospholipase A2 activity, thus reducing symptoms. Corticosteroid mitigates nerve conduction slowing due to inflammation (26). Corticosteroids also affect cell-mediated activity and cytokines, which may be involved in the pathogenesis of radicular pain. Corticosteroids effects could be counted as anti-inflammatory, inhibiting C fiber transmission, inhibiting ion conductance, stabilization of nerve membranes inhibiting ectopic impulses and hyperpolarizing spinal neurons (7,10,12,15). The favorable outcome from cervical radiculitis from herniated disk may be due in part to the natural regression of disk herniation over time (22).

Fluoroscopic guided epidural injections advocate utilizing this technique in order to assure that medications reach the appropriate target of foraminal space (5). Inaccurate needle placement is a common problem encountered with any epidural injection (4). Cervical spondylotic foraminal stenosis, foraminal and entrance zone disk herniations and epidural fibrosis can potentially block the flow of medication for epidural injection to the involved dorsal root ganglion. MRI or at least multi-planar computed tomography should be obtained before proceeding with spinal interventions to avoid wrong trajectory. The vertebral artery path can be followed to evaluate for a tortuous vertebral artery overlying a foramen that may interfere with a transforaminal injection (1). If complications develop after CTSI, a preprocedure MRI is very helpful to compare to a new MRI for any changes.

There are two options for cervical steroid injections as transforaminal and interlaminar (17). The important differences between interlaminar and transforaminal epidural injections include that while interlaminar entry delivers the medication close to the assumed site of pathology and the transforaminal approach is the target-specific modality requiring the smallest volume to reach the primary site of pathology and also leading to the site of pathology ventrally (24). We used target specific transforaminal trajectory in our study.

Complications reported with CTSI include dural puncture, vertebral artery injury, nausea, neck pain, transient increased radicular pain, vasovagal reaction, non-specific headache, transient lightheadedness, dyspepsia, fluid retention, transient global amnesia, paralysis, cord infarction and cerebellar infarction, and death(21). Ma et al. reviewed records of 1,036 cervical transforaminal epidural steroid injections in 844 subjects (14). Immediate complications were recorded by the radiologist performing the procedure. The authors' reported complications occurred in 14 subjects (1.66 %). These included headache/dizziness (0.59 %), transient pain or weakness (0.71 %), hyper-

sensitivity reaction (0.12 %), transient global amnesia (0.12 %), vasovagal reaction (0.12 %), and wrong site injection (0.36 %). Huston et al. performed a prospective, controlled study with independent interviewer of lumbar and cervical selective nerve root injections on 151 subjects who received 306 injections. Of the cervical group, there were 89 cervical selective nerve root injections performed on 37 subjects and immediate complications were increased pain at injection site 22.7 %, increased radicular pain 18.2 %, lightheadedness 13.6 %, increased spine pain 9.1 %, non-specific headache 4.5 %, and nausea 3.4 % (14). Our complications were dural puncture in 2 patients.

Lin et al. retrospectively reported on 70 consecutive subjects that underwent CTSI for radicular pain from a herniated cervical disk (20). All patients had been offered surgical treatment but given the option of CTSI. Mean follow-up was 13 months (range, 6 months to 4 years) with 65.3 % good to excellent relief with Odom criteria and avoidance of surgery. The authors found more favorable result in those over age 50 and symptom duration less than 100 days. Vallee et al. prospectively evaluated CTSI performed on 32 consecutive subjects with radicular pain from foraminal stenosis either from spondylosis or disk herniation (30). At 6 months follow-up greater than 50 % relief occurred in 56% who also resumed full activities. There are comprehensive reviews that reported the effectiveness of CTSI (3,6,8-9,18,23). Also some studies compared the particulate and non-particulate CTSI and they reported no significance difference at results but they do not suggest particulate steroids because of serious side effects (19,28). Our results are supporting the pain relief ratios of the literature and we use non-particulate steroid (dexamethazone) for the procedure.

CTSI have been postulated to be effective because accurate delivery of medication to the site of pathology is possible. CTSI may be recommended to the patients whom have failed previous pharmacotherapy, physical therapy and also not be eligible for surgery.

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## ORIGINAL ARTICLE / ORJİNAL MAKALE

EPIDUROSCOPY USAGE FOR PAIN MANAGEMENT  
OF FAILED BACK SURGERY SYNDROMEBAŞARISIZ BEL CERRAHİSİ SENDROMUNUN AĞRI  
YÖNETİMİNDE EPIDUROSKOPİ KULLANIMIHüsnü SÜSLÜ<sup>1</sup>, Cumhur Kaan YALTIRIK<sup>2</sup>, Selçuk ÖZDOĞAN<sup>3</sup>, Özgür ŞENOL<sup>3</sup>,  
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## SUMMARY

**Purpose:** The aim of this study is to evaluate the pain relief ratio of epiduroscopy on patients with failed back surgery syndrome.**Materials-Methods:** We inspected 19 patients who are diagnosed as FBSS and 2 patients who were operated for disc herniation that had recurrent discopathy. Data was collected retrospectively from patient's files. Each patient underwent a standard physical examination and was asked to complete a 100-mm visual analogue scale (VAS) questionnaire before epiduroscopy and 1st, 3rd, 6th and 12th months after epiduroscopy.**Results:** Mean pre- and post-procedure VAS scores at 1st, 3rd, 6th, and 12th months were 8.44±0.71 (7.24-9.64), 4.67±2.13 (2.45-9.50), 4.34±1.26 (2.12-6.87), 4.28±1.73 (2.65-7.12), 4.68±1.09 (2.53-6.15), respectively. The changes in pre-procedure and post-procedure VAS scores through follow-ups were statistically significant (p<0.001). Post-hoc tests (Wilcoxon signed-ranks test) revealed that the pre-procedure VAS levels were significantly higher than the post-procedure VAS scores. The changes in VAS scores at 1st, 3rd, 6th, and 12th months when compared to the pre-procedure VAS scores were 45.7%, 48.3%, 43.6%, and 44.2%, respectively.**Conclusion:** Epiduroscopy could be an option as a final step of pain management for FBSS before palliative procedures, such as spinal cord stimulation or intrathecal drug delivery.**Key Words:** Epiduroscopy, Failed back surgery syndrome, Epidural adhesiolysis**Level of Evidence:** Retrospective clinical study, Level III

## ÖZET

**Amaç:** Bu çalışmanın amacı başarısız bel cerrahisi sendromlu hastalarda epiduroskopinin ağrıyı dindirme oranı bulmaya çalışmaktır.**Materyal ve Metod:** 19 başarısız bel cerrahi sendromlu hasta ve 2 bel fıtığından ameliyat olmuş ve nüks etmiş hasta incelendi. Veriler hasta dosyalarından retrospektif olarak toplandı. Her hasta standart fizik muayeneden geçti ve 100mm'lik vizüel analog skala skorları prosedür öncesi ve prosedürden 1,3,6 ve 12 ay sonra hesaplandı.**Sonuçlar:** İşlem öncesi ve sonrası 1,3,6 ve 12. aylardaki ortalama VAS değerleri 8.44±0.71 (7.24-9.64), 4.67±2.13 (2.45-9.50), 4.34±1.26 (2.12-6.87), 4.28±1.73 (2.65-7.12), 4.68±1.09 (2.53-6.15) olarak hesaplanmıştır. İşlem öncesi ve sonrası değerler arasında istatistiksel olarak anlamlı değişim bulunmuştur (p<0.001). Post-hoc testi (Wilcoxon signed-ranks test) işlem öncesi değerlerin işlem sonrasında göre anlamlı derecede yüksek olduğunu göstermiştir. İşlem sonrası 1,3,6 ve 12. aylardaki VAS skorlarının işlem öncesi değerler arasındaki değişim oranı ise %45.7, %48.3, %43.6 ve %44.2 olarak hesaplanmıştır.**Çıkarım:** Epiduroskopi başarısız bel cerrahisi sendromlu hastalarda, spinal kord stimülasyonu ve intratekal ilaç kullanımı gibi palyatif prosedürler öncesi ağrı yönetiminde son basamak olarak önerilebilir.**Anahtar Kelimeler:** Epiduroskopi, Başarısız bel cerrahisi sendromu, Epidural adezyonların açılması**Kanıt Düzeyi:** Retrospektif klinik çalışma, düzey III

## INTRODUCTION:

Epiduroscopic lysis of adhesions for epidural fibrosis is commonly performed procedure for treatment of failed back surgery syndrome (FBSS) and spinal stenosis (SS) (13). FBSS is defined as persistent or recurrent back and/ or leg pain following an anatomically successful back surgery. SS is defined as anatomical narrowing of the central canal, lateral recesses, or fo-

ramina. Many studies have used < 12 mm for relative stenosis and < 10 mm for absolute stenosis to define lumbar SS in image-based modalities (3,24). Prevalence rates of FBSS from past studies of heterogeneous populations provide a wide range, varying 10 % to over 40 % (5).

Regardless of whether the epidural scar tissue was created by surgery or a non-surgical reason, the

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common suggestion for treating FBSS with epiduroscopy is that the presence of epidural fibrosis can both cause pain and prevent delivery of medications for relief. Another proposed mechanism of action for epiduroscopic lysis of adhesions is the wash out of inflammatory cytokines from the affected area (13). Mechanical dissection of scar tissue at the level of the affected nerve root with the tip of the endoscope and constant instillation of saline may allow restoration of blood supply and nerve root nutrition with possible pain relief and nerve root recovery(6).

Endoscopic epidural adhesiolysis is a minimally invasive technique for the treatment of axial spine or radicular pain when conservative therapy has failed. We reported the results of 21 patients treated with endoscopic epidural adhesiolysis for FBSS.

### MATERIALS AND METHOD:

We inspected 19 patients who are diagnosed as FBSS and 2 patients who were operated for disc herniation that had recurrent discopathy. All 21 patients have had conservative therapies such as medical and physiotherapy and had been operated at least once for lumbar spinal diseases. Data was collected retrospectively from patients files. Inclusion criteria were to be older than age of 40, to have all type of conservative treatments and fail, had been operated for lumbar vertebral level with instrumentation, had been diagnosed as recurrent discopathy, visual analogue scale score  $\geq 7$  and have not been treated with any epidural injection methods before. Exclusion criteria were pregnancy, coagulation disorders, glaucoma, malignancy, or allergy to radio-opaque contrast medium, local anesthetics, steroids, or hyaluronidase, progressive motor disorders, incontinence and post-surgical pseudomeningocele. All patients treated with epiduroscopic epidural adhesiolysis.

#### Technique of Epiduroscopy:

The patient was placed in the prone position on a horizontal operating table. A pillow was placed under the abdomen to minimize lumbar lordosis. Cardiac and saturation monitorization is made and oxygen is given by nasal canule at 3lt/min. Sedation anesthesia was given with intravenous dosage of 0.02-0.05 mg/kg midazolam and 0.1-0.2 mg fentanyl. After sterile preparation of the surgical field, an 18-gauge Tuohy needle is introduced into the sacral hiatus, and its tip was confirmed to be in the caudal epidural space by lateral X-ray or by injection of a contrast medium (iotrolan 10 ml, Isovist 240; Schering, Osaka, Japan) through the needle. A 0.8-mm guide wire is then inserted through the needle under fluoroscopic guidance. Using the Seldinger technique, the 10F introducer (LMC pain treatment kit, EMOTEC®, Italy) with a



**Figure-1**

12F dilator was advanced over the guide wire into the sacral epidural space. After removal of the dilator and the guide wire, a 0.77mm endoscope (Polydiagnost®) (Figure-1) covered with a 8F video-guided catheter (PolyScope, Polydiagnost®) is introduced into the epidural space through the introducer. The endoscope is gently steered and advanced in a cephalic direction under direct vision in the epidural space. And also, fluoroscopy is used to determine the vertebral level of the endoscope tip(Figure-2).



**Figure-2**

The epidural space was irrigated and distended by infusion of saline during the procedure to obtain a good visual field. When adhesions or heavy connective tissues were detected in the epidural space, they were broken down by bolus injections of a small amount of saline through the catheter combined with careful and gentle movement of the catheter. When a sufficient field to steer the endoscope could not be obtained, or paraesthesia or resistance was noted, no attempt was made to steer the epiduroscope into such an area. Before and after lysis of adhesions, epidurography was performed to determine if the connective tissue strands interfered with the nerve root. The procedure was terminated when epidurography demonstrated that the contrast medium had reached the affected nerve root sheaths.

At the end of the procedure, lidocaine 1% 8 ml and triamcinolone acetate 40 mg were injected around the area through the catheter. The mean (range) total volume of saline used during the procedure was 298 (100–650) ml. that aspirated at the end of the procedure mostly.

#### Follow-up:

Each patient underwent a standard physical examination and was asked to complete a 100-mm visual analogue scale (VAS) questionnaire, in which 0 mm represented no pain and 100 mm the worst imaginable pain, for low back pain and leg symptoms on movement during activities of daily living, before epiduroscopy and 1, 3, 6 and 12 months after epiduroscopy. Two patients who had recurrent disc herniations and they did not benefit from the procedure. So on they have had surgery after 3 months of the procedure.

#### Statistical Analyses

Descriptive data of VAS scores were presented as mean, standard deviation, minimum and maximum.

The categorical variable gender was presented as frequency and percent. The comparisons between independent two groups were conducted by Mann-Whitney U test. The changes during the follow-ups were compared by using Friedman test, and when a statistically significant difference was observed, post-hoc analyses were performed by Wilcoxon test. SPSS software version 21 (IBM Inc., USA) was used for the statistical analyses. Statistical significance level was considered as 0.05 in the analyses of this study.

#### RESULTS:

Mean age of the patients was  $63.67 \pm 10.28$  (43–79) years. Eleven patients were female (52.4 %), and 10 were male (47.6 %). Mean age of the females and males were  $67.73 \pm 9.06$  years and  $59.20 \pm 10.08$  years, respectively. Females were significantly older than the males ( $p=0.048$ , Mann-Whitney U test).

Mean pre- and post-procedure VAS scores at 1<sup>st</sup>, 3<sup>rd</sup>, 6<sup>th</sup>, and 12<sup>th</sup> months were  $8.44 \pm 0.71$  (7.24–9.64),  $4.67 \pm 2.13$  (2.45–9.50),  $4.34 \pm 1.26$  (2.12–6.87),  $4.28 \pm 1.73$  (2.65–7.12),  $4.68 \pm 1.09$  (2.53–6.15), respectively. The changes in pre-procedure and post-procedure VAS scores through follow-ups were statistically significant ( $p<0.001$ ). Post-hoc tests (Wilcoxon signed-ranks test) revealed that the pre-procedure VAS levels were significantly higher than the post-procedure VAS scores.

The comparisons of pre- and post-procedure VAS scores according to gender are presented in Table 2. The analyses revealed that there were no significant differences between males and females regarding pre- and post-procedure VAS scores.

The changes in VAS scores at 1<sup>st</sup>, 3<sup>rd</sup>, 6<sup>th</sup>, and 12<sup>th</sup> months when compared to the pre-procedure VAS scores were 45.7%, 48.3%, 43.6%, and 44.2%, respectively.

**Table-1.** Pre-procedure and post-procedure VAS scores (\*: Friedman test)

	Mean	Standard Deviation	Minimum	Maximum	p
	8,44	0,71	7,24	9,64	<0.001*
1.month VAS	4,67	2,13	2,45	9,50	
3.month VAS	4,34	1,26	2,12	6,87	
6.month VAS	4,28	1,73	2,65	7,12	
12.moth VAS	4,68	1,09	2,53	6,15	

**Table-2.** Pre-procedure and post-procedure VAS scores according to gender

	Female				Male				p
	Mean	SD	Min	Max	Mean	SD	Min	Max	
Preprocedure VAS	8,34	0,73	7,24	9,64	8,55	0,70	7,54	9,56	0,573
1.month VAS	4,45	1,61	2,45	7,35	4,92	2,66	2,54	9,50	0,944
3.month VAS	4,39	1,43	2,12	6,87	4,29	1,06	3,13	6,54	0,934
6.month VAS	4,78	1,28	2,65	7,12	3,73	2,05	0,00	5,12	0,258
12.moth VAS	4,85	1,07	2,89	6,15	4,44	1,14	2,53	6,12	0,321

## DISCUSSION:

Epiduroscopy also known as periduroscopy, epiduraloscopy, extraduroscopy, and spinal endoscopy is a minimally invasive technique that offers diagnostic and therapeutic advantages in cases of chronic low back pain and radiculopathy. It is especially interesting in patients with FBSS which can be difficult to treat. FBSS, postlumbar surgery syndrome and postlaminectomy syndrome are terms used to describe patients who have undergone lumbar spine surgery with unsatisfactory outcomes (1). Presumed causes of FBSS include facet joint pain, epidural fibrosis, arachnoiditis, discitis, foraminal stenosis, canal stenosis, retained disc fragment, recurrent disc herniation, spinal instability and sacroiliac joint pain(7). The rate of FBSS can range from 10% to 50%, depending on the evaluation criteria used. Success of surgery rates may decrease to approximately 30% after the second surgery and 15 % after the third (9). In such cases, epiduroscopy can give us a better understanding of the cause of pain with visualization and improve the quality and efficacy of steroid injection or lysis of adhesions simultaneously (2).

All patients had low back and leg symptoms with positive postural factors, that were not cured by conservative therapy consisting of physiotherapy, bracing, non-steroidal anti-inflammatory drugs (NSAIDs) and sporadic epidural injection of local anesthetics with or without steroids (6). Patients with FBSS and symptomatic lumbar spinal stenosis frequently have large amounts of scar tissue surrounding nerve roots, which forms as a result of nerve root inflammation, chronic chemical radiculitis, extrusion of nucleus pulposus and following surgical bleeding from spinal surgery (12,17,19). Epidural scar tissue is thought to interfere with nerve root nutrition and blood supply and prevents the steroid solution from coming into contact with the nerve root (20).

Endoscopic epidural adhesiolysis not only include adhesiolysis and washout of inflammatory cytokines, but also lavage of the epidural space, suppression of ectopic discharge from injured nerves and enhancing blood flow to ischemic nerve roots (13). Local anesthetics induce sympathetic nerve blockade and improve blood flow to the ischemic neural elements (28). Steroids reduce inflammatory edema of the injured nerve root and additionally improve intraneural blood flow (26). Fibrosis is thought to cause leg pain by interfering with the mobility of the dural sleeves of the spinal roots (16). Suggestion is that mobility of the nerve roots may be restored after epiduroscopy and this may contribute to the long-term pain relief, exceeding the intrinsic effective duration of epidural injectates (9).

As for any procedural intervention, bleeding, meningitis and nerve damage are some of the general complications associated with epiduroscopy (23). The added risks associated with entering the epidural space include cerebral spinal fluid leakage, subsequent post-dural puncture headache, neurological squeal resulting from a hematoma or compression from large volume inject administration like acute monoplegia, a bent needle tip, torn catheters during withdrawal, sheared catheter remnant, intrathecal placement of catheter, epidural abscess and neurogenic bladder (8,11,18,21,25). We have no general or severe complication in our series.

At the present time, only a few prospective studies have been conducted to establish the benefits of epiduroscopy. Bosscher et al. showed with their 139 patient series with prospective study that lumbosacral epiduroscopy predicts outcome of treatment accurately in the majority of patients and they suggested that information obtained through epiduroscopy may carry significant diagnostic and prognostic value (4). Geurts et al reported a prospective study included 20 patients with the relief of pain results 55% at third, 40% at sixth, 35% ninth and 35% at twelfth months(7). Richardson et al. inspected 38 patients prospectively and at the end of 12-month period results showed statistically significant reductions in pain scores and disability (19). Although many retrospective small series studies have described the clinical effectiveness and cost-effectiveness of epiduroscopy in patients with herniated disks or severe low back pain after back surgery (9,14,22). Although there are various reports as interlaminar approach with endoscopy, epiduroscopic laser neural decompression and ozone application by endoscopy (2,10,15). Our results are supporting the literature pain relief ratios on the treatment of FBSS with epiduroscopy.

Epiduroscopy has great value in the diagnosis of nerve root pathology and is more sensitive than gadolinium enhanced magnetic resonance imaging for visualizing scar tissue (27). The role of epiduroscopic adhesiolysis in patients with epidural scar tissue affecting nerve root nutrition warrants further investigation. The better outcome obtained in some patients with the epiduroscopy technique can be related to direct visualization of the pathological areas, better diagnosis, more accurate lysis of adhesions, and direct application of steroids and hyaluronidase at the site of the pathology.

Although definite evidence cannot be drawn from our study about the efficacy of the technique without having a control group, the decrease in median VAS evaluated in our study suggests that epiduroscopy could be an option as a final step of pain management for FBSS before palliative procedures, such as spinal cord stimulation or intrathecal drug delivery.

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ORIGINAL ARTICLE / ORJİNAL MAKALE

# TOTAL HEALTH EXPENDITURE AND TOTAL SPINE RELATED PROCEDURE EXPENDITURE IN A FIVE-YEAR PERIOD (2008-2012) IN TURKEY

2008-2012 YILLARI ARASINDA ÜLKEMİZDE TOTAL SAĞLIK HARCAMALARI VE TOTAL OMURGA CERRAHİSİ HARCAMALARI

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## SUMMARY

**Objective:** Total health expenditure may vary due to a variety of factors. The aim of this study is to analyze many parameters including total health expenditures, its rate per gross domestic product, health expenditures paid per person, and total spine related procedure expenditure.

**Materials and methods:** Based on statistics of Turkish Statistics Administration and Social Security Administration, many parameters including total health expenditure, and spine related procedure expenditure performed between 2008 and 2012 were analyzed.

**Results:** Total health expenditure increased by 32 % between 2008 and 2012. In the same time period total health expenditure per person increased by 25.6 % in Turkish Lira and decreased by 10.2 % in US Dollars. The rate of total health expenditure per person was found to be decreasing. It decreased from 6.1% in 2008 to 5.4 % in 2012. Total spine related procedure expenditure increased by 79.3 % between 2008 and 2012.

**Conclusion:** It is concluded that total health expenditure increases steadily, and gross domestic product decreases. Similarly, the number and expenditures of spine related procedures increase. However, due to many reasons, the increase in the expenditures of spine related procedures has been more prominent than increase in the total health expenditure.

**Keywords:** Expenditures of spine related procedures, gross domestic product, total health expenditure

**Level of evidence:** Retrospective statistic study, Level III

## ÖZET

**Amaç:** Toplam sağlık harcaması birçok etkene bağlı olarak değişebilmektedir. Bu çalışmanın amacı 2008-2012 yılları arasında ülkemizde yapılan toplam sağlık harcamaları, bunun gayri safi yurt içi hasıladaki payı, yıllık kişi başına düşen sağlık harcaması, omurga sağlığı için yapılan harcamaları belirlemektir.

**Gereç ve yöntem:** 2008 ile 2012 yılları arasındaki Türkiye İstatistik Kurumu ve SGK verilerine dayanarak, toplam sağlık ve toplam omurga harcamaları analiz edilmiştir.

**Bulgular:** 2008'den 2012'ye gelindiğinde toplam sağlık harcaması % 32'lik bir artış göstermektedir. 2008'den 2012'ye gelindiğinde kişi başına sağlık harcaması TL bazında % 25,6 artış göstermişken, dolar bazında % 10,2 azalma göstermiştir. Gayri safi yurtiçi hasıla içindeki toplam sağlık harcamasının payında da azalma dikkati çekmektedir. Bu oran 2008'de % 6,1 iken 2012'ye gelindiğinde % 5,4'e düşmüştür. Toplam omurga harcaması 2008'den 2012'ye gelindiğinde % 79,3'lük bir artış göstermiştir.

**Sonuç:** Ülkemizde toplam sağlık harcaması düzenli bir şekilde artarken, gayri safi yurtiçi hasıla içindeki sağlık harcamaları payında azalma görülmektedir. Omurga operasyon sayıları ve harcamalarında da artış görülmekle beraber, omurga harcamalarındaki artış, birçok nedene bağlı olarak, toplam sağlık harcamasındaki artıştan daha belirgin olmuştur.

**Anahtar Sözcükler:** Gayri safi yurtiçi hasıla, toplam omurga harcaması, toplam sağlık harcaması

**Kanıt Düzeyi:** Retrospektif istatistik çalışma, Düzey III

## INTRODUCTION:

The health service is provided to all layers of the society. As in a number of countries, this service is a constitutional right in our country. The health service not only is for recovering the patients but also includes the enhancement of the health conditions and protection from diseases.

All the expenditures for all protection, development, maintenance, nutrition and emergency program which adopts the aim of development and protection of the health are accepted as "Health Expenditure". The health expenditures are one of the main expenditures of countries and it might change depending on a number of variables such as develop-

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ment rate, population rate, composition of the population and the applied socio-economical program. A successful health service presentation satisfies both the population and the administrators managing the population. However, there is a cost of a successful health service presentation. All of those costs constitute the health expenditures. The health expenditures consist of the expenditures of the diagnosis and treatment in hospital, drugs and consumables used and the surgical consumables implanted into the body. Besides, although the health expenditures, terminologically, include the expenditures made for health, this concept was described in other ways. Thus, while making analysis of the literature about this issue, not only the total health expenditure are compared but also the current and general health expenditures are mentioned.

While the **Current health expenditure (CHE)**, is defined as the expenditures apart from the investment expenditures for providing the health services (salary, consumable and so on), **total health expenditure (THE)** is defined as the current expenditures + investment expenditures (*the limit of OECD health expenditure*) and the **general health expenditure (GHE)** is expressed as total health expenditure + expenditures for the services related to health (research, development, environmental health services, education, food, sanitation and hygiene) (*the limit of Turkey health expenditure*) (3, 6, 8).

The percentage of CHE in THE in our country was 95.5% in 2009, 95% in 2010, 94.9% in 2011 and 95.5% in 2012. This shows that the investment percentage is in fact approximately 5% (1).

While qualifying the staff and increasing the health service quality with technological equipments is aimed in the health service, the health expenditures are tried to be decreased. The main reason for that is the financial crisis and limitations in the health budget. In a number of countries, health expenditures became the center of saving measures. As in a number of developing countries, health system in our country is having a transformation. In this environment, the health expenditures and policies are regularly being monitored and analyzed. As a natural result of this process, decrease of the costs for different items of health expenditures is being tried. This requires knowing the costs of each health subunit.

In our country, the health expenditures are ana-

lyzed and published mainly in SGK database, Turkish Statistical Institute, TEPAV Life Sciences and Health Policies Institute (2).

Besides there are a number of variables in the cost reduction process, among those variables, the surgery costs are the leading. In this level, SGK, which is the largest health insurance institute in our country, has the leading role and directs the health economy. Thus, the role of SGK in health expenditures and cost analyses gain importance.

The aim of this study to show the health expenditures made in our country in last 5 years, to determine the percentage of the spinal surgeries in those expenditures and to present the percentage of the spinal surgeries in the annual health expenditures in our country.

## MATERIAL AND METHOD:

The study includes 2008, 2009, 2010, 2011, and 2012. The data analyzed in the study are given below:

- 1- The quantity of the total and current health expenditure and hospital expenditures in the analyzed years
- 2- The percentage of the total health expenditure in Gross National Product (GNP) in the analyzed years
- 3- The total health expenditure, population relation and the quantity of health expenditure per capita in the analyzed years
- 4- The number of total spinal surgery and its expenditure in the analyzed years
- 5- The types of the surgery and their costs in the analyzed years
- 6- The percentage of the spinal surgeries in the total health expenditure and other expenditures in the analyzed years
- 7- The emergent unit price of the spinal surgeries in the analyzed years

For the total health expenditures, the data of Turkish Statistical Institute (TUIK) were based on. By determining the codes for the basic spinal surgeries and the operations having those codes were documented. The data of those codes were obtained from SGK Presidency, General Health Insurance General Management. Accordingly, the types of the major spinal surgeries and their SGK codes were determined firstly (**Table-1**).

**Table-1.** Analyzed applications and their codes

Operation	Related codes
Lumbar discectomy	P615880, P615890, P615900, P615910, P615920, P615930
Spinal Instrumentation	P613690, P613700, P613710, P613720, P613730, P613920, P613930, P613880, P614040, 614050
ACD, ACDF	P615940, P615950
Kyphoplasty	P614150
Vertebroplasty	P614140
Laminectomy	P616010, P616020
Lumbar fusion	P613870, P613880
Thoracic discectomy	P615980, P615990

Then, the numbers of specific operations and the corresponding health expenditure quantity were determined. Here the point that is especially desired to be expressed is that the expenditures made for the operations whose codes are indicated and which are performed by brain surgeons and orthopedic surgeons. The operations performed with algology, physical therapy, neurology, family physician, rheumatology or medical treatment were not included into the study.

More clearly, the concept described as total spinal expenditure (TSE) in this study includes on the spine patients operated due to specific pathologies. It does not include the spine patients who are except for the

analyzed codes and the limited number of non-evaluated patient group and the spine patients who were not operated. Likewise, it does not include the cases operated with their own budget in the private sector and could not benefit from SGK.

## RESULTS:

### 1- The quantity of the total and current health expenditure and hospital expenditures in the analyzed years:

According to information provided by TUIK depending on SGK data, the total health expenditure in our country was 57 billion 740 TL in 2008 (current expenditure is 52 billion 320 million TL, hospital expenditure is 22 billion 984 million TL), 57 billion 911 million TL in 2009 (current expenditure is 55 billion 294 million TL, hospital expenditure is 23 billion 241 million TL), 61 billion 678 million TL in 2010 (current expenditure is 58 billion 623 million TL, hospital expenditure is 24 billion 933 million TL), 68 billion 607 million TL in 2011 (current expenditure is 65 billion 372 million TL, hospital expenditure is 28 billion 543 million TL), and it reached to 76 billion 358 million TL in 2012 (current expenditure is 72 billion 820 million TL, hospital expenditure is 32 billion 801 million TL). An increase in the total health expenditure was observed as 0.29% in 2009 when compared to 2008, 6.5% in 2010 when compared to 2009, 11.5% in 2011 when compared to 2010, and 10.7% in 2012 when compared to 2011 (**Table-2**). There is a 32% increase in the total health expenditure from 2008 to 2012. A similar expenditure increase is also valid for the current health expenditure and hospital expenditure.

**Table-2.** Total health expenditure (THE), current health expenditure (CHE) and hospital expenditure (HE) amounts (TL x1000.000)

Year	THE	Increase	CHE	Increase	HE	Increase
2008	57.740	-	52.320	-	22.984	-
2009	57.911	0,29 %	55.294	5,6 %	23.241	1,11 %
2010	61.678	6,5 %	58.623	6,02 %	24.933	7,2 %
2011	68.607	11,5 %	65.372	11,5 %	28.543	14,4 %
2012	76.358	10,7 %	72820	11,3 %	32.801	14,9 %

### 2- The percentage of the total health expenditure in GNP in the analyzed years:

According to information provided by TUIK depending on SGK data, despite the increase in the total health expenditure in our country, the percentage of total health expenditure in GNP decreased from 6.1% to 5.4% from 2008 to 2012 (**Table-3**).

### 3- The relationship of the total health expenditure with the population in the analyzed years:

Turkish population was calculated as 71.517.100, 72.561.312, 73.722.988, 74.724.269 and 75.627.384

people in 2008, 2009, 2010, 2011 and 2012, respectively. The health expenditures per capita is shown in **Table-4** in both TL and dollars. Accordingly, the health expenditures per capita (HEPC) was 812 TL (624 \$) in 2008, 804 TL (521 \$) in 2009, 845 TL (563 \$) in 2010, 928 TL (553 \$) in 2011 and 1.020 TL (566 \$) in 2012.

Here, there is a fact when considered carefully. HEPC showed a 25.6% increase in TL from 2008 to 2012, but it showed a 10.2% decrease in dollars.

**Table-3.** The ratio of the total health expenditure to gross national product (GNP)

Year	Ratio to GNP
2008	6,1 %
2009	6,1 %
2010	5,6 %
2011	5,3 %
2012	5,4 %

**Table-4.** The health expenditure per capita (HEPC)

Year	HEPC TL	HEPC \$
2008	812	624
2009	804	521
2010	845	563
2011	928	553
2012	1020	566

#### 4- The number of total spinal surgery and its expenditure in the analyzed years:

According to SGK data, the spinal surgery numbers in our country was 84.615 in 2008, 92.843 in 2009, 91.662 in 2010, 110.520 in 2011 and 137.756 in 2012 (**Table-5**). There is a 62.8% increase in the total surgery number from 2008 to 2012.

When the economical aspect of the applications are considered, the against invoice of the applications was 94.844.931 TL in 2008, 89.227.521 TL in 2009, 108.439.736 TL in 2010, 136.834.179 TL in 2011 and 170.117.734 TL in 2012 (**Table-6**).

Accordingly, the total spinal expenditure increased from 94.844.931 TL to 170.117.734 TL from 2008 to 2012 and this shows a 79.3% increase.

**Table-5.** The operations performed in 2008, 2009, 2010, 2011 and 2012 and their numbers (LD: Lumbar discectomy, CD: Cervical discectomy, TLI: Thoracolumbar instrumentation, KP: Kyphoplasty, VP: Vertebroplasty, TD: Thoracic discectomy)

	2008	2009	2010	2011	2012
LD	54.354	59.619	60.868	71.397	82.426
	64,2%	64,2%	66,40%	64,60%	59,83%
CD	5.902	6623	6.024	7.713	10.142
	7%	7%	6,57%	6,98%	7,36%
TLI	13.209	13498	14.076	18.736	25.725
	15%	14,4%	15,36%	16,95%	18,67%
KP	693	723	447	163	390
	0,8%	0,8%	0,49%	0,15%	0,28%
VP	-	-	698	1.298	2.211
			0,76%	1,17%	1,61%
Laminectomy	10.201	11.587	7.920	9.206	13.333
	12%	12,4%	8,64%	8,33%	9,68%
Arthrodesis	1.044	1.409	1.608	1.976	3.489
	1,2%	1,5%	1,75%	1,79%	2,53%
TD	14	32	21	31	40
	0,01%	0,03%	0,02%	0,03%	0,03%
Total	84.615	92.843	91.662	110.520	137.756

**Table 6.** The costs of the operations performed in 2008, 2009, 2010, 2011 and 2012 in TL (LD: Lumbar discectomy, CD: Cervical discectomy, TLI: Thoracolumbar instrumentation, KP: Kyphoplasty, VP: Vertebroplasty, TD: Thoracic discectomy)

	2008	2009	2010	2011	2012
LD	52.791.708	59.324.921	70.025.091	84.136.115	96.432.380
	55,6%	66,4%	66,5%	61,4%	56,6%
SD	9.656.546	10.947.920	13.221.525	17.696.412	23.239.925
	10,1%	12,2%	12,1%	12,9%	13,6%
TLE	31.038.945	16.417.704	19.116.477	27.418.379	36.906.618
	32,7%	18,3%	17,6%	20,3%	21,6%
KP	668.777	774.738	550.729	201.948	876.519
	0,7%	0,8%	0,5%	0,14%	0,51%
VP	-	-	1.086.657	2.058.468	4.014.194
	-	-	1%	1,5%	2,3%
Laminectomy	1.902.579	2.087.848	2.487.565	2.976.790	4.442.756
	2%	2,3%	2,29%	2,17%	2,61%
Arthrodesis	781.050	1.630.275	1.910.463	2.273.955	3.835.677
	0,8%	1,8%	1,76%	1,66%	2,2%
TD	25.545	56.918	41.239	61.621	69.671
	0,02%	0,06%	0,03%	0,04%	0,04%
Total	94.844.931	89.227.521	108.439.736	136.834.179	170.117.734

### **5- The types of the surgery and their costs in the analyzed years:**

#### **1. Lumbar discectomy:**

While 54.354 discectomies were performed in 2008, this number reached to 59.619 in 2009, 60.868 in 2010, 71.397 in 2011 and 82.426 in 2012. Accordingly, lumbar discectomy consisted of 64.2% of all spinal surgeries in 2008, and this value was 64.2% in 2009, 66.4% in 2010, 64.6% in 2011, and 59.83% in 2012 (**Table-5**).

On the other hand, when the economical aspect of lumbar discectomies is considered, the amount of invoice for discectomy was detected as 52.791.708 TL in 2008, 59.324.921 TL in 2009, 70.025.091 TL in 2010, 84.136.115 TL in 2011 and 96.432.380 TL in 2012. Those amounts were calculated as 55.6% in 2008, 66.4% in 2009, 66.5% in 2010, 61.4% in 2011 and 56.6% in 2012 as the percentage in total spinal surgery amount (**Table-6**).

#### **2. Cervical discectomy with and without fusion:**

5.356 anterior cervical discectomy and fusion (ACDF) were performed in 2008, 5.857 in 2009, 5.447 in 2010, 7.147 in 2011 and 9.366 in 2012.

546 simple anterior cervical discectomy without fusion (ACD) were performed in 2008, 766 in 2009, 577 in 2010, 566 in 2011 and 776 in 2012.

As a result, the total number of the cervical discectomy either with fusion or without fusion (ACD + ACDF) was calculated as 5.902 in 2008, 6.623 in 2009, 6.024 in 2010, 7.713 in 2011 and 10.142 in 2012.

Accordingly, the number of ACD + ACDF consisted of 7% of all spinal surgeries both in 2008 and 2009, 6.57% in 2010, 6.98% in 2011 and 7.36% in 2012 (**Table-5**).

When we consider the economical aspect of ACD and ACDF, the invoice amount for ACDs were 622.507 TL, 923.120 TL, 825.004 TL, 845.865 TL, and 1.124.267 TL in 2008, 2009, 2010, 2011 and 2012, respectively.

In the same years, the invoice amount for ACDF were 9.034.039 TL and 10.024.799 TL, 12.396.520 TL, 16.850.546 TL and 22.115.658 TL, respectively.

More clearly, in the indicated periods, the invoice amount for all cervical discectomy operations (ACD + ACDF) was 9.656.546 TL, 10.947.920 TL, 13.221.525 TL, 17.696.412 TL and 23.239.925 TL, respectively.

Those amounts were calculated as 10.1% in 2008,

12.2% in 2009, 12.1% in 2010, 12.9% in 2011 and 13.6% in 2012 as the amount in total spinal surgery (**Table-6**).

#### **3. Thoracolumbar instrumentation:**

13.209 thoracolumbar instrumentations were performed in 2008, and this number was 13.498 in 2009, 14.076 in 2010, 18.736 in 2011 and 25.725 in 2012. Accordingly, the number of performed thoracolumbar instrumentation consisted of 15% of total spinal surgeries in 2008, 14.4% in 2009, 15.36% in 2010, 16.95% in 2011 and 18.67% in 2012 (**Table-5**).

When the economical aspect of the thoracolumbar instrumentation was considered, the amount of the invoice was 31.038.945 TL in 2008, 16.417.704 TL in 2009, 19.116.477 TL in 2010, 27.418.379 TL in 2011 and 36.906.618 TL in 2012. Those amounts were calculated as 32.7 % in 2008, 18.3 % in 2009, 17.6 % in 2010, 20.03 % in 2011 and 21.6 % in 2012 as the amount in total spinal surgery (**Table-6**).

**4. Kyphoplasty:** 693 kyphoplasty surgeries were performed in 2008, 732 in 2009, 447 in 2010, 163 in 2011 and 390 in 2012. Accordingly, the number of kyphoplasty operation consisted of 0.8% of all spinal surgeries in 2008, 0.8% in 2009, 0.49% in 2010, 0.15% in 2011 and 0.28% in 2012 (**Table-5**).

The amount of the invoice for the kyphoplasty operations was 668.777 TL in 2008, 774.738 TL in 2009, 550.729 TL in 2010, 201.948 TL in 2011, and 876.519 TL in 2012. Those amounts were calculated as 0.7% in 2008, 0.8% in 2009, 0.5% in 2010, 0.14% in 2011 and 0.51% in 2012 as the amount in total spinal surgery (**Table-6**).

#### **5. Vertebroplasty:**

The data for vertebroplasty operations could not be reached in 2008 and 2009. 698 vertebroplasty operations were performed in 2010, 1298 in 2011, and 2211 in 2012. Accordingly, the percentage of the vertebroplasty operations in all spinal operations was calculated as 0.76% in 2010, 1.17% in 2011 and 1.61% in 2012 (**Table-5**).

The amount of the invoice for vertebroplasty applications was 1.086.657 TL in 2010, 2.058.468 TL in 2011 and 4.014,194 TL in 2012.

Those amounts were calculated as 1% in 2010, 1.5% in 2011 and 2.3% in 2012 as the amount in total spinal surgery (**Table-6**).

## 6. Lumbar Laminectomy:

10.201 total laminectomy in 2008, 11.587 total laminectomy in 2009 and 5.125 total laminectomy and 2.795 hemi-laminectomy in 2010 (7.920 in total) were performed. 7.387 total and 1.819 hemi-laminectomy in 2011 (9.206 in total) and 11.365 total and 1.968 hemi-laminectomy were performed in 2012 (13.333 in total). Accordingly, the total lumbar laminectomy number (total and hemi-laminectomy) consisted of 12% of all surgeries in 2008, 12.4% in 2009, 8.64% in 2010, 8.33% in 2011 and 9.68% in 2012 (**Table-5**).

The total invoice of the laminectomy and hemi-laminectomy applications was 1.902.579 TL in 2008, 2.087.848 TL in 2009, 2.487.565 TL in 2010, 2.976.790 TL in 2011, and 4.442.756 TL in 2012.

Those amounts were calculated as 2% in 2008, 2.3% in 2009, 2.29% in 2010, 2.17% in 2011 and 2.61% in 2012 as the amount in total spinal surgery (**Table-6**).

## 7. Arthrodesis operation:

Arthrodesis codes were entered in 1044 cases in 2008, 1409 cases in 2009, 1.608 cases in 2010, 1.976 cases in 2011 and 3.489 cases in 2012. Accordingly, the percentage of the arthrodesis in all spinal operations was calculated as 1.2% in 2008, 1.5% in 2009, 1.75% in 2010, 1.79% in 2011 and 2.53% in 2012 (**Table-5**).

The invoice amount in the indicated periods between 2008 and 2012 are 781.050 TL, 1.630.275 TL, 1.910.463 TL, 2.273.955 TL and 3.835.677 TL for arthrodesis operations, respectively. Those amounts were calculated as 0.8% in 2008, 1.8% in 2009, 1.76% in 2010, 1.66% in 2011 and 2.2% in 2012 as the amount in total spinal surgery (**Table-6**).

## 8. Thoracic discectomy:

13 thoracic discectomies were performed in 2008, 32 in 2009, 21 in 2010, 31 in 2011 and 40 in 2012. Accordingly, the percentage of the intervention into thoracic discs in all spinal operations was calculated

as 0.01% in 2008, 0.03% in 2009, 0.02% in 2010, 0.03% in 2011 and 0.03% in 2012 (**Table-5**).

The invoice amount in the indicated periods are 25.545 TL, 56.918 TL, 41.239 TL, 61.621 TL and 69.671 TL for thoracic discectomy operations, respectively. Those amounts were calculated as 0.02% in 2008, 0.06% in 2009, 0.03% in 2010, 0.04% in 2011 and 0.04% in 2012 as the amount in total spinal surgery (**Table-6**).

## 6- Total health expenditure in the analyzed years and the percentage of the spinal surgeries in other expenditures:

The total spinal expenditures consisted of the 0.14% of total health expenditure in 2008, 0.16% in 2009, 0.14% in 2010, 0.16% in 2011 and 0.18% in 2012 (**Table-7**).

The percentage of the total spinal expenditure in the current health expenditure was calculated as 0.16% in 2008, 0.16% in 2009, 0.15% in 2010, 0.16% in 2011 and 0.18% in 2012 in the indicated years (**Table-7**).

The percentage of the total spinal expenditure in hospital expenditure was calculated as 0.36% in 2008, 0.35% in 2009, 0.32% in 2010, 0.33% in 2011 and 0.31% in 2012 (**Table-7**).

## VII. The unit price of the spinal operations in the analyzed years:

When the available data are evaluated, the amount which was paid for each surgery shows up (Table 8). This evaluation includes a margin of error due to a number of factors. Namely, the short segment and long segment instrumentation operations, whose prices are different, were put into same basket and their mean value was taken into consideration. Similar case is also prevalent for the cervical discectomy with and without fusion, hemi-laminectomy and total laminectomy and single level or multi-level discectomy.

**Table-7.** The amount of total health expenditure (THE) and total spinal expenditure (TSE). The percentage of TSE in THE, the percentage of TSE in current health expenditure (CHE) and the percentage of TSE in hospital expenditures (HE) are also seen in the list.

Year	THE	TSE	THE/TSE	CHE/ TSE	HH/TSE /TOH
2008	57.740.000.000	84.615.000	0,14%	0,16%	0,36%
2009	57.911.000.000	92.843.000	0,16%	0,16%	0,35%
2010	61.678.000.000	91.662.000	0,14%	0,15%	0,32%
2011	68.607.000.000	110.520.000	0,16%	0,16%	0,33%
2012	76.358.000.000	137.756.000	0,18%	0,18%	0,31%

**Table-8.** The paid amount for each surgery type by SGK in the analyzed years (LD: Lumbar discectomy, CD: Cervical discectomy, TLI: Thoracolumbar instrumentation, KP: Kyphoplasty, VP: Vertebroplasty, TD: Thoracic discectomy)

	2008	2009	2010	2011	2012
LD	971	995	1150	1178	1169
SD	1636	1653	2194	2294	2291
TLE	2349	1216	1358	1463	1434
KP	965	1071	1232	1238	2247
VP	-	-	1556	2585	1815
Laminectomy	186	180	314	323	3332
Arthrodesis	748	1157	1188	1150	1099
TD	1824	1778	1963	1987	1741

**Table-9.** Total health expenditures of each year since 1999

Year	THE (Million TL)	THE (Million dollar)
1999	4.985	11.790
2000	8.248	13.140
2001	12.396	10.052
2002	18.774	12.389
2003	24.279	16.159
2004	30.021	20.975
2005	35.359	26.205
2006	44.069	30.599
2007	50.904	30.864
2008	57.740	44.364
2009	57.911	42.270
2010	61.678	47.440
2011	68.607	49.357
2012	76.358	59.654

## DISCUSSION:

The dominant role of the government in health makes it necessitates for the government to allocate from the budget to this field. While the government is the largest health presenter (with the health minister), it also has the largest insurance institute role (with SGK). This necessitated that the government protects both the balance of income and expenses and a number of social aspects of the health.

While the health expenditures are being analyzed, one should know that the expenditures show variations depending on a number of parameters. Some of those parameters are the income level of the country, the population and thus the expenditure status per capita, the amount of the expenditure to public and private sector and the expense items.

According to World Bank data, the GNP of Turkey increases approximately 3.5 % annually since 1998 (4). Although those percentages hit rock bottom due to the crisis in March 2009, the general trend is in positive direction. In summary, the income status of our country gets better regularly.

When the percentage of the health expenditures in GNP is considered, there is an increase in those percentages between 1999 and 2008. In addition, the public expenditures are the leading in this increase.

Unfortunately, this increase in the health expenditures in GNP until 2008 did not continue in the last years in a similar way. When the health expenditures and its percentage in GNP is considered, while this value was 6.1 % in 2008, it decreased to 5.4 % in 2012 (5). In summary, when the total health expenditures are considered, there is an increasing expenditure in last year's in our country (**Table-9**).

In 2008 and 2012, which is the interest of our study, it can be seen that the 57 billion 740 million TL total health expenditure increased to 76 billion 358 million TL. This was found as equal to a 32.2 % increase. In the same periods, it is seen that the current health expenditure increased from 52 billion 320 million TL to 72 billion 820 million TL (**Figure-1**) and the hospital expenditure increased from 22 billion 984 million to 32 billion 801 million TL (**Figure -2**).

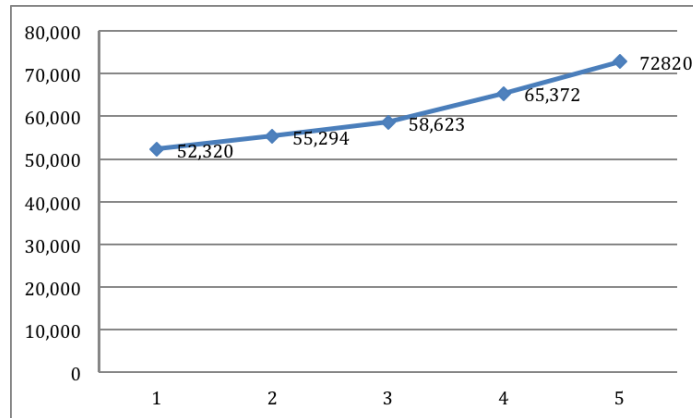
Can we also see this increasing trend of the health expenditures for the surgical treatment of the spinal

diseases? The answer of this question is possible by looking at the expenditures for the spinal surgeries and whether it follows this trend or not.

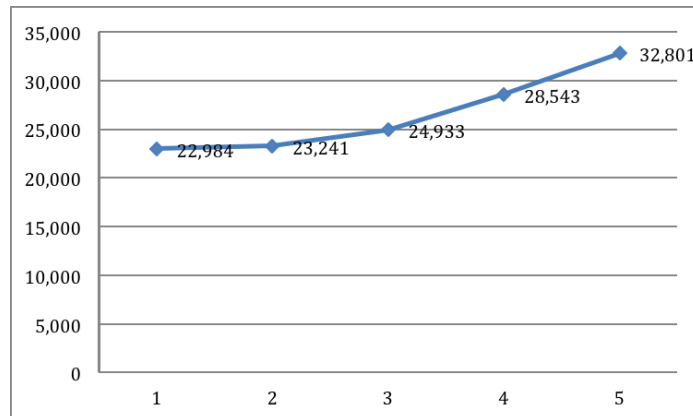
In this study, the total spinal expenditure is seen to increase from 94.844 million TL to 170.734 million TL between 2008 and 2012. This was found as equal to a 79.3 % increase (**Figure-3**).

How can those increases be explained? Although this situation is a research subject independently, the available data are not enough to present all the reasons. This increase cannot only be explained with the increase in the public. It is obvious that the private sector has also a significant role in this sense. According to the data of Ministry of Health the percentage

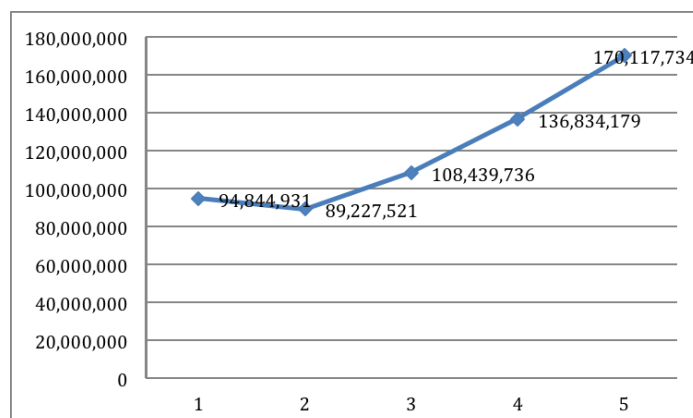
**Figure-1.** The increase-decrease trend of the current health expenditures (1000.000 TL)



**Figure-2.** The increase-decrease trend of the hospital expenditures (1000.000 TL)



**Figure-3.** The increase-decrease trend of total spinal expenditures



of the private sector increased from 6.2% (2001) to 17.3 % (2008) (5), and according to the report prepared by Ministry of Development the percentage of the private sector in total application was 4.6 percent in 2002 but it increased to 18.8 % in 2012 (7). Unfortunately, there is no differentiation of the private sector and public in the present study.

When the number and the expenditure percentages of the spinal surgeries are considered, there is limited number of comprehensive studies (10, 11). In a study reported by Naderi, the numbers of the surgeries in last 5 years were presented in detail (10, 11). In those studies, the spinal surgeries were slightly mentioned in terms of the costs.

Those studies showed that the operations such as cervical discectomy, thoracic discectomy, lumbar discectomy and lumbar laminectomy performed for the degenerative cases consists of the largest group of all the spinal surgeries and they consist of 81.63 % of all spinal surgeries in 2010, 79.94 % in 2011, and 76.9 % in 2012 (10-11).

According to this study, the number of discectomy increased from 54.354 in 2008 to 82.426 in 2012. The total spinal operation number was increased from 84.165 to 137.756 in the same period. In other words, while the total spinal operations increased 62.8 % in 5 years, the discectomy number increased as 51.6 %. In addition, when the population number and lumbar discectomy number is considered, the 0.07 %, 0.002 %, 0.08 %, 0.09 % and 0.01 % of the population was administered herniated disc surgery between 2008 and 2012, respectively.

It should be indicated there is an increase in laminectomy operation number (30.7%) similar and less than that of total operation number, there is an increase in cervical discectomy (71.8%), thoracolumbar instrumentation (94.7 %), thoracic discectomy (185.7 %) and arthrodesis (234.1 %) and those percentages are over the increase of the total spinal operation.

When the expenditures for the spinal surgeries are considered, it can be seen that the total spinal expenditure increased from 94.844 million TL to 137.756 TL between 2008 and 2012 as mentioned above. This was found as an increase equal to 79.3 %.

When the increase in the spinal surgery number and the expenditures made in those surgeries are collocated, it can be seen that there is a 62.8 % increase in the number of spinal surgery and 79.3 % increase in the expenditures.

How can the increase of the spinal surgery and expenditures be explained?

Firstly, there might be the role of the increase of the degenerative diseases seen in geriatric age group together with the increase in the age of population. However, since the time period is short, the role of this factor should not be exaggerated. In addition, the increase of the country population and getting easier of reaching the physician due to the social policies might have role in this process.

Another reason might be the increase in surgeon number. The increase in the number of the surgeons performing the degenerative spinal surgeries might have role in this issue. Indeed, spinal surgeries consist of a large portion of the brain surgery and the most easily performed operations of the brain surgeons, whose number increase gradually, in both training institutes and public and private hospitals are degenerative spinal operations. Due to both this reason and tending of some orthopedic surgeons to spinal surgeries led to an increase in the number of those surgeries.

Another issue to be emphasized is that there might be other reasons besides the increase of the country population, increase of the geriatric population, getting easy to reach the physician and increase in the surgeon number.

One of those reasons is the easy request of diagnostic modalities such as MR and changes in the surgical indications. In other words, the administration of surgery to a number of degenerative spine patients, who do not require surgery with MR might lead to an increase in the operation numbers. Basically, this number, although it is not too high, cannot be detected. This issue can only be overcome with education.

The increase in the spinal expenditures might be due to the decrease of the disc surgery percentages and the increase in the instrumentation percentages. However, this also cannot be the only reason. The fact that the spinal surgeries were low previously and recovery of it, although minor, might have a role in this process.

However, those explanations made with both the increase in the spinal surgeries and the increase in the expenditures requires more comprehensive analyses at the end of detailed evaluations. The major limitation for the studies is that we do not have the data of other countries as in the case for the items such as total health expenditure. In other words, since there

are no data of other countries to compare our data about the spine, it is not reliable to identify our spinal expenditures as high or low in reality.

The health expenditure made in our country show increases in last years. It is obvious that a number of factors are effective in this increase. The most significant ones of those factors are the increase of the geriatric population in parallel with this increase, increase in the private health institutions and increase in reaching to those institutions and also relative increase in the physician number.

The total health expenditure shows a 32 % increase from 2008 to 2012. While the health expenditure per capita showed a 25.6 % increase in TL, it showed a 10.2 % decrease in dollars from 2008 to 2012. The fact that the increase in total health expenditure is higher than the increase in expenditure per capita might be explained with the imbalance of the expenditures and the population increase rate.

Another data showing this situation is the percentage of the total health expenditure in GNP. Indeed, when the statistics in recent years is analyzed,

the decrease of total health expenditure in GNP is remarkable. While this percentage was 6.1 % in 2008, it decreased to 5.4 % in 2012.

When the total spinal expenditure is considered, on the other hand, there is a 79.3 % increase in the expenditure from 2008 to 2012.

When the spinal operations and the expenditures are considered, there was an increase in the total operation numbers and it was seen that the increase in lumbar discectomy is less than that of all spinal operations, and the rate of increase in thoracolumbar instrumentation is more than that of all spinal operations. This might be explained with performing different new surgical techniques in some different cases. This necessitates the review of the studies of the specialties working on the spinal health and the civil society organizations about those branches.

In summary, there might be a number of reasons of the increase in the number and costs of the spinal surgeries. Presentation of those reasons is obligatory for decreasing the SGK cost analyses in following years.

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**Acceptance date:** 21th January, 2015



## CASE REPORT / OLGU SUNUMU

## IDIOPATHIC SPINAL CORD HERNIATION

## İDİOPATİK SPİNAL KORD HERNİASYONU

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## SUMMARY

Idiopathic spinal cord herniation is a rare diagnosis. The differentiation of spinal cord herniation from arachnoid cyst is important. MRI (Magnetic Resonance Imaging) is helpful for the diagnosis. We report a patient with lumbar spinal stenosis and an idiopathic spinal cord herniation at the thoracic level.

**Key words:** Idiopathic spinal cord herniation, thoracic spine, surgical treatment

**Level of evidence:** Case report, Level IV

## ÖZET

İdiopatik spinal kord herniasyonu nadir görülen bir durumdur. Spinal kord herniasyonunu araknoid kistten ayırımı yapmak önemlidir. MRG( Manyetik Rezonans Görüntüleme) tanıda yardımcıdır. Biz bu çalışmamızda torasik bölgede idiopatik spinal kord herniasyonu ve lomber spinal stenozu olan bir hastayı bildirdik.

**Anahtar kelimeler:** İdiopatik spinal kord herniasyonu, torakal omurga, cerrahi tedavi

**Kanıt düzeyi:** Olgu sunumu, Düzey IV

## INTRODUCTION:

Idiopathic spinal cord herniation is a rare diagnosis. The differentiation of spinal cord herniation from arachnoid cyst is important. MRI (Magnetic Resonance Imaging) is helpful for the diagnosis. We report a patient with lumbar spinal stenosis and an idiopathic spinal cord herniation at the thoracic level.

## CASE REPORT:

A 43-year-old woman with a history of weakness and numbness in her right leg presented to the clinic. Neurological examination revealed as lightly decreased muscle strength in the right leg (clinical grade of motor power was 4/5 for ankle dorsiflexion) and full muscle strength in the left leg (motor power was 5/5). She had hypoesthesia at T5-T6 level with decreased position sensation bilaterally.

She reported no bowel or bladder complaints. The rest of the general and neurological examinations revealed no significant abnormalities. Based on the neurologic examination, a sacral L5-S1 root injury and thoracic medullary compression were considered. She had no significant history of trauma, surgery or infection. Her laboratory tests were all within normal limits. Plain films of the thoracic and lumbar spine were unremarkable. The patient underwent MR imaging of the thoracic and lumbar spine on 1.5T Sagittal

T1- and T2-weighted MR sequences obtained on a 1.5-T imaging unit, which showed ventral displacement of the spinal cord at the T5-T6 level with prominence of the posterior subarachnoid space at this level, in addition to lumbar spinal stenosis at L4-L5 and L5-S1 levels (Figure-1,2). Sagittal T2-weighted MR image showed a focal anterior kink of the spinal cord at the T5-T6 level. The cord was adjacent with the posterior surface of the vertebral body. Additional 26 imaging studies were performed due to a possible posterior intradural arachnoid cyst.



**Figure-1.** Thoracic sagittal image of the MR of the patient.



**Figure-2.** Lumbar sagittal image of the MR of the patient with the spinal stenosis in the L4-5 disc level.

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Myelography and CT myelography confirmed the ventral displacement of the cord at the T5-T6 level. Widening of the dorsal subarachnoid space without any filling defect was shown on CT myelography (Figure-3). Calcified material from chronic disc herniation, and herniation of the left anterolateral portion of the cord through a dural defect were detected on axial CT myelogram (Figure-4).



**Figure-3.** Thoracic sagittal image of the MR of the patient postoperatively.



**Figure-4.** Thoracic axial image of the MR of the patient postoperatively.

Depending on the radiological findings, idiopathic herniation of the spinal cord and lumbar spinal stenosis were diagnosed. We operated on the patient for lumbar spinal stenosis and confirmed spinal cord herniation. The neurologic findings regressed after surgery. Right and the left leg muscle strengths were equal (clinical grade of motor power was 5/5).

## DISCUSSION:

Idiopathic thoracic spinal cord herniation is a rare and uncommon cause of myelopathy (6). Brown-Séquard syndrome can be the initial presentation of idiopathic spinal cord herniation (8-9,12-13). In idiopathic spinal cord herniation, spinal cord herniated or prolapsed through an anterior or lateral defect in the dura mater (6).

The presence of a dural defect can be considered as a precondition for the development of idiopathic spinal cord herniation. Entry of the cerebrospinal fluid into the extradural space through this defect forms a localized fluid collection which can be referred to by some as an extradural arachnoid cyst (1).

Cerebrospinal fluid pulsations force the spinal cord through this defect that can lead to adhesions, distortions and possible vascular compromise of the cord, causing progressive myelopathy (3). Idiopathic spinal cord herniation has an unknown cause which is unrelated to trauma or a previous operation. Pressure erosion, thoracic disc extrusion, congenital disorder (preexisting ventral meningocele), duplication of the

ventral duramater, congenital extradural arachnoid cyst, inflammatory process and congenital abnormal adhesions of the spinal cord to the anterior dura are possible underlying causes that have been postulated to explain the occurrence of this dural defect (1,10).

Idiopathic spinal cord herniation is probably an under diagnosed disorder that is being diagnosed more commonly due to increased use of MRI (5). It is diagnosed by its characteristic imaging appearance. Imaging features of spinal cord herniations generally include a dural tear through which a portion of the cord protrudes.

Cerebrospinal fluid flows freely through the defect, causing increased turbulence in the fluid just dorsal to the site of herniation. The observation of this feature may allow the differentiation of spinal cord herniation from an arachnoid cyst. In addition, the calcification of nucleus pulposus leakage from a herniated disk may produce a linear area of hyperattenuation on computed tomography or signal hyperintensity on magnetic resonance imaging, the latter is an imaging feature known as the "nuclear trail" sign (6).

The first report of an idiopathic spinal cord herniation was published by Wortzman et al (14). Our review of the relevant literature revealed only limited number of reports, and most cases were published in the neurosurgical literature. The features of this condition in imaging need to be recognized. Several of the reported cases were initially misdiagnosed and resulted in a delay in the correct management (5).

The most common misdiagnosis in the literature was misinterpretation of the expanded dorsal subarachnoid space for an arachnoid cyst (2). In previous reports, this condition is often seen in middle-aged people (range 21-78 years; mean 51 years) with a female predominance (male to female 1:1.8) (5). In the 80 % of the patients, the T2-T7 levels are affected with all other cases occurring in the thoracic spine (range T2 to T9). Negative pressure in the thoracic extradural space and proximity to the heart (high cerebrospinal fluid pressure) accounts for the thoracic distribution of spinal cord herniation. Most of the cases have been reported with Brown- Séquard syndrome which is the most frequent clinical presentation of spinal cord herniation and seen in approximately 80 % of patients (5).

The tract affected first by herniation is the lateral spinothalamic tract. This results in diminished pain and temperature sensation, and is frequently unilateral and ascending. As the corticospinal tracts become involved, gradual, progressive weakness and spasticity of the leg(s) also occur. The resultant dissociated sensory deficit with asymmetric spastic paraparesis is known as Brown-Séquard syndrome (1).

Other presentations of this condition were also reported, including included spastic paresis, bowel or bladder sphincter dysfunction, isolated motor or sensory disturbance, and chest pain (2,11).

Most of the previously cases were treated surgically, and published principally in the neurosurgical literature. The main purpose of surgical treatment is decreasing the pressure and reducing the spinal cord herniation. Surgery is usually indicated in patients with progressive myelopathy and Brown-Séquard syndrome. It is believed that the outcomes of surgery are more successful than cases with spastic paraparesis (4-5). In our patient we did not plan an operation for idiopathic spinal cord herniation due to the reported complications of surgery (2). We have planned the surgery for lumbar spinal stenosis, we have done posterior instrumentation and posterior laminectomy.

After the operation there was a progressive improvement in the neurologic status of patient. Similar to our management, there are other authors who also did not consider surgery in idiopathic spinal cord herniation. (7). If the patient has no progressive myelopathy and Brown-Séquard syndrome, observation in this condition alone can be helpful for preventing the reported complications of surgery. Our case emphasized the importance of neurologic examination and also pointed the importance of rare conditions that all physicians have to keep in mind. We believe that increasing use of the spinal MRI will decrease the rates of misdiagnosis in idiopathic spinal cord herniation.

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CASE REPORT / OLGU SUNUMU

# CERVICAL EPIDURAL ABCESS DUE TO NASAL SEPTAL PERFORATION

## NAZAL SEPTAL PERFORASYONA BAĞLI OLUŞAN SERVİKAL EPİDURAL APSE

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Mert BAŞARAN<sup>4</sup>, Ersin ERDOĞAN<sup>5</sup>

### SUMMARY

Spinal epidural abscess is a rare but serious condition; where as delayed diagnosis and medical treatment can cause neurological deficiency or even death. Generally symptoms are non-specific that patients generally attend hospitals because of neck and waist pain, localized tenderness. In advanced stages fever and neurological symptoms can be seen. Seldom; it can be seen in cervical region. We present a case report of a 52 years-old man with nasal septal perforation attended our clinic because of neck pain, developed fever and neurological symptoms diagnosed as spinal epidural abscess and treated with drainage of abscess.

**Key words:** Cervical epidural abscess, nasal septal perforation, surgical treatment

**Level of evidence:** Case report, Level IV

### ÖZET

Spinal epidural apseler nadirdir fakat gecikmiş tanı ve tedavi nedeniyle nörolojik hasar hatta ölüme neden olabilen ciddi durumlardır. Genellikle hastaların boyun ve sırt ağrısı ve lokalize hassasiyetle hastaneye başvurmalarına neden olan belirtiler özgün değildir. İlerlemiş evrede ateş ve nörolojik bulgular görülür. Nadiren servikal bölge tutulumu olur. Bu çalışmada boyun ağrısı, ateş ve nörolojik belirtilerle başvuran ve burundan septal perforasyon gelişen, spinal epidural apse tanısı konulan ve absenin drenajı ile tedavi edilen 52 yaşında bir erkek hasta sunulmuştur. Bu olgu sunumunda nadir görülen bu antitenin tanı ve tedavisi literatür bilgileri ışığında tartışılmıştır.

**Anahtar Kelimeler:** Servikal epidural apse, nazal septal perforasyon, cerrahi tedavi

**Kanıt Düzeyi:** Olgu sunumu, Düzey IV

### INTRODUCTION:

Nasal septal perforation can be result of not only traumatic and iatrogenic causes but also sarcoidosis, Wegener's granulomatosis, systemic lupus erythematosus (SLE), Rheumatoid arthritis (RA), Crohn's disease, tuberculosis, syphilis, AIDS, inflammatory diseases, carcinomas or using of cocaine and long-term medication such as topical corticosteroids. Untreated infections such as septal abscess can cause septal cartilage necrosis and also intracranial and systemic complications (2-3,8,13).

Spinal epidural abscess is formed by collection of pus or inflammatory granulation tissue between dura mater and the overlying vertebral column (13). This is a rare disease with non-specific symptoms such as localized tenderness, neck and waist pain which makes difficult to diagnose. With early diagnosis and appropriate treatment, excellent recovery could be gained (8).

Spinal epidural abscess generally occurs in thoracic and lumbosacral area (11). It can be rarely seen in cervical region. When seen in cervical region; it generally causes neck pain. During advanced stages neurological deficits and high fever can be seen.

We represent a case that attended our clinic with neck pain and developed neurological symptoms and fever afterwards and diagnosed as cervical spinal epidural abscess that was unresponsive to medical therapy and treated successfully with abscess drainage by an anterior approach.

### CASE REPORT:

A fifty two-year-old male with head and neck pain and high fever for 3 days admitted to our clinic. Ear nose and throat (ENT) examination showed 8x9 mm (width x length) nasal perforation in nasal septal cartilage and purulent drainage in nasal cavity and nasopharynx. Patient's blood tests showed sedimentation 28 mm/h, CRP 100.70 mg/L and complete blood

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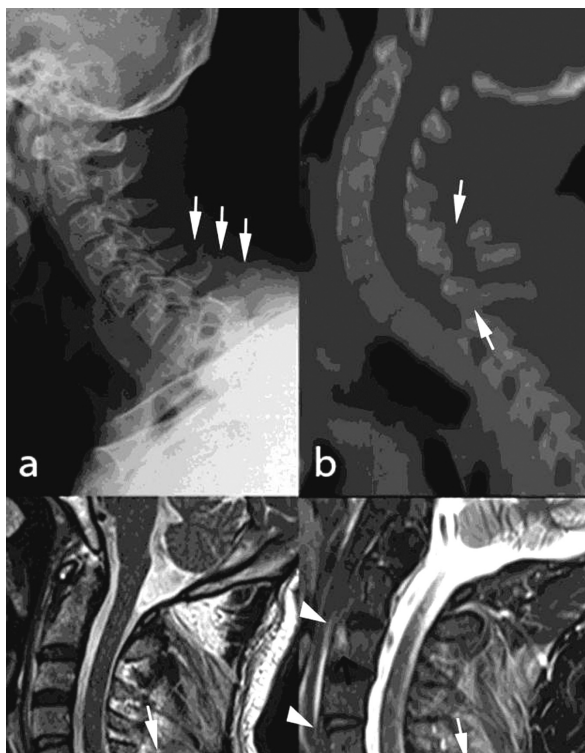
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count  $11.55 \times 10^3$  leukocytes/ $\mu\text{L}$  with neutrophil predominance (82.27 %) were present. Then patient is hospitalized and blood, urine culture and urinalysis were taken during high fever. Brucella agglutination test and human immunodeficiency virus antigens were negative. A paranasal computed tomography scan showed only hypertrophy of left inferior and middle turbinate and septal perforation. A cervical tomography showed osteophytes changes in vertebrae and degenerative changes in facet joints. When patient suffered numbness in both arms, a cervical vertebral magnetic resonance imaging (MRI) was taken. Thickness of dural structures starting from C3 proximal level to C4, C5-6 disc level; edematous changes, compression of epidural granulation and hypertrophic structures seen in anterior of epidural space in dural sac and anteriorly of right paracentral of spinal cord in level of C3; heavily of right anterior dural sac and spinal cord starting from C4; dural sac, spinal cord, both anteriorly to neural root in C4-5; dural sac and spinal cord and left lateral anteriorly from C5 to C6-7. Intense enhancement of the mass was observed (Figure-1). (T1 Weighted Sagittal image).



**Figure-1.** Preoperative sagittal T1-WI enhanced MRI revealed highly enhanced elevation of longitudinal ligament and hypointense center. Anterior subarachnoid space narrowed and abscess that pushes cord and narrows anterior-posterior diameter of spinal channel is shown (arrow).

The patient's blood cultures and nasal cavity cultures revealed *Staphylococcus aureus* (*S. aureus*) and methicillin-resistant coagulase-negative staphylococci. Then cephalosporins, rifampicin, and daptomycin group of antibiotics were started; and patient was performed an anterior cervical discectomy. A right paramedian incision was made under the cricoid cartilage, laterally to medial margin of sternocleidomastoid muscle; trachea, esophagus medially were excluded. Disc space was opened and osteophytes located posteriorly were cleaned. Abscess was drained by opening both PLL and foramen. Postoperative CRP was 8.80 mg/L and sedimentation rate was 69 mm/hr and patients symptoms were settled down later on. Pathological examination of abscess showed fibrous cartilage. Abscess culture also showed *Staphylococcus aureus*. Postoperative follow-up was performed by a computed tomography with no complications and patient was discharged on postoperative third day. In the six-month postoperative follow-up showed no recurrence (Figure-2).



**Figure-2.** A postoperative sagittal CT scan shows a PEEK cage and postoperative decrease in edema and compression. Patient had approximately 6mm septal perforation (arrow).

## DISCUSSION:

The spinal epidural space is a continuous vertical sleeve filled with fat, arteries and venous complexes (13). Abscess in this area move through dural sheath, may involve multiple segments. Generally a spinal epidural abscess occurs posteriorly (3). Spinal epidural abscess were generally seen in males and in 6-7<sup>th</sup> decades.

Etiopathogenesis of about 30-40 % of all spinal epidural cases is unknown. However, spreading with direct invasion was seen about 10-30 % of cases and generally takes places from vertebral osteomyelitis or psoas muscle abscess. Baker et al. showed 26 % of cases arisen from infections like fruncles, pharyngitis and dental abscess (2) where as other reviews showed cases arisen from skin, urinary and respiratory system about 50 % (11). Iatrogenic factors after invasive procedures such as lumbar puncture, peridural and epidural anesthesia, occurs in 15 % cases (5). Although invasive procedures may be major factors alone; they can also result in abscess formation via ascendant path through skin (9). Abscess can also be seen during paraspinal injection of steroid and analgesics (2,9). About 15-35 % cases develops after a trauma. Other risk factors include diabetes mellitus, advanced age, alcoholism, intravenous drug use, immune deficiency diseases, such as HIV/AIDS may take place. Peridural/Epidural catheters placed more than 2-4 days also increase the risk (13). But in this case no morbidity was found.

Most common (75 %) pathogen bacteria is found to be *Staphylococcus aureus* (2,15). Gram negative bacteria are found about 10-45 % (13). Other pathogens include *Haemophilus parainfluenzae* (1), *Brusella* (10) and *Actinomyces israeli* (7) and *Aspergillus* species in patients with AIDS (6). However, culture can be negative in 40 % of cases (4).

Especially in early stages nonspecific symptoms make harder to diagnose. Patients generally consult for pain and tenderness in the abscess area (12). In advanced stages, depending on the level of abscess compression, incontinence and paralysis may occur.

This process may vary from several days to several months. Headache, fever, and neurological deficits constitute the triad of abscess (14). Increase in inflammation markers in blood is observed. The definite diagnosis can be made with myelography and gadolinium enhanced MRI (4).

After surgery medical treatment is the primary option, surgeries such as laminectomy, hemilaminectomy or laminar fenestration implementation is recommended. Paralysis more than four days may not benefit from surgical intervention for repairing neurological deficit therefore led a poor outcome. In our case, the patient's neurological deficits disappeared following surgery, and the patient was discharged without any deficits.

In our case, patient was 55 years old and male. He attended our clinic for his neck pain and in two days fever and neurological symptoms especially arm tenderness and difficulty in walking occurred. After these symptoms MRI was taken and abscess formation was shown. Culture taken from perforated mucosa showed *S. Aureus*. Blood culture taken simultaneously also showed growth of *S. Aureus* which might indicate nasal septum perforation was the focus of infection. It is known that nasal septal abscess can cause nasal perforation and intracranial abscess formation (14). In literature, there are no cases of spinal epidural abscess as a complication of nasal septal perforation. However, patients with nasal septal perforation with neck pain and neurological deficits, spinal epidural abscess should be thought as a complication. This association may be coincidental, but in patients with cervical spinal epidural abscess, nasal pathology should be considered as focus of infection.

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CASE REPORT / OLGU SUNUMU

# IS CUFF LEAK TEST VALID IN MANAGING DIFFICULT EXTUBATION AFTER CERVICAL SPINE FUSION OPERATION?

## SERVİKAL OMURGA FÜZYON AMELİYATI SONRASI ZOR ENTÜBASYON UYGULAMASINDA "CUFF LEAK" GEÇERLİ BİR TEST MİDİR?

Onur ÖZLÜ<sup>1</sup>, Sema ŞANAL BAŞ<sup>2</sup>, Uygur ER<sup>3</sup>, Serkan ŞİMŞEK<sup>4</sup>

### SUMMARY

We report a 38 year old male patient underwent basilar invagination and Arnold-Chiari type I malformation. Although he has effective spontaneous ventilation, he is fully awake, there were no signs of laryngeal edema, and negative cuff leak test following the extubation the patient could not breathe because of complete laryngeal obstruction at the end of the operation. The patient could not be ventilated via a face mask, supraglottic airway, and intubation bought but could be ventilated with emergent tracheostomy under sedation. Airway complications after posterior cervical spine surgery are the most commonly because of laryngeal edema and macroglossy. If there is risk of airway edema for extubation, difficult intubation and extubation management strategy should provide lifesaving factor in cervical spine surgery.

**Key Words:** Airway tube, Cervical fusion, Chiari Malformation, Cuff-leak test, Difficult extubation, Posterior spine surgery

**Level of Evidence:** Case report, Level IV

### ÖZET

Baziler invajinasyon ve Arnold-Chiari tip I malformasyonu olan 38 yaşında erkek hasta sunuldu. Etkili bir spontan solunumu olması, tam uyanık olması, larinks ödemeine ait bir bulgusu olmaması ve negatif "cuff-leak" testi olmasına rağmen ameliyat sonunda tam bir laringeal tıkanma sonucunda ekstübasyon sonrası hasta nefes alamadı. Hasta yüz maskesi ve supraglottik hava yolu cihazı ile nefes alamadı ve sedasyon altında acil trakeostomi açıldı. Posterior servikal omurga ameliyatları sonrası hava yolu komplikasyonları en sık larinks ödemi ve makroglosi nedeniyle gelişir. Posterior servikal omurga cerrahisinde ekstübasyonda hava yolunda ödem gelişme riski varsa zor entübasyon ve ekstübasyon yönetimi stratejisi hayat kurtarıcı olur.

**Anahtar Kelimeler:** Chiari malformasyonu, Cuff-leak test, Havayolu tüpü, Posterior omurga cerrahisi, Servikal füzyon, Zor entübasyon

**Kanıt Düzeyi:** Olgu sunumu, Düzey IV

### INTRODUCTION:

The airway complications associated with anterior cervical spine operations depend on pharyngeal edema, hematoma, graft dislodgement, angioedema, and leakage of cerebrospinal fluid (8,9). Airway complications after posterior cervical spine surgery are most common due to laryngeal edema and macroglossia (2). Although incidence of the airway complications is 6.1 %, life threatening serious airway obstruction requiring tracheostomy or reintubation is rare as 1.9 % (8). Here we report a patient who underwent emergent tracheostomy after negative cuff leak test and unsuccessful ventilation via a face mask, supraglottic airway, and intubation bought due to laryngeal edema

and failed reintubation by direct laryngoscopy because of immobilization of the neck due to cervical (C) 1-2 fixation and fusion operation posteriorly.

### CASE REPORT:

A 38 year-old male patient with ASA 1 physical status was scheduled for basilar invagination and Chiari type I malformation. He had a short neck, low hairline, inability of tilting head, and restricted neck extension with Mallampati score of 3.

Following monitorization, orotracheal intubation was performed with a fiberoptic bronchoscope under Propofol sedation. Anesthesia was lasted for 5 h 40 min and duration of surgery was 5 h 20 min. At the final of the operation, total blood loss and urine out-

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puts were 3400 ml and 1000 ml respectively. During the operation, 6 unites erythrocyte suspensions and 3 unites fresh frozen plasma in addition to 2900 ml colloid and 2500 ml of crystalloid solutions were infused.

The valve of at the end of the anesthesia, neither marked facial nor scleral edema was observed, SpO<sub>2</sub> was greater than 95 % during spontaneous ventilation with room air and the patient was fully awake responds to verbal stimuli such as hand-wringing and lifting his head. The air leak test was negative and extubation was decided. Intubation bought was inserted. Just after tracheal tube was removed, the patient showed the signs and symptoms of upper airway obstruction with holding up his hands to his neck and he could not breathe at all. The patient could not be ventilated via a face mask, supraglottic airway (ILMA), and intubation bought failed reintubation by direct laryngoscopy. After tracheostomy was performed by an ear-throat and nose surgeon, the heart rate was 20-30 breath/min and SpO<sub>2</sub> was 20-30 %, electrocardiography (ECG) showed ventricular fibrillation. Therefore rapidly defibrillation was used after that ECG was sinus rhythm. When tracheostomy cannula was introduced, SpO<sub>2</sub> was rapidly increased to 90%. Laryngeal edema was observed by fiberoptic laryngoscopy in the intensive care unit. The invagination into posterior fossa of upper cervical region, shallow posterior fossa, narrow foramen magnum, and metallic fixation materials were seen on computerized tomography postoperatively. At the 4<sup>th</sup> postoperative day, the patient could breathe spontaneously through the tracheostomy cannula. However, the patient presented spastic paresis on the right lower extremity, hyperactive deep tendon reflexes, difficulty in swallowing, and articulation disorder.

## DISCUSSION:

Basilar invagination is a developmental defect of basiocciput and rim of foramen magnum with normally growled odontoid and arch of atlas which may cause odontoid and arch of atlas invagination (4). Operative treatment is required to stabilize the cranio-vertebral junction. The atlantooccipital gap, distance from the posterior arch of the atlas to the occiput, and a narrow atlanto-occipital gap have been suggested as a cause of difficult intubation (8,9). We intubated the patient using fiberoptic bronchoscopy (FOB) because of restricted extension of the neck poor view of oropharynx.

The risk factors particular with airway obstruction after cervical spine operations include exposures above C4, predicted blood loss greater than 300 ml,

transfusion of four or more red cell units, and operative time of >5 hours (2,8). In this case, operation time lasting 5 hours, 6 units red cell transfusion because of 3400 ml blood loss and C1-C2 fixation and fusions are risk factors for postoperative respiratory failure because of upper airway obstruction. One of the etiologic factors of pharyngeal and laryngeal edema is declined venous return from the upper neck and face during prone position (8). The patient who has a difficult airway at the anesthetic induction time must be considered as having a difficult airway at the time of extubation (7). And also the patient has a difficult intubation that we performed fiberoptic for intubation (3). It is suggested that when there is a suspicion that a patient may have difficulty with oxygenation and ventilation after tracheal extubation the clinician could plan the reintubation management (1,7). In addition to have difficult airway at the anesthetic induction time, our patient's neck was fixed at mild flexion position at the end of the operation additionally.

We did not observe scleral edema and macroglossia as the predictors of laryngeal edema just after the operation. We performed a cuff leak test for responsive and spontaneously breathing patient by turning off the cuff, blocking the endotracheal tube opening and hearing a leak around the cuff while the patient inspired (2). We did not determine air leakage. Because cuff leak test's poor sensitivity in detecting subsequent ventilatory failure after extubation (2,7) and absence of clinical predictors of pharyngeal and laryngeal edema we decided to extubate the patient. Intubation bought was inserted to guide for reintubation. When the patient could not breathe just after extubation, ear-throat-neck surgeon was called for emergent tracheotomy. The patient could be ventilated through the tracheostomy cannula successfully. Although reintubation management plan is necessary for difficult extubation, personal experience of the practitioner is the main determinant in electing the strategy (1,6). Also postoperative fiberoptic assessment of the airway for confirmation of airway edema would reduce the incidence of airway complications after cervical spine surgery (2,10).

Cuff leak test is used to evaluate confidently for subglottic caliber for difficult extubation (5). And also intubation bought is put into before tracheal extubation to accelerated intubation. The patient's cuff leak test was negative and there were no clinical signs of pharyngeal or laryngeal edema. The patient was fully awake and could breathe spontaneously at the end of the anesthesia. Although the cuff leak test may not predict laryngeal edema after extubation. In conclusion, neither cuff leak test nor supraglottic airway

(ILMA), intubation bought is used difficult extubation management safety. If there is a probability of airway edema, postoperative fiberoptic evaluation of the airway would prevent early extubation and the re-intubation management strategies will be lifesaving factor in cervical spine surgery. And also anesthesiologist could be the tracheostomy cannula successfully as ear-throat-neck surgeon.

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## REVIEW ARTICLE / DERLEME

## CROSSING LAMINAR SCREW FIXATION OF THE AXIS

## AKSİSİN ÇAPRAZ LAMİNAR VİDA İLE FİKSASYONU

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## SUMMARY

Crossing C2 laminar screwing is a potentially safe and effective technique for both initial and salvage applications of cranio-cervical and atlantoaxial fixation as well as for incorporation of C2 into sub-axial fixations especially in cases having unsuitable anatomy for pedicle screw fixation. However, a careful preoperative radiologic evaluation is essential to determine the suitability of laminar anatomy for the screw placement on an individual basis. Our purpose of this study is to review previous literature on the anatomical, clinical and radiological basis and to create a useful guidance for C2 translaminar screw fixation.

**Keywords:** Lamina, anatomy, radiology, laminar screw, axis, fixation

**Level of Evidence:** Review Article, Level V

## ÖZET

C2 çapraz laminar vidalama özellikle pedikül vida fiksasyonu için uygun olmayan anatomiye sahip olgularda kraniyoservikal ve atlantoaksiyel fiksasyon uygulamalarının hem başlangıç hem de kurtarma ameliyatlarında, aynı zamanda C2'nin subaksiyel fiksasyonlara dahil edildiği durumlar için potansiyel olarak güvenli ve etkin bir tekniktir. Bununla birlikte, bireysel bazda vida yerleştirilmesi için laminar anatominin uygunluğunun saptanmasında dikkatli bir ameliyat öncesi radyolojik değerlendirme önemlidir. Bu çalışmadaki amacımız anatomik, radyolojik ve klinik bazda daha önceki literatürü gözden geçirmek ve C2 translaminar vida fiksasyonu için kullanışlı bir klavuz oluşturmaktır.

**Anahtar Kelimeler:** lamina, anatomi, radyoloji, laminar vida, aksis, fiksasyon

**Kanıt Düzeyi:** Derleme Düzey V

## INTRODUCTION:

A variety of techniques have been described for C-2 fixation since the initial wiring technique described by Gallie, including the use of laminar hooks, posterior and anterior transarticular fixation, transpedicular screws, ishtmus screws, and, more recently, laminar screws (9,11,14,29). All these techniques have been aimed to provide safe and solid fixation.

Initially, numerous wiring techniques had been used safely (6,8-9). However, they have been associated with high pseudoarthrosis rate despite the use of halo or brace immobilization after surgery. Therefore, many types of screwing methods had been developed for C-2 fixation because of their higher biomechanical stability. Firstly, transarticular screwing proposed by Magerl and Seeman in 1987, was used for C-2 fixation with high rate of fusion (21). However, it was technically demanding and carries a risk for fatal neurovascular injury. Afterwards, the C-1 lateral mass and C-2 pedicle screw insertion suggesting by Harms and Melcher was become a widely accepted screw-based technique as a safer method, but it was

still technically demanding due to the danger of vertebral arter injury (11).

The ideal instrumentation technique for cervical screwing should provide both solid fixation as well as higher biomechanical stability, while reducing the risk of neurovascular injury. Crossing laminar screw fixation method described recently gained an increasing popularity among the C-2 screw fixation techniques due to providing excellent stability with eliminating the risk of vertebral artery injury (29). In addition, it does not require the use of intra-operative navigation, because all relevant structures are directly visualized during surgery. However, careful preoperative planning using fine-cut computed tomography is necessary to determine the feasibility of laminar screw placement due to intra and interindividual variations of C-2 laminar anatomy.

## PREOPERATIVE PLANNING:

Despite several modifications and advances in surgical technique since the first description by Wright in 2004, first stage in the laminar screw placement is a careful preoperative planning. The first step in the

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planning is to define whether lamina is intact and its anatomy is suitable for screw placement, using imaging method. The most advantageous method for preoperative planning is thin-slice tomography which provides high resolution in the bony structure. Information required for laminar screw placement is collected through 3D reformation of the images that are obtained from thin-slice tomography (Figure 1). At this stage, the thinnest laminar width, shortest laminar height and length and spinous process height should be assessed with the reformatted images to determine the suitable screw dimension and avoid screw collision along the ideal screw trajectory. At the same time, spinolaminar angle, the angle formed by the C2 spinous process and a line parallel to the longitudinal axis of the lamina, should be determined. So that, ventral violation into the spinal canal can be prevented. Only direct radiogram study regarding laminar screwing has been conducted by Lehman et al. on cadavers. Despite it is an intraoperative available and practical method, c-arm fluoroscopy was reported to be insufficient in showing ventral or dorsal violations (18).



**Figure-1.** The reformatted axial CT images by using OsiriX imaging software (version 3.8.1, Pixmeo, Geneva, Switzerland) for preoperative planning.

## AXIS TRANSLAMINAR SCREWING TECHNIQUE (WRIGHT TECHNIQUE) AND ITS MODIFICATIONS:

In the Wright technique, first a high-speed drill was used to open a small cortical window at the junction of the C2 spinous process and lamina on one side, close to the rostral margin of the C2 lamina. With a hand drill, the contralateral (left) lamina was carefully drilled to a depth of 30 mm. It is slightly directed toward posterior in order to prevent violation from the cortical bone into the spinal canal. It is checked, whether or not there is a violation into the spinal canal through the drilling depth, with using a small probe. Polyaxial screw is then carefully inserted along the same trajectory. Whereas in placement of contra-

lateral screw a small window, which was opened on the rostral half of the lamina spinous process junction at the beginning, is opened close to the caudal half in order to prevent a collision. Then the screw is placed by the same way (29). Herein, the most important issue at the planning stage is to define whether or not the height of the spinous process is sufficient in order to prevent collision. The second important issue is that; although whether the penetration into the spinal canal was checked with a probe, ventral cortical breach into the spinal canal is yet likely to occur. The third important issue is challenge in insertion of the bone graft after translaminar screw placement. Therefore, several modifications were developed in the Wright technique for reduce complications and facilitate application of C-2 laminar screw placement.

Firstly, Jea et al. opened an exit cortical window at facet-lamina junction in addition to the entry hole at the junction of spinous process and the lamina. They used pedicle finder instead of high-speed drill in order to increase the sensitivity in disjunction of the cancellous and cortical bone. By this way, they carried out C-2 translaminar screwing by directing from entry hole of the spinous process-lamina junction to exit window at the facet-lamina junction without a need for fluoroscopy and preventing ventral violation into the spinal canal (13).

Secondly, Kabir et al. placed a unilateral laminar screw after removing of the upper part of the spinous process of C2 (15). With this modification, laminar screw application combined with a unilateral pedicle screw was achieved in the presence of unilateral high riding vertebral artery. Additionally, bone graft can be inserted in the surgical site and cortical breach can be prevented. As a disadvantage, this method is not suitable for bilateral screw placement.

Finally, in their study with computerized images of the population under 18 years of age, Xia et al. reported that, violation into the spinal canal can be avoided using an entry window more ventral from the junction of spinous process and lamina, and an exit window more dorsal from the junction of facet-lamina. Disadvantage of this modification was found to be requirement of using shorter screws (30).

## COMPUTERIZED TOMOGRAPHY STUDIES:

In their study with 42 patients (23 male, 19 female) Nakanishi et al. reported that 80% of the male and 63% female patients have laminar width sufficient for 3-mm diameter screw placement, while only 50% of the male and 24% of female patients have laminar width sufficient for 4-mm diameter screw placement. In addition, the thinnest laminar width measured in

the males and females was found as 0,8 mm and the largest laminar width as 8,4 mm. In conclusion, they emphasized that, the left-right distinction and height of the lamina is not effective in screw placement, while gender and individual differences are quite important (22).

In their study on 102 patients (60 male, 42 female, mean age 48.4) aged between 20 and 81 years, Kim et al. reported that, half of the patients have not laminar width sufficient for placement of 3.5 mm diameter laminar screw unilaterally. In their study, 68% of the male and 38% of female patients have laminar width sufficient for placement of 4 mm diameter laminar screw unilaterally, while only 50% of the male and 24% of female patients have laminar width sufficient for placement 4 mm diameter laminar screw bilaterally. Male population was reported that have a larger laminar width, although this was not of statistical significance. In addition, all the patients had a laminar length that been able to tolerate 22mm screw without foramen transversarium penetration. They emphasized that the importance of careful preoperative radiological evaluation, because of the thinner laminar width in Korean society than the western societies (16).

In a computerized tomography study performed with the 100 cadavers axis (50 male, 50 female), Yue et al defined a drilling entry point on the 5–6 mm posterior to the post-edge of the spinal canal of the C2 spinous process, and they reported that it was the more feasible and safer entry point for guiding a crossing laminar screw placement. The screw pass ratio from this entry point is 85%. Furthermore, they found the mean angulations in the coronal plane in this entry point as  $9.57 \pm 4.36$  degrees, the widest screw length as  $21.74 \pm 2.44$  mm and spinolaminar angle between  $49.68 \pm 4.64$  and  $59.19 \pm 4.70$  degrees. In conclusion the authors suggested that, preoperative radiological evaluation is necessary because of the individual differences in screw angulations (31).

Bhatnagar et al compared the suitability of C2 pedicle versus laminar screws in 50 patients using CT angiograms. They reported that 24% of patients having anatomy that would preclude 3.5-mm C2 pedicle screw fixation and more than 90% of patients having anatomy that could tolerate 3.5-mm C2 laminar screw fixation. They stated that C2 intralaminar screw fixation is a suitable option in cases having a vertebral artery anatomy precluding C2 pedicle screw fixation (2).

In a study with 113 pediatric patients (61 boy, 52 girl), Xia et al. reported that all the patients could tolerate longer than 30-mm-screw length in at least one side of the lamina. Of the patients, 95.6% could tolerate 4.5-mm diameter screw placement in at least

one side of the lamina. Height of the spinous process was sufficient in 72.6% of the patients for bilateral screw placement. In addition, a marked shortening in the screw length and increase in the spinolaminar angulation were observed through measurements performed using modified Wright technique, and it was reported that shorter screws should be preferred in laminar screw placement when using modified Wright technique (30).

### CADAVER STUDIES:

In their study with 420 adult cadavers (118 black female, 85 white female, 100 black male and 117 white male) Casinelli et al. reported that, 92.6% of the axis bones have a lamina wider than 4mm and more than 99% were able to tolerate a screw length longer than 20 mm. Although race, height and weight were not of statistical significance, gender was found to be effective on all the parameters measured. In conclusion, the authors mentioned importance of the preoperative planning for safe screw placement (4).

In a study on axis samples of 38 cadavers, Wang reported that 16 sides of 14 samples (37%) were not suitable for placement of 3.5-mm diameter laminar screws, assuming the need for a 0.5 mm space for safety margin around the screws and, 32 sides of 18 samples (47%) were not suitable for placement of 4-mm diameter laminar screws. In this study, the average maximal screw length was found as 31.6 mm (27).

In a study on 84 adult cadavers by Dean et al using CT revealed that 97% of the axis samples could tolerate 3.5-mm diameter laminar screw and all could tolerate 20-mm long laminar screw. They found a poor correlation between direct measurements of the spinolaminar angle and computerized tomographic measurements in the axis samples, but they attributed this to the measurement variability. In conclusion, they emphasized that preoperative planning to be performed through computerized tomography is necessary for safe crossing laminar screw placement (7).

In a study by Hu et al. on 28 adult cadavers (18 male, 10 female, mean age: 52), axial laminar screws with the length of 24-27 mm were safe in fixation. Furthermore, the authors argued that pedicle screwing is the most suitable method for C-2 fixation even in the presence of abnormal vertebral artery, as long as pedicle anatomy is sufficient for screwing. They suggested that laminar screwing would be reliable approach in the presence of hypoplastic or unilaterally occluded vertebral artery in which asymmetric vertebral artery is clearly seen. They stated that however, surgical experience and status of the patients are the most important factors in selection of the surgical technique (12).

## BIOMECHANICAL STUDIES:

In their study with 6 fresh human cadavers, Gorek et al. compared fixation with bilateral C-2 translaminar screwing, Harms technique, unilateral pedicle and contralateral laminar screw and, reported that an equal stability was achieved (10).

In a study on 8 fresh human cadavers, Lapsiwala et al. compared flexion, extension, axial rotation and lateral bending motion of the neck after atlantoaxial fixation through 3 different methods with non-instrumented intact cervical spine. Furthermore, they added fixation by cable to the posterior fixation methods. Flexion, extension and axial rotation obtained with the atlantoaxial fixation which was performed through C-1 lateral mass and C-2 intralaminar screwing was found to be equal with the atlantoaxial fixation biomechanically obtained using transarticular and pedicle screws. Whereas resistance to lateral bending was lower in the first method than in other two methods (17).

In a study on 8 fresh human cadavers, Reddy et al. compared the methods of posterior cervical fixation with C-3 lateral mass in addition to C-2 pedicle screwing and posterior cervical fixation with C-3 lateral mass in addition to C-2 translaminar screwing with the intact spine. They found that both the instrumentation methods provided a significant stiffness compared to intact spine. Although C-2 pedicle screwing method was seen to cause more restricted motion, no statistically significant difference was observed between both methods in terms of biomechanical stability (25).

In their study on 11 fresh human cadaveric samples, Lehman et al. proposed that C-2 laminar screwing provided the strongest fixation both in the initial and salvage operations. In addition they reported that C-2 laminar screwing provided a stronger fixation compared to lateral mass screwing (19).

In a study on 6 fresh cadaveric cervical spines, Benke et al. compared flexion, extension, axial rotation and lateral bending motions of the neck following the posterior cervical fixation with C3-6 lateral mass screwing in addition to C-2 pedicle screwing and posterior cervical fixation with C3-6 lateral mass screwing in addition to C-2 intralaminar screwing with the intact spine. They reported that, laminar screws were more rigid in all the motion planes when compared to intact spine. In addition, they reported that laminar screws were less rigid in lateral bending, equal strictness in flexion-extension and more rigid in axial rotation when compared to the pedicle screws (1).

## CLINICAL STUDIES:

Wright described C-2 crossing laminar screwing technique for the first time in 10 patients (8 male, 2 female) presenting with trauma. Postoperatively all patients had used cervical collars for 6 weeks and only one patient died at the postoperative second month due to cardiac problems. Wright proposed that, although biomechanical results are not available, this technique would gain increasing popularity and would be used in a greater number of patients without risk of vertebral artery injury (29).

Wang used the crossing laminar screws for axis fixation in 30 patients (12 male, 18 female, mean age:55) with various pathologies. None of the patients developed intraoperative complication. Dorsal laminar breach was seen in 11 patients and ventral violation (into the spinal canal) in 1 patient, but no neurological symptom was observed. Hardware fracture was seen in 2 patients in the early period. The author reported that intralaminar screws were under increased stress and strain due to the unique position of the screw heads and therefore recommended use of the larger diameter screws or additional fixation points at the adjacent levels (28).

Rhee et al. prevented screw collision in a 81 years old female patient who had low profiles of C2 lamina with modification of trajectory of inferior laminar screw by drilling the bifid inferior base of C2 spinous process at two points on the entry side. They also reported that simple modifications provide stability of fixation in patients with low profiles C2 laminae. In addition, they stated that the importance of careful preoperative evaluation (26).

In their study with 167 patients, Parker et al. compared C2 translaminar and C2 pedicle screwing for axial (n=31) and subaxial (n=136) cervical fusions. Revision surgery was required in 4 patients undergone subaxial fixation with translaminar screwing due to pseudoarthrosis or screw loosening at the first year follow-up. The authors reported that C2 translaminar screws were equally effective as C2 pedicle screws for axial fixation at the one-year follow-up, but durability was lower in C-2 translaminar screwing than in C-2 pedicle screwing for subaxial fixation (24).

Chaumon et al. used C-2 translaminar screwing for axial and subaxial fixation in 7 pediatric patients (4 boy, 3 girl) and reported this method is safe with high fusion rates (5).

Ma et al. retrospectively examined 35 patients (19 male, 16 female, mean age: 45) underwent atlantoaxial fixation with C-2 translaminar screwing in addition to C-1 lateral mass screwing, and found on computerized tomography that partial dorsal laminar breach occurred in 10 patients at mean follow-up of 29 months (6-54 months). However, none of the patients required revision due to pseudoarthrosis or screw

loosening, and fusion was observed in all the patients at the end of the follow-up period. The authors reported that, C-2 fixation with translaminar screws is a straightforward and efficient method in cases of the unilaterally occluded vertebral artery or if the pedicle anatomy is not convenient for screw placement (20).

Bransford et al. retrospectively examined 383 patients who underwent axis fixation using different screwing techniques (pedicle, pars, isthmus and laminar) and laminar screws were placed for C-2 fixation in 63 of them in a four-year period. No complication regarding to C-2 laminar screwing was observed in their series of 58 patients except for 5 patients whom without having a CT in follow-up period (3).

Park et al. followed 14 patients (8 male, 6 female) who underwent posterior fixation with C2 translaminar screws for various pathologies, during mean fol-

low-up 11.6 months. They observed radiographically bony fusion in 11 (91.7%) patients at the end of the 6 months follow-up, and five of them demonstrated improvement in initial neurological deficit. The authors stated that, fixation using C-2 translaminar screws is a quite practice method with preoperative planning and, stress and strain of the laminar screws could be reduced by additional connectors (23).

### **CONCLUSION:**

Consequently, translaminar screwing technique is a method that could be confidently preferred and readily applied both in the initial and salvage operations in case of need for axis fixation. As it is seen in all above mentioned studies, preoperative planning is the most important consideration for determination of the length and diameter of the screws.

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## REVIEW ARTICLE / DERLEME

## ANAESTHESIA MANAGEMENT IN SPINAL CORD INJURY PATIENTS

## SPİNAL KORD HASARLI HASTADA ANESTEZİ YAKLAŞIMI

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## SUMMARY

Spinal cord injuries occur in 1.3% of multiple trauma patients. The most frequent reasons of death in spinal cord injured patients are aspiration and shock. The most important aim in the anesthesia management of the spinal cord injury (SCI) patients is to prevent secondary spinal damage. In trauma patients, maintaining Airway Breathing Circulation (ABC) is a life saving procedure. In SCI patients, induction of anesthesia, maintenance of airway and anesthesia, stabilization of hemodynamic parameters are important factors affecting mortality and morbidity. In this review, we aimed to investigate the anesthesia management of spinal cord injured patients.

**Key Words:** Spinal Cord Injury, Anesthesia, Trauma

**Level of evidence:** Review article, Level V

## ÖZET

Multitравmalı hastaların %1,3'ünde spinal kord hasarı oluşmaktadır. Spinal kord yaralanmalarında en başta gelen ölüm sebebi aspirasyon ve şoktur. Spinal Kord Hasarlı (SKH) hastaların anestezi yönetiminde en önemli amaç sekonder spinal hasarın önlenmesidir.

Travmada ABC (A: havayolu, B: solunum, C: dolaşım) denilen, ilk aşamada hava yolunun açık tutulması, solunum ve dolaşımın sağlanması hayati önem taşımaktadır. SKH'lı hastada anestezi indüksiyonu, havayolunun sağlanması, anestezi idamesi, hemodinaminin stabilizasyonu hastaların morbidite ve mortalitesini etkileyebilecek farklılıklar göstermektedir. Bu derlemede, spinal kord hasarlı hastaya anestezi yaklaşımlar gözden geçirilmiştir.

**Anahtar Kelimeler :** Spinal Kord Hasarı, Anestezi, Travma

**Kanıt Düzeyi:** Derleme, Düzey V

## INTRODUCTION:

In multiple trauma patients cervical damage is observed 4.3%, thoraco-lumbar vertebrae damage is observed 6.3% and spinal cord injury is observed 1.3%. Every year in United States of America, 12000 spinal cord injury (SCI) patients are being operated (14). Cervical segment is most commonly effected (42%), thoracic (31%) and lumbar (27%) regions follow it.

Trauma is the one of the common causes of death in young population. Half of the trauma patients lost their life at the time of the trauma and 30% of it in the first few hours after trauma (13). Average age of observation is 40 and male are affected 4 times more frequently than women. Spinal cord traumas are not common in pediatric age group, and in that group when compared to head trauma rate is 1/30. In pediatric age group ligaments are damaged more than bone structures (1,7).

In vertebrae fractures without SCI, anesthesia method is similar to vertebrae instrumentation surgery but in SCI patients it includes additional precautionary approaches.

SCI following vertebrae fracture holds a risk of 50% mortality in early period. In total SCI possibility of the return of the normal neurological functions is 10% and in partial SCI this number is 75%. At the acute phase of the damage, during surgery, stability of the patients are very important for neurological sequel, morbidity, mortality, and health care costs. Most common causes of mortality in spinal cord injury are aspiration and shock (5). In trauma, ABC (A: airway, B: breathing, C: circulation), maintaining airway, respiration and circulation is crucial.

SCI in the C3-C5 levels may cause deterioration in the pulmonary reserve due to phrenic nerve injury. Catecholamine release levels are also depending on the level of the injury. For induction of anesthesia in

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spinal cord injury patients, it must be kept in mind that hypotension period during depth of anesthesia maintenance at the intubation may lead to a decrease in cord perfusion.

### **INTRAOPERATIVE NEUROMONITORIZATION:**

In patients whom intraoperative motorization is planned, because cortical evoked potentials are affected from anesthesia agents especially from inhalation anesthetics best choice for anesthesia is total intra-venous anesthesia (TIVA). Simultaneous use of SSEP (Somato-sensory evoked potential) and MEP (Motor evoked potential) are more efficient and safe (6). Muscle relaxants due to their effect on inhibiting muscle response, should not be administered in repetitive doses after the induction.

### **AIRWAY:**

It must be kept in mind that all high energy traumas might result in spinal injury. It is important to consider cervical trauma in patients with injury above clavicles. Golden standard for showing cervical bone damage is 3 way cervical vertebral x-rays. Even if the radiological imaging is normal, it must be kept in mind that there might be injury due to some other reasons. Complete neurological examination must be performed before anesthesia. Injuries above C5 level may accompany diaphragm paralysis and respiratory distress. Early airway control is a safe approach (10). Due to gastric atony, these patients must be considered as saturated patients and necessary precautions must be made to prevent aspiration. In the induction of anesthesia, use of succinyl choline as a muscle relaxant is not appropriate due to the risk of hyperkalemia and cardiac arrest in spinal injury patients.

If more than one vertebra were injured or there is collapse in more than 50% of the vertebral body it is considered as unstable vertebrae injury.

Maintenance of airway in SCI patients with stable vertebrae:

1. In patients whom direct laryngoscopy is expected to be easy, fast intubation after induction must be preferred.

2. In patients whom direct laryngoscopy is expected to be hard, awake fiber optic intubation must be planned.

Maintenance of airway in SCI patients with unstable vertebrae:

1. If direct laryngoscopy is possible without neck manipulation, fiber optic intubation under direct laryngoscopy with manual in-line stabilization (MILS) must be performed.

2. If direct laryngoscopy is not possible without neck manipulation, awake fiber optic intubation must be planned.

Manual in-line stabilization (MILS) is a safe technique in which one person stands at the head of the patients and with his fingers holds the mastoid protuberance while with his palms support neck and temporo-parietal region and another clinician performs intubation simultaneously (15).

Interventions including mask ventilation before intubation result in more mobilization in cervical vertebrae than direct laryngoscopy intubation.

In patients with thoracic fractures, whom anterior surgery is planned, selective bronchial intubation may be required.

### **BRADICARDY:**

Bradycardia is a result of cardiac sympathetic afferent loss and unmet vagal activity and can be treated with atropine. After acute SCI distinct bradycardia (<45 beats/min) is observed in 71% of the patients. In cases where no atropine response is observed, it must be kept in mind that temporal venous pacemaker might become necessary (10). Before anesthesia induction, in patients whom aspiration is needed application of sedation and 0.5 mg atropine iv., and procedure taking short time is very important. Under anesthesia, if aspiration is needed or patient must be positioned face down, in which injury is triggered serious bradycardia or even cardiac arrest might be observed.

### **HYPOTENSION AND SPINAL SHOCK:**

SCI below T6 hypotension is common, and bradycardia, hypotension, ventricular dysfunction and dysthymia is seen in injuries above T6. Spinal shock is most commonly seen in SCI patients with a level higher than C7. At the first stage of the injury, sympathetic activity is increased. Sympathetic denervation is seen in lesion above T6 and this period lasts for 8 weeks.

Episodic hypotension after acute SCI is seen in 68% of the cases, and need for vasopressor drugs are 35%. Continuous invasive blood pressure monitoring of the patients is important for deciding the intraoperative treatment scheme (11). Hypotension if develops, generally treated with fluid replacement but in cases that the volume load increases vasopressor use might be required to keep mean arterial pressure at 60-70 mmHg. Keeping pulmonary capillary occlusion pressure at 14-18 mmHg is sufficient for spinal cord perfusion. Vasopressor of choice should have

beta agonist properties. Blood deficit is sustained by the use of blood products (erythrocyte suspension or fresh frozen plasma).

After hypotension resulting from loss of vascular tonus due to sympathetic denervation, bleeding and spinal shock could be observed. This is more commonly observed with penetrating trauma (8). Intra-operative controlled hypotension for bleeding control must be approached with precaution because in SCI patients this method may deteriorate spinal cord perfusion.

### **STEROIDS:**

Methylprednisolone due to its effects on increasing spinal cord circulation and decreasing lipid peroxidation resulting in free radical formation can be administered 30 mg/kg bolus and 5.4 mg/kg/h infusion for 23 hours. Even though, when reviews in the literature are considered, in acute SCI application of methylprednisolone in the first 8 h may decrease spinal injury (2), most recent studies showed high doses of methylprednisolone might be harmful and should not be administered (9).

Spinal cord injuries may mask other organ injuries below the level of lesion (like abdominal injury), and this must always be considered (3).

In patients whom head injury accompanies SCI, intracranial pressure increase, pneumothorax and ARDS, heart contusion, tamponade, and intra-abdominal hemorrhage and hemorrhagic shock in patients with accompanying abdominal trauma, fat embolus in patients with accompanying extremity fractures and multiple fractures are the problems anesthetists face in multiple trauma patients (12).

It is well known that in those patients, thermoregulatory mechanisms may be disrupted due to autonomic dysreflexis. Continuous motorization must be performed during the maintenance of anesthesia in SCI patients (4).

### **CONCLUSION:**

It must be kept in mind that most important aim in the anesthesia of spinal cord injury patients is preventing secondary spinal damage. Patient's airway must be ensured as early and safely as possible, and patients must be surveyed hemodynamically normovolemic, normotensive, normothermic and normo-osmolar.

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# BIBLIOGRAPHY OF SPINE AND SPINAL CORD HEALTH AND DISEASE RELATED BOOKS PUBLISHED IN TURKISH

## TÜRKÇE BASILMIŞ OMURGA - OMURİLİK SAĞLIĞI VE HASTALIKLARI İLE İLGİLİ ESERLER BİBLİYOGRAFİSİ

Sait NADERİ<sup>1</sup>

### SUMMARY

Spine health is an important medicine field involving many disciplines. As in other disciplines, many manuscripts and books have been published in this field. The aim of this study is to review books written in this field in Turkish language. This study found out 77 books published since 1976. 24 of books were published for general readers, and 53 books were published for spine health professionals. 62 of books were original and 15 of the books were found to be translated version of books written in another language. The topic of books have been found to be different, the most common topics include low back and back pain in 29 books, lumbar disc herniation and spine trauma in 7 cases. It is concluded that this bibliography reveled the list of these books, and enlightened the future studies.

**Key words:** Bibliography, medical book, health of spine, spinal surgery

**Level of evidence:** Retrospective bibliographic study, Level III

### ÖZET

Omurga sağlığı birçok disiplini ilgilendiren bir sağlık alanıdır. Diğer sağlık alanlarında olduğu gibi, bu alanda da birçok makale ve kitap yazılmaktadır. Bu çalışmanın amacı ülkemizde omurga sağlığı ile ilgili yazılan kitapların bibliyografyasını yapmaktır. Çalışmamızda 1976'dan günümüze kadar 77 omurga sağlığı ile ilgili kitap saptanmıştır. Kitapların 24'ü genel okur ve hastalara dönük kitaplar olduğu, 53'ü ise omurga sağlığı profesyonellerine dönük olduğu anlaşılmaktadır. Eserlerin 62'sinin orijinal, 15'inin çeviri olduğu anlaşılmaktadır. Eserler konularına yönelik incelendiğinde, 29 eserle en çok bel-sırt ve boyun ağrısı ile ilgili eser yazıldığı, bu eserleri 7'şer eserle, lomber disk hernileri ve omurga-omurilik yaralanmaları izlediği belirlenmiştir. Sonuç olarak, bu bibliyografya çalışması ülkemizde eserlerin künyesini ortaya koyduğu gibi, ileriki çalışmalara ışık tutmaktadır.

**Anahtar Sözcükler:** bibliyografi, kitap, omurga sağlığı, omurga cerrahisi

**Kanıt Düzeyi:** Retrospektif bibliyografik çalışma, Düzey III

### INTRODUCTION:

Diagnosis and treatment of spinal diseases in Turkey continue since Ottoman times. In the work of Şerefeddin Sabuncuoğlu, *Cerrahiyetül Haniye*, there are illustrated sections on sciatica, lumbar pain, treatment of spinal trauma proving that it goes long way back (3,10,12),. 19.

Cemil Pasha's laminectomy and abscess drainage in 1893 is the first spinal intervention in the 19th century (2, 4, 9). After 1896, when x-ray devices started to serve patients in Ottoman Empire, diagnosis and treatment of spinal diseases gained speed (12). This can be observed from the articles published and presentations at the congress. Especially after 1920s

surgeons showed close interest to spinal disorders. In 1920s first spinal tumor and spinal fusion surgeries (1,9), in 1940s lumbar discectomies (11) and lumbar spinal canal stenosis surgeries (8), and in 1960s cervical discectomy (11) and Harrington surgeries become achievable (6-7). Despite all these developments, until 1970s not a single book was published on spine health. And in 1970s and 1980s only one work per decade was published.

In 1990s, orthopaedic surgeons and neurosurgeons showed more interest in spine surgery, and as a result many spine related books have been published. The aim of this study is to review spine related books published in Turkey.

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## MATERIALS AND METHODS:

Literature on spine health care published in Turkish in the last 50 years were examined bibliographically. Copyright page (title, author, editor and translator, publication address and press), distribution according to years, type (original, translation), target audience (general reader and patient, health care professionals) were reviewed.

## RESULTS:

Total of 77 publications on spine health was found. Distribution of the publications according to years is listed in Table-1, alphabetical distribution in Table-2 and author index is listed in Table-3.

When all 77 publications are taken into consideration 62 was original, 15 was translation. Publications with numbers 13,17,18,22,37,44,47,54,58,59,60,69,70,71 and 74 are translations.

Distribution of the publications according to the years is given in Table-4.

When publications are studied according to contents, 53 were intended for health care professionals like physicians, physiotherapists and nurses, 24 were intended for general population and patients.

Publications were investigated according to their subjects. 20 publications were about back and lower back pain, 7 publications were on lumbar disc herniation and spinal trauma groups separately (Table-5).

**Table-1.** Index of the publications according to years.

<b>1. Omurga Kireçlenmesi</b>
Necdet Tuna, İstanbul, 1976, Şekerbank Kültür Serisi, 57 s.
<b>2. Craniocervical ve vertebral anomaliler.</b>
Editör: Erdoğan Cireli, İzmir, 1989, Ege Üniversitesi Tıp Fakültesi Dekanlığı Yayın Bürosu, 88 s.
<b>3. Omurga hastalıkları ve deformiteleri.</b>
Emin Alıcı, İzmir, 1991, Dokuz Eylül Üniversitesi Yayınları, 527 s.
<b>4. Bel ağrıları tanı ve tedavisi.</b>
Tülay Kудay, İstanbul, 1993, 52 Logos Yayıncılık, 73 s.
<b>5. Omurga sağlığıımız ve spor; Epidemiyolojiden sportif egzersizlere.</b>
Rasim Kale, İstanbul, 1993, Alaş Ofset, 116 s.
<b>6. Servikalspinal cerrahide komplikasyonlar.</b>
Cengiz Kудay, Emin Özyurt, İstanbul, 1994, Logos Yayıncılık, 160 s.
<b>7. Bel ağrısı okulu.</b>
Mehmet Arman, Ankara, 1994, Palme Yayıncılık, 88 s.
<b>8. Bel ağrısı sendromları.</b>
<b>Rene Cailliet</b>
Çev.: Necdet Tuna, İstanbul, 1994, Nobel Tıp Kitabevleri, 289 s.
<b>9. Bel ağrıları ve tedavi yöntemleri.</b>
Mehmet Arman, İstanbul, 1995, AD yayıncılık, 95 s.
<b>10. Omurga cerrahisi ve siz.</b>
Ümit Kipoğlu, İstanbul, 1996, Nobel Tıp Kitabevleri, 62 s.
<b>11. Bel fıtığı ve korunma yolları,</b>
1. Baskı, Ahmet Yıldızhan, İstanbul, 1997, Fatih yayıncılık, 142 s.
2. Baskı, İstanbul, 1998, Fatih yayıncılık, 111 s.
3. Baskı, İstanbul, Milli gazete yayıncılık, 1999, 111 s.
4. Baskı, İstanbul, Fatih yayıncılık, 1999, 111 s.
5. Baskı, İstanbul, Fatih yayıncılık, 2001, 143 s.
6. Baskı, Bel fıtığı ve korunma yolları. Bel sağlığı için 100 tavsiye, İstanbul, Fatih yayıncılık, 2002, 144 s.
7. Baskı, Bel fıtığı ve korunma yolları. Bel sağlığı için 100 tavsiye, İstanbul, Elit Kültür yayınları, 2007, 120 s.
<b>12. Omurilik ve Omurga cerrahisi.</b> 2 c., Ed.: Mehmet Zileli, Fahir Özer, 1. bs. İzmir, 1997, Saray Yayıncılık, 1111 s.
2. Baskı, İzmir, 98 2002, Meta Basım, 1870 s.

3. Baskı, (3 c.); İzmir, 2013, İntertıp Kitabevi, 1998.s.

**13. Omurga enstrümantasyonunun biyomekaniği.**

Edward Benzell, Çev.: Sait Naderi, Kemal Yücesoy, Serdar Özgen İstanbul, 1998, Marmara Üniversitesi Nörolojik Bilimler Enstitüsü Yayınları, 278 s.

**14. Spinal terminoloji.** Erhan Emel, Feyza Karagöz, İstanbul, 1998, Kayacan Firması, 43 s.

**15. Bel ağrıları.** Ed.: Turqut Göksoy, İstanbul, 1998, Eksen Matbaacılık, 300 s.

**16. Bel ağırlı hastalara öneriler.** Mehmet Zileli, İzmir, 1999, Ege Üniversitesi Matbaası, 32 s.

**17. Bel ağrısı; Bilmeniz gereken her şey.** Shelagh Masline, Çev.: Atay Eriş, İstanbul, 1999, Boyner 121 Holding Yayınları, 190 s.

**18. Sırt ve bel ağrıları,** Nelen Bridge, Çev.: Semih Aydın, İstanbul, 1999, Alkım Kitabevi, 131 s.

**19. Lomber disk hastalığı.** Ed.: Fahir Özer, İstanbul, 2000, Logos Yayıncılık, 438 s.

**20. Biyomekanik.** Ed.: Murat Hancı, Ergün Bozdağ, Alaeddin Arpacı: İstanbul, 2000, Logos Tıp Yayıncılığı, 328 s.

**21. Medullaspinalis yaralanmaları.** Ed.: Murat Hancı, Önder Aydıngöz İstanbul, 2000, Logos Tıp Yayıncılığı, 526 S.

**22. Baş ve boyun ağrısı sendromları; Klinik, tanı medikal ve fizik tedavi.** Walter Paulus, Peter Schöps, Çev.: Zahide Demirel Eroğlu, İstanbul, 2000, Yüce Yayınları, 314 s.

**23. Bel ağrıları; Radiküler ve psöдорadiküler sendromları.** Necdet Tuna, İstanbul, 2000, Nobel Tıp Kitapevleri, 127 s.

**24. Bel ağrısı.** Ed.: Yeşim Gökçe-Kutsal, Ankara, 2000, Güneş Kitabevi, 133 s.

**25. Lomber disk hernileri.** Ülkü Akarırmak, Hidayet Sarı, İstanbul, 2001, Roche İlaçları, 169 s.

**26. Boyun Ağrılı Hastalara Öneriler.** Mehmet Zileli, İzmir, 2001, Ege Üniversitesi Matbaası, 28 s.

**27. Spina bífida tedavi ve rehabilitasyon.** Ed.: Nadire Özasar, Selim Yalçın, İstanbul, 2001, Avrupa Tıp Kitapçılık, 131 s.

**28. Spinal enfeksiyonlar.** Ed.: Selçuk Palaoğlu, İzmir, 2001, Türk Nöroşirürji Derneği Spinal Cerrahi 167 Grubu Yayınları, 284 s.

**29. Spinal tümörler.** Ed.: Fahir Özer, İstanbul, 2001, Logos Yayıncılık, 703 s.

**30. Lomber disk hernileri.** Hakan Kayalı, Serdar Kahraman, Sait Şirin, Altay Bedük, Erdener Tinürkaynak, Ankara, 2002, GATA Yayınları, 40 s.

**31. Omurilik yaralanması ile yaşamak.** Hatice Kaya, İstanbul, 2002, Evde Bakım Derneği Yayınları, 49 s.

**32. Postoperatif lomber spondilodiskit.** Murat Hancı İstanbul, 2002, Logos yayıncılık, 72 s.

**33. Servikobrakialjilerde ayırıcı tanı; Baş boyun bel ağrıları.** Aksel Siva, Murat Hancı, İstanbul, 2002, İÜ. Cerrahpaşa Tıp Fakültesi Yayınları, 239 s.

**34. Spinal füzyon.** Ed.: Selçuk Palaoğlu, İzmir, 2002, Türk Nöroşirürji Derneği Spinal Cerrahi Grubu yayınları, 375 s.

**35. Spinal biyomekaniğin temelleri.** Ed.: Sait Naderi, İzmir, 2003, Türk Nöroşirürji Derneği Spinal Cerrahi Grubu Yayınları, 410 s.

**36. Bel okulu;** Hastalar için el kitabı. Turqut Göksoy, İstanbul, 2003, İlaç Firması Yayınları, 72 s.

**37. Omurga; En sık 100 tanı.** Michael Brant - Zawadzki, Çev.: Levent Altın, Elif Rayegan Koç, İstanbul, 2003, Nobel Tıp Kitabevleri, 301 s.

**38. Bel ağrısı; Anlama ve koruma. Oğuz Kanbir, İstanbul, 2004, Ekin Basım Yayın, 308 s.**

**39. Dejeneratif disk hastalığı.** Ed.: Fahir Özer, Sait Naderi, İzmir, 2004, Türk Nöroşirürji Derneği Spinal Cerrahi Grubu Yayınları, 320 s.

**40. Spinal enstrümantasyon.** Ed.: Sait Naderi, Ankara, 2004, Türk Nöroşirürji Derneği Spinal Cerrahi Grubu Yayınları, 510 s.

**41. Bel ağrısı hakkında öğrenmek istedikleriniz.** Emel Özcan, İstanbul, 2004, Yelken Basım Yayın, 48 s.

**42. Omurilik yaralanmaları; Hastalarda nörojenik mesane disfonksiyonlarına multidisipliner yaklaşım.** Yeşim Akkoç, İzmir, 2005, Ege Üniversitesi Yayınları, 165 s.

**43. Bel ve sırt ağrıları.** Yeşim Kirazlı, İstanbul, 2005, Boyut Yayınları, 96 s.

**44. Sırt ağrısı.** Malcolm Jayson Çev.: Alp Aker, İstanbul, 2005, Morpa Kültür Yayınları, 68 s.

**45. Omurga enfeksiyonları.** Teoman Benli, Ankara, 2006, Türk Omurga Derneği Yayınları, 599 s.

**46. Omurilik yaralanmalarında rehabilitasyon hemşireliği.** Mediha Gürgöze İstanbul, 2006, Nobel Kitabevi, 342 s.

**47. Sırt ve bel ağrılarını iyileştirmek.** John E. Sarno Çev.: Işıl Aydın, İstanbul, 2006, GOA Basım Yayın, 192 s.

**48. Dejeneratif omurga hastalıkları.** Ed.: Tarık Yazar, Necdet Altun, Ankara, 2007, Türk Omurga Derneği, 866 s.

**49. Bel ağrılarında tanı ve tedavi.** Turqut Göksoy, İstanbul, 2007, Bilimsel Medikal Yayıncılık, 378 s.

**50. Doksandokuz sayfada bel fıtığı ve bel ağrısı.** Emel Özcan, İstanbul, 2007, Türkiye İş Bankası Kültür Yayınları, 99 s.

**51. Mekanik bel ağrıları.** Ed.: Fikret Tüzün, Haluk Aksoy, İstanbul, 2007, Bilim ilaç, 64 s.

**52. Tanıdan tedaviye bel ağrıları.** Ed.: Ömer Faruk Şendur, İstanbul, 2007, Akademi Uluslararası Yayıncılık, 251 s.

**53. Lomber dejeneratif disk hastalığı.** Ed.: Kemal Koç, Ankara, 2008, Türk Nöroşirürji Derneği Yayınları, 540 s.

**54. Bel ağrısıyla nasıl başa çıkabilirsiniz.** Jeffrey NM. Katz, Gloria Parkinson Çev.: Özlem Tüzel Akal, İstanbul, 2008, Acıbadem Yayınları, 240 s.

55. **Omurga cerrahisinde damar yaralanmaları.** Murat Hancı İstanbul, 2009, Nobel Tıp Kitabevleri, 95 s.
56. **Servikaldejeneratif disk hastalığı ve üst ekstremitte tuzak nöropatileri.** Ed.: Kemal Koç, Ankara, 2009, Türk Nöroşirürji Derneği, 438 s.
57. **Başa(ğ)ırsız bel cerrahisi.** Murat Hancı, İstanbul, 2010, Nobel Tıp Kitabevleri, 159 s.
58. **Minimal invaziv omurga cerrahisi uygulamaları.** Ed.: Martin H. Savitz, John C. Chiu, Wolfgang Rauschning, Anthony T. Yeung Çev. Ed.: Tolgay Satana Ankara, 2010, Güneş Tıp Kitabevi, 728 s.
59. **Bel ağrısı. Ziya L. Gökaslan, Lee HunterRiley** Çev.: Özlem Tüzel Akal İstanbul, 2010, Anadolu Sağlık Merkezi Yayınları, 162 s.
60. **Alexander tekniğiyle bel ağrısının üstesinden gelin.** Richard Crase, Çev.: Özlem Tüzel Akal, İstanbul, 2011, Optimist Yayın Dağıtım, 192 s.
61. **Bel Ağrısı; Anlama – Korunma – Tedavi.** Oğuz Kanbir İstanbul, 2011, Seçkin Yayıncılık, 280 s.
62. **Omurga cerrahisinde komplikasyonlar ve revizyon.** Ed.: Alpaslan Şenel, Süleyman Çaylı, Sedat Dalbayrak, Cüneyt Temiz, Ali Arslantaş Ankara, 2010, Türk Nöroşirürji Derneği Spinal ve Periferik Sinir Cerrahisi Eğitim ve Öğretim Grubu Yayınları, 352 s.
63. **Lomberdejeneratif disk hastalığı ve dinamik stabilizasyon.** Ed: Fahir Özer İstanbul, 2011, Amerikan Hastanesi Yayınları, 334 s.
64. **Omurga travmalarında tedavi prensipleri.** Ed.: Alpaslan Şenel, Süleyman Çaylı, Sedat Dalbayrak, Cüneyt Temiz, Ali Arslantaş Ankara, 2011, Türk Nöroşirürji Derneği Spinal ve Periferik Sinir Cerrahisi Öğretim ve Eğitim Grubu Yayınları, 340 s.
65. **Minimal invaziv omurga cerrahisi.** Ed.: Ali Arslantaş, Sedat Dalbayrak, Serkan Şimşek, Cumhur Kılınçer, Ankara, 2012, TND Spinal ve Periferik Sinir Cerrahisi Grubu Yayınları, 482 s.
66. **Omurga 328 omurilik yaralanmaları.** Murat Hancı, Belçin Erhan Ankara, 2012, Güneş Kitabevi, 240 s.
67. **Omurga ve omurilik yaralanmaları.** Ed.: Murat Hancı, Sedat Çağlı, Ankara, 2012, Türk Nöroşirürji Derneği, 288 s.
68. **Omurga ve omurilik yaralanmalarında görüntüleme.** Ed.: Murat Hancı, Antalya, 2012, İntertıp Yayınevi, 759 s.
69. **Spinal cerrahi pratik cerrahi noktalar.** Ed: A.R. Vaccaro, TJ Albert Çev. Ed.: Serdar Kahraman, Ankara, 2012, Güneş Kitabevi, 298 s.
70. **Expert DDX beyin ve omurga.** Anne G. Osborn, Jeffrey S. Ross, Karen L. Salzmann. Çev.: Civan Işlak, Osman Kızılkılıç, Ankara, 2012, Rotatıp Kitabevi, 1000 s.
71. **Skolyozun üç boyutlu tedavisi.** ChristaLehnert-351 Schroth Çev.: Gülseren Kayalar, 2013, Pelikan Yayıncılık, 272 s.
72. **Spinabifida eğitim programı.** Resa Aydın İstanbul, 2014, İ.Ü. Fiziksel Tıp ve Rahabilitasyon Anabilim Dalı Yayını, 31 s.
73. **Bel ağrısı.** Serdar Erdine, İstanbul, yayın yılı belirtilmemiş, Roche, 39 S.
74. **Nöroşirürji teknikleri atlası; Omurga ve periferik sinirler.** Richard GlennFessler, LaligamSekhar Çev. Ed.: Ahmet Çolak, Ankara, 2014, Habitat Yayıncılık, 600 s.
75. **Omurga biyomekaniği.** Ed.: Murat Hancı Antalya, 2014, İntertıp Yayınevi, 53 s.
76. **Omurganın cerrahi anatomisi.** Hüseyin İçeroğlu, Murat Hancı, Antalya, 2014, İntertıp Yayınevi, 102 s.
77. **Spinalenstrümantasyon teknikleri.** Editörler: Erkan Kaptanoğlu, Emre Acaroğlu, Antalya, 2014, İntertıp Yayınevi, 385 s.

Table-2. Alphabetic list of the publications.

<b>Overcome lumbar pain by Alexandria technique: 60</b>	<b>Low back pain syndromes: 8</b>
<b>Head and neck pain syndromes; Clinic, diagnosis, medical and physical treatment: 22</b>	<b>How can you deal with back pain: 54</b>
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<b>Lumbar pain: Understanding, prevention and treatment: 61</b>	<b>Lumbar degenerative disc disease and dynamic stabilization: 63</b>
<b>Everything you want to learn about lumbar pain: 41</b>	<b>Lumbar disc disease. : 19</b>
<b>Lumbar pain; everything you should know: 17</b>	<b>Lumbar disc herniation: 25</b>
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<b>Spinal cord injuries: 21</b>
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<b>Complications and revision spine surgery: 62</b>
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<b>Arthritis of the Spine: 1</b>
<b>Spine diseases and deformities: 3</b>
<b>Surgical anatomy of the spine: 76</b>
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<b>Spinal cord injuries: 66</b>
<b>Backbone of our health and fitness; Epidemiology from the sporty workout: 5</b>
<b>Principles of treatment of spinal trauma: 64</b>
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<b>Spinal cord and spine surgery: 12</b>
<b>Spinal cord injuries; Multidisciplinary approach to patients with neurogenic bladder dysfunction: 42</b>

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**Table-4.** Distribution of publications on vertebra heals according to years.

<b>1971-1980</b>	<b>1</b>
<b>1981-1990</b>	<b>1</b>
<b>1991-2000</b>	<b>22</b>
<b>2001-2010</b>	<b>35</b>
<b>2010-2014</b>	<b>18</b>

**Table-5.** Distribution of the publications according to subjects

Degenerative disc disease	2
Congenital disease	3
Deformity	2
Lumbar-back and neck pain	29
Complication	4
Vertebrae-spinal diseases-general	2
Biomechanic	4
Terminology	1
LDH	7
Trauma	7
Infection	3
Tumor	1
SDH	2
Fusion	1
Instrumentation	1
Min. inv. Vertebrae surgery	2
Spinal imaging	2
Surgical technique	3
Vertebrae surgery anatomy	1

## DISCUSSION:

In this article, 77 publications on spine health in the last 50 years were reviewed. The reported high number of books does not belong to only medical or single surgical discipline. Our study showed that 24 of these publications were book, written for general reader and patients, while 53 targeted physicians, physiotherapists and nurses.

Publications targeting health care professionals were either for a single discipline or multidisciplinary. When the contents of the publications were analyzed, the highest number of publications (29) were on lumbar-back and cervical pain, and the most of the publications in this group was targeted to general population and patients. This study also revealed that many different disciplines published spine related books.

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**CME QUESTIONS / STE SORULARI**

**1- What kind of specimen was used in the biomechanical test machine in the study of Karakaşlı et. al.?**

- a) Pig
- b) Cow
- c) Lamp
- d) Rabbit
- e) Dog

**2- Which sentence of the below is incorrect according to the study of Karakaşlı et al?**

- a) The displacement values of hemilaminectomy and total discectomized spine specimens were similar to studies in the literature.
- b) The displacement values of hemilaminectomy discectomized spines were closer to the values of intact specimens.
- c) Comparing both groups, displacement values of extension and left-bending positions were similar.
- d) After a total discectomy, a reduction in annulus fibrosis tension caused laxity at the mobile spine segment.
- e) Increased mobilization caused instability at the spine mobile segment.

**3- How many patients were included in the first study of Düzkalır et al?**

- a) 76
- b) 86
- c) 96
- d) 106
- e) 116

**4- Which one of the below was investigated the correlation with lumbosacral angles in the second study of Düzkalır et al?**

- a) Height
- b) Spinal deformity
- c) Weight
- d) Age
- e) Physical activity

**5- Which one of the below measurement is not evaluated with CT according to the study of Balioğlu et al?**

- a) Basion-axis interval (BAI)
- b) Basion-dens interval (BDI)
- c) Atlanto-occipital interval (AOI)
- d) Cervical lordosis (CL)
- e) posterior atlantodental interval (PADI)

**6- What did it find about comparison with pre and postoperative spinopelvic values in the study of Kaya et al statistically?**

- a) No difference in sacral slope
- b) Important difference in all values
- c) Low difference in thoracic inlet alignment
- d) Similar in all values
- e) No difference in pelvic incidence angle

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**7- Which pain score was used in the first study of Süslü *et al.***

- a) SRS22
- b) SRS24
- c) VAS
- d) JOA
- e) SF-32

**8- Which one of the below is incorrect according to the results of the first study of Süslü *et al.*?**

- a) Fluoroscopy allowed the development of injection procedures.
- b) The analyses revealed that all VAS scores were similar between males and females.
- c) If complications develops after CTSI, a preprocedure MRI is very helpful to compare to a new MRI for any changes.
- d) No complication was seen in their study
- e) CTSI may be recommended to the patients whom have failed previous pharmacotherapy, physical therapy and also not be eligible for surgery.

**9- Could epiduroscopy an option as a final step of pain management for FBSS before palliative procedures, such as spinal cord stimulation or intrathecal drug delivery according to the second study of Süslü *et al.*?**

- a) No effective
- b) Less effective
- c) Final step
- d) More effective
- e) Contraindicated

**10- Which period was analyzed according to the study of Naderi and Naderi?**

- a) Between 2004 and 2008
- b) Between 2008 and 2012
- c) Between 2012 and 2014
- d) Between 2000 and 2012
- e) Between 2008 and 2015

**JTSS 25(4) issue CORRECT ANSWERS  
OF CME QUESTIONS:**

- 1. d
- 2. d
- 3. b
- 4. d
- 5. b
- 6. b
- 7. b
- 8. c
- 9. a
- 10.d

ANNOUNCEMENTS / DUYURULAR



# MARMARA OMURGA GRUBU TOPLANTILARI

**15 Nisan 2013 - Çarşamba, Saat: 19.00 / Yer: Amerikan Hastanesi, Nişantaşı / İstanbul**

*"TLISS Torakolomber vertebra kırıkları tedavisini değiştirdi mi?"*

*"Evet, değiştirdi."* Dr. Onat ÜZÜMCÜGİL

*"Hayır, değiştirmede."* Dr. Turgut AKGÜL

*"İnteraktif Tartışma"*

Tartışmacılar: Dr. Emre KETENCİ, Dr. Deniz KARGIN, Hilmi KARADENİZ, Serhat YANIK

Moderatör: Dr. Cüneyt ŞAR

**10 Mayıs 2013 2013 - Çarşamba, Saat: 19.00 / Yer: Marmara Üniversitesi Tıp Fakültesi, Wyndham**

**Otel, Kalamış / İstanbul**

*"Transforaminal endoskopik disk cerrahisi"*

Dr. Murat BEZER

*"Minimal invazif TLIF"*

Dr. Çağrı KÖSE

Moderatör: Dr. Mehmet AYDOĞAN

## DÜZENLEME KURULU

Dr. Cüneyt ŞAR (Başkan)

Dr. İ. Teoman BENLİ

Dr. Mehmet TEZER

Dr. Murat BEZER

Dr. Şevki ERDEM

Dr. Mehmet AYDOĞAN

Dr. Çağatay ÖZTÜRK

Dr. Yunus ATICI (Sekreter)

\* Bu toplantılar Türk Ortopedi ve Travmatoloji Birliği Derneği (TOTBİD), Türk Omurga Derneği (TOD) tarafından desteklenmektedir.

