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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 katkılar sağlamaktır.

Türk Omurga Cerrahisi Dergisi, Türk Omurga Derneği'nin resmi yayın organıdır. Derginin amacı, Türk omurga cerrahlarının çalışmalarını ve literatürdeki yeni gelişmeleri yayınlayarak 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 sağlamaktadır. Reklâm bedelleri aktüel fiyatlara göre belirlenir. Dergi yayın 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 tasarıyı gösterir ve tasarı da hipotezi gösterir. Bir raporun etkililiği kısalık ve odak ile ilgilidir. Az noktaya dikkat çekmek yazarların kritik konulara odaklanmasını sağlar. Kısalık 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 ağdalı 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.

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 Alıcı 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 eyebands. 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,

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, welldesigned 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 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, 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 laboratuar 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 belirmelidirler.

Hastanın isminin ve bilgilerinin saklanması esastır. Hastanın kimliğinin dikkatli bir şekilde korunacağının 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 yasalar 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 yayınlanmış 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 İncelemenin 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 secimi, cerrahi müdahale secimi 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, teshisin veya tedavi seciminin az veya çok belirli değerlendirilmesine engel olan literatürdeki boşluklarla ilgili olacaktır. Literatürdeki çelişmeler kısaca araştırılmalıdır. Okuyucu sadece sınırlamaları araştırarak literatürü perspektife oturtur. Yazarlar "Tartışma" bölümünü, "Özet" bölümünün sonunda kısa haliyle verilecek olmasına benzer şekilde özet ifadeler ile bitirmelidir.

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.

- **Orjinal 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 olacaklardır. Ayrıca "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 almalıdır. 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 girişi 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, metotları, 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 gerekceleri 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 sonucları raporlayan arastırmacılar tek bir açıklamaya bağlı kalmamalıdır.

Gerçekten yeni materyallerin olduğu ender istisnalarla birlikte, yazarlar gerekçeler öne sürerken temsili literatüre referans vermelidir. Bu gerekçeler yenilik ve soruların geçerliliğini kurar ve literatüre yerleştirir. Yazarlar öncülleri ilgili aktarmalar ile sade bir sekilde belirtmeli ve alıntılar ile yazarlarının isimlerini tanımlamaktan kaçınmalıdır. Bu yaklaşımdaki istisnalar yeni bir metot için gerekçe geliştirmekte gerekli olduğunda geçmiş metotların tanımını, veya geçmiş örnek oluştururken önemli olduğunda yazarların isimlerine ithafı içerir. Alıntıların açıklamaları uygun görülürse Tartışma bölümünde takip edebilir. Bir gerekce 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 epidemiyolojik, demografik bilgileri, klinik ve radyolojik çalışmaları, cerrahi teknik, sonuçların değerlendirme metodu ve istatistik çalışmalar bu bölümde ayrıntılı olarak belirtilmelidir.

Prensip olarak "Materyal ve Metot"lar çalışmayı tekrarlamak 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 yayınlanmıştır ve ayrıca uzun tanımlar okumayı zorlaştırır. Bununla beraber, Materyaller ve Metotlar bölümü tipik olarak en uzun bölümdür.

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

Başlangıcta okur temel çalışma taşarışını görmelidir. Yazarlar daha önce raporlanmış metotları sadece kısa bir şekilde tarif etmeli ve atıfta bulunmalıdır. Yazarlar bu metotları değiştirdiğinde bu değişiklikler ilave açıklama gerektirir. Klinik çalışmalarda hasta sayısı ve demografisi başta belirtilmelidir. Klinik çalışmalar dahil olan ve hariç olan kriterleri, serilerin ardıl mı veya seçilmiş mi olduğunu; seçilmişse seçimde rol oynayan kriterleri belirtmelidir. Okuyucu bu tanımdan yargının tüm potansiyel kaynaklarını, teşhisi, istisnayı, tekrarı veya tedavi fikrini anlamalıdır. Temel olarak gelecek çalısmalar 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 geçmişe dayalı çalışmalar mevcut olan bilgilerin çoğunu sunar. Bununla beraber yazarlar takipte kayıp, zorluklar, eksik veri ve geçmişe dayalı çalışmalarda yaygın olan çeşitli fikir formları gibi potansiyel problemleri tanımlamalıdır.

Yazarlar istatistiksel analiz kullanırsa, Materyaller ve Metotlar bölümünün sonunda kullanılan tüm istatistiksel testleri belirten bir paragraf yer almalıdır. Birden fazla test kullanıldıysa yazarlar hangi testlerin hangi veri seti için kullanıldığını belirtmelidir. Tüm istatistiksel testler varsayımlar ile ilişkilidir, verilerin bu varsayımları karşılayacağı açıkça görülmezse yazarlar ya destekleyici verileri sunmalıdır yada alternatif testler kullanmalıdır. Önem seviyesi seçimi kanıtlanmalıdır. 0,05'lik alfa ve 0,80'lik beta seviyesi seçilmesi yaygın olmasına rağmen bu seviyeler bir şekilde isteğe bağlıdır ve her zaman uygun değildir. Bir hata çıkarımının ciddi olduğu durumda, klinik veya biyolojik önemi değerlendirmek için çalışma tasarısında farklı alfa ve beta seviyeleri seçilebilir. - **Sonuçlar (250-750 kelime):** "Sonuçlar" mümkün olduğunca anlaşılır ve özet belirtilmeli, ayrıntılı sonuçlar tablolarda verilmelidir. Okuyucunun daha iyi anlayabilmesi için sonuçlar bölümü alt başlıklarla bölünebilir.

Sorular veya konulara "Giriş" bölümünde yeterli şekilde odaklanıldıysa, "Sonuçlar" bölümünün uzun olması gerekmez. Genelde okuyucuyu metotların geçerliliğine ikna etmek için bir veya iki paragrafa ihtiyaç duyulur, açıkçaortaya konan her soru veya hipotezi anlatan bir paragrafve son olarak yeni ve beklenmeyen bulguları raporlayan paragraflar. Her paragrafın ilk (konu) cümlesi konuyu belirtmeli veya soruyu yanıtlamalıdır. Okuyucu "Sonuçlar" bölümündeki her paragrafın sadece ilk cümlesini göz önüne aldığında, yazarın çıkarımlarının mantığı açık olmalıdır. Tüm rakam ve tablolara yapılan parantez içi ithaflar, yazarı verilerin 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 karşılaştırmalı 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 olmadığını 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 konusunda daha iyi fikir verecektir.

- Tartışma (750-1250 kelime) : Tartışma bölümü spesifik unsurlar içermelidir: bunun için problem veya sorunun tekrar belirtilmesi, sınırlamalar ve varsayımların araştırılması, literatürdeki bilgiler ile bir karşılaştırma, karşılaştırmanın bir sentezi ile sonuca ulaşmak gereklidir. Problem veya sorunun yeniden belirtilmesinin vurgu amacıyla kısa olması gerekmektedir. Bunun sonrasında varsayımların ve sınırlamaların verilmelidir. Sınırlamaları araştırmadaki başarısızlık, 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 gerekceleri icerecektir. Verilen bir çalışmanın özellikleri nedeniyle, 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 sekilde 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 kullanmalıdır. 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:

Dergiden Makale:

1. Berk H, Akçalı Ö, Kıter 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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2. Wedge JH, Kirkaldy-Willis WH, Kinnard P. Lumbar spinal stenosis. Chapter 5. In: Disorders of the lumbar spine. Eds.: Helfet AJ, Grubel DM, JB Llippincott, Philadelphia 1978, pp: 61-68.

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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.

Kitap ve Cilt No:

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, Philadelphia1984, pp: 987-1092.

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

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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. St. Louis, CV Mosby, 1972, pp : 186-201.

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 anlatılmamalıdır. 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 isaretini 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 St yle 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 altyazıyla 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 cümlenin 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)

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 çalışmanın 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.

 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 yayınını 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 alındılanır. 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, yazışmayı 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

 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-l 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

 Zayıf referans aralığı olan istatistiksel önemlilik verileri yapılmayan vaka serileri

DÜZEY – V.

 Uzman görüşü
 Bir çalışma hakkında kişisel deneyimlerin aktarıldığı bilimsel dayanağı olmaksızın bildiren görüş yazıları Makale Anatomi Temel Bilimler **Biyomekanik** Deformite Skolvoz Adölesan idiopatik Kifoz Konienital Dejeneratif Tanısal yöntemler Epidemioloii Fizik Tedavi Fonksivon Halk sağlığı Literatür gözden geçirme Meta-Analiz İş sağlığı Sonuçlar Tedavi Konservatif tedavi Primer tedavi Yasam kalitesi Tedavi etkinliği Pediatrik Rehabilitasyon Cerrahi Klinik cerrahi Disk cerrahisi Nöroşirurji Rekonstriksiyon cerrahisi görüntüleme rehberliğinde cerrahi endoskopi Başarısız omurga cerrahisi Mikrocerrahi BT yardımıyla Minimal invazif Görüntüleme Radyoloji MRI ΒT Füzvon Füzyon kafesleri Enstrümantasyon Pedikül vidası Fiksasyon Ağrı Kronik ağrı Bel ağrısı Postoperatif ağrı Ağrı ölçülü Boyun ağrısı Diskojenik ağrı Nöroloii Nörofizyoloji Nörolojik muayene Nörokimya

Nöropatoloji

hastalıkları

Kognitif nöroloji Nöromusküler omurga

TABLO-2. KLİNİK ALANLAR

Servikal omurga Servikal miyolopati Servikal rekonstrüksiyon Servikal disk hastalığı whiplash Kraniyoservikal bileşke Atlantoaksiyel Torasik omurga Torakolomber omurga Lomber omurga Lumbosakral bileşke Psikoloii Sinir Sinir kökü Siyatik Enjeksiyon Epidural Diğer Hastalık Metabolik kemik hastalıkları Epilepsi Lupus Kanser Parkinson Tüberküloz Romatoloji Artrit Osteoporoz Kemik Kemik dansitesi Kemik biyomekaniği Kemik rejenerasyonu Kemik grefti Greft ürünleri Kırık Disk Disk dejenerasyonu Herniye disk Disk patolojisi Disk replasmanı Artifisial disk IDET Travma Spinal kord Spinal kord yaralanması Klinik eğilimler Randomize çalışmalar Biyoloji Biyokimya Moleküler bivoloji Tümör Genetik Stenoz Enfeksiyon Non-Operatif Tedavi Hareket Analizi Fizik Tedavi Manüplasyon Anestezi

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 multidisiplinary 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 guality of a report depends on the quality of thought in the design and the rigor of conduct of the research. Well-posed guestions 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 guestions 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

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 "Bisphosponates 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 seientific 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 ofsections, perhaps the most critical. The Introduction must effectively state the issues and formulate the rationale for those issues or questions. Its organization might differ some what 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 emphasizet 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 techniqueapplied; 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 shouldgrasp the basic study design. Authors should only brieflyd escribe 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 understandrom 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, 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. Parenthetic 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 readermay ask). Additionally, avoiding the terms 'statistically different' or 'sgnificantly 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 atconclusions. 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 alwayscontains 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 anargument. 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 arenot 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

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 wellaccepted 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, bookand other reference styles:

Journal article:

1. Berk H, Akçalı Ö, Kıter 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 f

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.

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

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- 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 of figure is either subject or object of a sentence. Parenthetic reference places emphasison interpretation of the information in the table or figure, and not the table or figure.

7. Regularly count words from the Introduction through Discussion.

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.

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Signature Printed Name	Date

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 ignificance for consecutive subjects are based on predefined criteria and a comparison with universal (gold standard) reference is performed

 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

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

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EDITORIAL / EDİTÖRDEN

Dear Colleagues,

We sincerely wish the new education session of 2015-2016 brings peace, happiness and health to all my colleagues and their families. We are happy to accomplish the fourth issue of 2015.

There are 4 research articles in this issue. The first article is the experimental animal study analyzing for results of the effects of etofenamate and methylprednisolone on spinal cord injury of 31 male Wistar-Albino rats. The second study are about themorphometric anaysis of the disc space. The radiological evaluation and comparison of the brusellosis and tuberculosis spondylitis is discussing in third article. In the forth study, the results of low back pain management were presented. That article is from the azeribajyan. We believe that all those studies will quietly interest the readers.

There are also one case reports in this issue which is neurologic deficit secondary to cement leakage during percutaneous vertebroplasty in multiple myeloma patient.

There are two reviews in this issue. The first one is the complications of anterior cervical spine surgery. Second one is about the adult scoliosis. Both of them are quiet comprehensive and informative reviews.

In this issue, in the "Frontiers of the Spinal Surgery" section, the biography was presented about the Prof. Jurgen Harms. The authors of the this article are Prof. İ. Teoman Benli, M.D. and Emre Karadeniz, M.D.

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 Assoc. Prof. Dr. Mehmet Aydoğan will perform the headship this year and 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 TOTBID TOTEK for recertification in this issue. The answers of the questions included in this issue should be sent to cutku@ada.net.tr or 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 TOTBID 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

EFFECTS OF ETOFENAMATE AND METHYLPREDNISOLONE ON SPINAL CORD INJURY

ETOFENAMATE VE METHYLPREDNİSOLONE' UN OMURİLİK HASARINA ETKİSİ

Burak KAZANCI¹, Uygur ER², Hakan SABUNCUOGLU³, Bülent GÜÇLÜ⁴

SUMMARY

This study evaluates the effects of etofenamate on secondary damage following a spinal cord injury and compares the effects with those of methylprednisolone. A total of 31 male Wistar-Albino rats were used. A weight-drop model was utilized for the experimental spinal cord injury and a 50g-cm impact was applied on the spinal cord. Rats were randomly assigned to one of the three study arms (saline, etofenamate 20 mg/kg, methylprednisolone 30 mg/kg). At the sixth hour of injury electrophysiological evaluations were conducted under anesthesia, and then rats were sacrificed for histopathology. Hematoxylin and eosin staining were applied to the specimens and evaluated under light microscopy. Etofenamate revealed more beneficial results in histopathological evaluations when compared with methylprednisolone, but these favorable results have not been confirmed by electrophysiological measurements. Etofenamate may be a promising agent in the medical treatment of spinal cord injury.

Keywords: Etofenamate, methylprednisolone, spinal cord injury, anti-inflammatory

Level of Evidence: Level II, Experimental clinical study

INTRODUCTION:

Spinal cord injury (SCI) is an untreatable traumatic condition that predominantly affects young males mostly in the second and third decades of life with an increasing annual incidence of 15-40 cases per million (16,39). Lifelong treatment and rehabilitation needs of patients along with the social and psychological problems constitute a major burden on both families and healthcare systems (16).

The pathophysiology of SCI has two main stages (31). The initial primary mechanical trauma results in deterioration of vasculature and cellular membranes of the spinal cord and edema (10,37). These lesions are followed by biochemical and metabolic consequences of primary injury that are called secondary

ÖZET

Bu çalışma omurilik hasarını izleyen ikincil olaylar üzerine etofenamate' ın etkisini değerlendirmek ve bu etkiyi metilprednizolon etkisi ile karşılaştırmak amacıyla yapılmıştır. Toplam 31 erkek Wistar-Albino sıçan kullanılmıştır. 50g-cm etkili ağırlık düşürme modeli deneysel omurilik hasarı oluşturmak için kullanılmıştır. Sıçanlar üç çalışma koluna randomize olarak ayrılmışlardır (saline, etofenamate 20 mg/kg, metilprednizolon 30 mg/kg). Hasarın 6.saatinde anestezi altında elektrofizyolojik değerlendirme yapılmış ve sonra histopatolojik inceleme için sıçanlar feda edilmiştir. Hematoksilin-eozin boyaması ile ışık mikroskopu altında değerlendirilmiştir. Etofenamate, metilprednizolon ile karşılaştırıldığında histopatolojik olarak daha faydalı bulunmuştur, fakat bu durum elektrofizyolojik olarak doğrulanamamıştır. Etofenamate omurilik hasarının tedavisinde ümit verici olabili**r.**

Anahtar sözcükler: Etofenamat, metilprednizolon, omurilik hasarı, antienflamatuvar

Kanıt Düzeyi: Deneysel çalışma, Düzey II

degenerative processes and include microvascular lesions, intracellular calcium increase, inflammation, electrolyte imbalance, lipid peroxidation, free radical formation, excitotoxicity by glutamate and apoptosis (10,15,23,26,29,38). The secondary processes begin immediately after primary damage and may last for several weeks to expand the area of destruction proportional to the impact of the primary traumatic injury (38).

The events in secondary processes are a chain in a continuum that trigger each other. When the integrity of the spinal vasculature has deteriorated, the occurring microhemorrhages cause accumulation of vaso-active amines and hypoxia (33,42). Subsequent neuronal injury is related to the release of excess amounts of glutamate which results in calcium influx into the

¹ MD, Assistant Professor of Neurosurgery, Neurosurgery Department, Dr Ridvan Ege Hospital, Medical School of Ufuk University, Ankara.

² MD, Professor of Neurosurgery, Neurosurgery Department, Research and Training Hospital, Medical School, Duzce University, Duzce.

³ MD, Associated Professor of Neurosurgery, Neurosurgery Department, Dr Ridvan Ege Hospital, Medical School of Ufuk University, Ankara.

⁴ MD, Associated Professor of Neurosurgery, Neurosurgery Department, Kartal Research and Training Hospital, Istanbul.

neurons and activation of ryanodine receptors in endoplasmic reticulum to release additional intracellular calcium that activates the apoptotic pathways (2,13,15,26-27,29,33,35,37). Another leg of the events during these steps is inflammation. The blood-brain barrier permits the migration of neutrophils and macrophages to the injury field for the clearance of debris, but meanwhile these cells release proteases and free oxygen radicals causing neuronal death by membrane damage (25).

Current medical treatments of SCIs aim to protect the neuronal structures against the secondary mechanisms of injury (17-18). The most comprehensively evaluated pharmacological agent is methylprednisolone. Early application of this agent on experimental animal SCI models has produced beneficial outcomes, but debates on its efficacy remain (1,11,32). This study aims in particular to evaluate the effects of etofenamate, a derivative of N-phenylanthranilic acid, which is an anti-inflammatory agent, by comparing the outcomes with methylprednisolone in an animal model of SCI. Etofenamate exerts its effects over inhibition of prostaglandin synthesis by inhibiting cyclooxygenase. Plasma half-life after parenteral administration is about two hours and urine half-lives vary from 15 to 24 hours (12). The hypothesis of this study is that etofenamate may be an option in the medical treatment of SCIs, depending on the long duration of effect in the organism and its anti-inflammatory properties.

MATERIAL AND METHODS

A total of 31 male Wistar-Albino rats of 220-270gr were included in three study arms randomly. After an experimental SCI in all rats, Group 1 (n=10) received 0.9% saline intraperitoneally (ip), Group 2 (n=11) received 20mg/kg etofenamate ip, and Group 3 (n=10) received 30mg/kg methylprednisolone ip.

Experimental SCI model:

A weight-drop model was used for SCI. After overnight fasting, and following a xylazine HCI (12 mg/ kg) and ketamine (75 mg/kg) anesthesia, a dorsal laminectomy was applied at T7-8 level. A 10gr pin at 0.3mm diameter was dropped directly on the spinal cord from a 5cm height (50 g.cm) through a tube. After the SCI, rats took the predetermined medications, or saline, in the study groups mentioned above.

Electrophysiological evaluations:

Spinal evoked potentials (SEP) and motor evoked potentials (MEP) were evaluated under xylazine and ketamine anesthesia at the postoperative sixth hour. For SEP measurements, an active electrode was placed close to the sciatic nerve between the major trochanter and the sciatic ischium, and a recording electrode was placed proximal (T5-6) and then distal (T9-10) to the trauma. The sciatic nerve was stimulated at submaximal level with 1Hz frequency. Stimulus time was 0.1 milliseconds and the stimulus was increased until apparent contraction in the left rear paw. Artifact rejection levels were 500µV and 50µV in distal and proximal trauma fields respectively, rejection initiation time was 2 milliseconds, stimulus type was single, stimulus repetition time was 2 pulsations per second, amplifier range was 2.5mV, filter was 3Hz-3kHz and sensitivity was 29µV for monitor and 5µV for store. A mean of 250 recordings was calculated for each subject, and the distances between the active electrodes and the stimulus electrode was recorded (mm). Qualitative evaluations of damaged potentials in posttraumatic SEP measurements were performed according to the modified scales of Zileli et al. (43) and Schramm et al. (28) Quantitative evaluations included latency (ms) and amplitude (μ V) measurements.

For the MEP recordings, a supramaximal stimulus was applied (maximum 100 mA, 1 ms) in proximal and distal trauma regions. An active electrode was placed on the gastrocnemius muscle and a reference electrode was placed on the Achilles tendon. Amplitude (mV), latency (ms), and velocity (distance between proximal and distal electrodes/negative peak latency difference; $\Delta X/\Delta L$; mm/ms) were calculated.

Histopathology:

Following the electrophysiological evaluations under anesthesia, rats were sacrificed, and approximately 2cm of spinal cord segment was dissected and fixed in 10% formalin solution. After the paraffin blocking, 4-6 micron sections were stained in hematoxylin-eosin and evaluated by light microscopy. A histopathologist, who was blinded to the intervention evaluated the specimens according to Ivan-Damjanov criteria, and reported the petechial hemorrhages, disseminated hemorrhages, grey and white matter patterns, edema, necrosis, and cystic degeneration (9,34).

Ethical statement:

The ethical committees of Ankara Diskapi Yildirim Beyazit Research and Training Hospital of Ministry of Health, and Veterinary Faculty of Ankara University approved this study.

Statistical Analysis:

Descriptive analysis for numerical variables was presented by mean and standard deviation. The quantitative measurements were compared by oneway analysis of variances (ANOVA), and the qualitative measurements were compared by Kruskal-Wallis
test between the study groups. SPSS for Windows 10.0.1 software was used for the analyses. A type I error of 5% was regarded as the level of statistical significance in the analyses.

RESULTS:

Electrophysiological findings:

Findings in the electrophysiological evaluations are presented in Table 1. The qualitative assessments of SEP findings according to Zileli et al. (43) and Schramm et al. (28) modified scales reveal that damage scores were lower in fields proximal to the trauma in all groups, but the differences regarding qualitative SEP evaluations in proximal and distal regions did not significantly differ between the study groups (p>0.05, for all). Nevertheless, in the proximal field evaluations, Group 3 had the most favorable results, and Group 2 had the lowest scores, and distal field evaluations revealed that groups were similar.

The quantitative SEP evaluations performed on the subjects reflected a normal response or morphological change in the qualitative assessments. In distal regions, initial latency was longer in Group 3, main negative potential (MNP) peak latency was longer in Group 2, and MNP amplitude was higher in Group 1. In proximal regions, initial latency was longer in Group 2, MNP peak latency was longer in Group 1, and MNP amplitude was higher in Group 3. However, the comparisons between study groups did not reveal any significant differences (p>0.05, for all). MEP evaluations included proximal and distal amplitudes and velocities. The findings reveal that proximal amplitude and velocity values were higher in methylprednisolone group but without statistical significance (p>0.05, for all). Also, distal amplitude values were higher in Group 2 without statistical significance (p>0.05).

Histopathology findings:

The histopathological findings are summarized in Figures 1, 2 and 3. When all the findings are considered together, it can be observed that petechial bleeding was present in all subjects. Widespread hemorrhage was not observed in Group 2, and was significantly lower in Group 3 than Group 1. Severe loss in the arrangement of grey and white matter was observed in Group 1, but it was lower in Group 2 and 3. Likewise, edema and necrosis were significant in Group 1, but lower in Group 2 and 3. Cystic degeneration was significant in Group 1, rare in Group 3, but not observed in Group 2. As a conclusion, Group 2 (etofenamate) were found to be protected from edema and hemorrhage.

DISCUSSION:

This is the first study evaluating the efficacy of etofenamate in traumatic SCI, compared with the well-established methylprednisolone application. The results reveal that etofenamate successfully protected the spinal cord histologically from the effects of secondary damage mechanisms following trauma.

	Group 1 (saline)	Group 2 (etofenamate)	Group 3 (methylprednisolone)	р				
Qualitative SEP								
Distal levels	4.4±1.1	3.7±1.4	4.8±0.4	>0.05				
Proximal levels	3.3±2.4	1.6±2.1	3.8±1.8	>0.05				
Quantitative SEP								
Distal initial latency (ms)	0.9±0.2	0.9±0.1	0.9±0.1	>0.05				
Distal MNP peak latency (ms)	2.6±0.9	2.7±0.9	2.5±0.6	>0.05				
Distal MNP amplitude (μV)	81.4±70	25.0±12.7	56.1±67.8	>0.05				
Proximal initial latency (ms)	0.9±0.2	1.1±0.3	0.9±0.01	>0.05				
Proximal MNP peak latency (ms)	2.9±0.9	2.4±0.3	2.5±0.4	>0.05				
Proximal MNP amplitude (μV)	7.3±6.9	6.1±5.2	14.5±14.2	>0.05				
МЕР								
Distal amplitude (mV)	6.4±1.8	7.6±3.2	6.8±1.9	>0.05				
Proximal amplitude (mV)	4.6±2.7	5.9±3.9	6.8±1.6	>0.05				
Velocity (mm/ms)	59.8±39.9	65.0±16.5	75.4±21.8	>0.05				

Table-1. Electrophysiological findings of the study groups.

SEP, Spinal evoked potentials; MEP, Motor evoked potentials; MNP, Main negative potential



Figure-1. Histopathology findings of Group 1 (saline): grey and white matter pattern loss; widespread hemorrhages and congestion; apparent vascular thrombus formation; apparent edema and cystic degeneration. **(A)** Widespread hemorrhage, distortion in white and grey matter (H&E, x32). **(B)** Hemorrhage, necrosis, and cystic degeneration (H&E, x400). Level 2-3 damage according to Ivan-Damjanov Criteria.



Figure-2. Histopathology findings of Group 2 (etofenamate): minimal loss in grey and white matter pattern; focal hemorrhage and congestion; no thrombus formation; minimum edema, no cystic degeneration. **(A)** Focal hemorrhage, no edema, necrosis, or distortion (H&E, x32). **(B)** Congestion and isolated cellular necrosis (H&E, x400). Level 1 damage according to Ivan-Damjanov Criteria.



Figure-3. Histopathology findings of Group 3 (methylprednisolone): mild loss in grey and white matter pattern; widespread hemorrhages and congestion; minimum edema, and cystic degeneration. **(A)** Focal hemorrhage and necrosis, separation of grey and white matter, minimum necrosis (H&E, x32). **(B)** Congestion, and isolated cellular necrosis (H&E, x400). Level 1-2 damage according to Ivan-Damjanov Criteria. Likewise, methylprednisolone also exerted a protective effect against the secondary damage process, but the protective effect was lower than etofenamate.

The histological assessments showed the protective effects of etofenamate, but these findings could not be replicated in electrophysiological evaluations. Nevertheless, qualitative SEP and MEP findings revealed that methylprednisolone was more effective than etofenamate in the protection of the neuronal functions, but this finding did not reach statistical significance.

A substantial number of studies show the efficacy of methylprednisolone in SCI. In many of these studies, favorable results were achieved in animal models of SCI, especially when the medication was initiated in early stages of the injury (11,32). The promising efficacy of methylprednisolone on SCI in experimental models led to the development of NASCIS (National Acute Spinal Cord Injury Study). Up to now three large-scale clinical trials were conducted. In NASCIS-I, high-dose and standard dose methylprednisolone were compared, but no difference was found regarding neurological improvement. NASCIS-II emphasized the early administration of methylprednisolone in the first eight hours after injury (6). Finally, NASCIS-III recommended prolonged maintenance treatment (48 hours) when the initial intervention is delayed after the first three hours (three to eight hours) (8).

In 2002, American Association of Neurological Surgeons/Congress of Neurological Surgeons Joint Section on Disorders of the Spine and Peripheral Nerves published the first guidelines for the management of acute SCI. Through the years, the guidelines were revised and in 2013 the latest revised version was published (36). The current guidelines comment on the use of methylprednisolone extensively, and report that the randomized controlled trials which produced Class I data on the topic had many flaws in design and interpretation of the results (5,7-8). As a consequence, the previous Class I evidence data were downgraded to Class III in the recent guidelines. The mainstay for this was explained as the results being based on post-hoc analyses and statistical corrections were not used in the methodology.

It is likely that the debate about the administration of methylprednisolone will continue. Meanwhile, novel therapeutic agents are being evaluated in the treatment of SCI. Some of them are Trilazad, uric acid, melatonin, methylene blue, mexilitine, thiopental, β -glucan, N-acetylcysteine, and erythropoietin (3-4,14,19-22,24,30,40-41). All of these agents showed beneficial results in SCI, mainly by exerting antioxidant effects. In this study we have evaluated the efficacy of etofenamate on the SCI. This anti-inflammatory agent inhibits the synthesis of prostoglandines, release of bradykinin, histamine, and lisosomal enzymes, and the hyaluronidase activity. Favorable results were obtained in histopathological evaluations in the etofenamate group in our study.

The early histopathological changes after SCI include widespread extravasation of erythrocytes and neutrophils (41). The light microscopic assessments reveal that bleeding was significantly lower in the etofenamate group when compared with the control and methylprednisolone groups. The continuum of the histopathological changes includes deteriorations in neuronal and supporting glial tissues (24), but again, in the etofenamate group, we have observed that the cystic degeneration and necrosis were lower. These results showed the neuroprotective effects of etofenamate in an experimental SCI model.

Our study had some limitations. First, we did not perform a neurological examination. Second, our histopathological findings did not correlate with the electrophysiological findings. This discrepancy raises the question of whether histopathology is related to clinical outcomes or not. Also six hours of intervention may not be enough for the effects of the drugs administered. This may also explain the discrepancy between histopathology and electrophysiology. Longer administrations of the drugs may provide more beneficial outcomes.

Our findings regarding the beneficial effects of etofenamate in SCI need further investigation by randomized clinical trials, but preliminary results are promising.

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Corresponding to: Uygur ER, MD. Duzce University Medical School, Department of Neurosurgery Duzce 81100, Turkey E-mail: uygurer@gmail.com Tel: 0090 505 589 23 55 Fax: 0090 380 542 13 87 Arrival date: 12th July, 2015 Acceptance date: 27th August, 2015

ORIGINAL ARTICLE / ORJÍNAL MAKALE

BRUCELLAR AND TUBERCULOUS SPONDYLODISCITIS: COMPARISON OF MAGNETIC RESONANCE IMAGING FINDINGS

BRUSELLÖZ VE TÜBERKÜLOZ SPONDİLODİSKİT: MANYETİK REZONAN BULGULARININ KARŞILAŞTIRILMASI

> Naciye KIS¹, Mahir KAPMAZ², Ali Haluk DÜZKALIR³, Selçuk ÖZDOĞAN⁴

SUMMARY

Objective: The aim of this retrospective study was to determine the magnetic resonance imaging (MRI) findings and differences of patients with brucellar and tuberculous spondylodiscitis.

Materials and methods: 13 patients with brucellar and 6 patients with tuberculous spondylodiscitis were included in the study. Patients were diagnosed based on clinical findings, laboratory tests and MRI findings. Vertebral corpus, disc, paravertebral soft tissues and epidural distances were evaluated in cases.

Results: Lumbar involvement was present in all of the brucellar, and majority of the tuberculous cases. Multifocal involvement, paravertebral involvement and bone erosion was higher in tuberculous cases.

Conclusions: MRI can be used in differentiating the cases with tuberculous and brucellar cases by using musculoskeletal findings which are seen together with spondylodiscitis. Brucellosis and tuberculosis must be placed in differential diagnosis of patients with musculoskeletal findings in endemic regions.

Key words: Brucellosis, Tuberculousis, Spondylodiscitis, Magnetic Resonance imaging

Level of evidence: Retrospective clinical study, Level III

INTRODUCTION:

Spondylodiscitis is the infection of the intervertebral disc and adjacent vertebral corpus. Spondylodiscitis may be associated with pyogenic, tuberculosis or brucellosis infections. Brucellosis and tuberculosis are still endemic infections in our country. Brucellosis is a multisystemic chronic granulomatous disease, which caused by brucella type bacteria (5). Disease transmission to humans is by non-pasteurized milk and

ÖZET

Amac: Bu retrospektif calısmanın amacı bruselloz ve tüberküloz spondilodiskit hastalıklarının Manyetik rezonans Görüntüleme bulgularını karşılaştırmaktır.

Materyal ve metod: 13 bruselloz ve 6 tüberküloz spondilodiskitli hasta çalışmaya dahil edildi. Hastalar klinik bulgular, laboratuar testleri ve MRI bulguları ile değerlendirilmiştir. Tüm olgularda vertebra korpus, disk, paravertebral yumuşak dokular ve epidural mesafeler değerlendirildi.

Sonuçlar: Brusellozlu olguların tamamında, tüberküloz olgularının büyük çoğunluğunda lomber bölgede tutulum mevcuttu. Multifokal tutulum, paravertebral tutulum ve kemik erozyonu tüberküloz olgularında daha fazlaydı.

Çıkarım: MRI, spondilodiskite eşlik eden kas-iskelet tutulum bulguları sayesinde tüberküloz ve brusellozlu olguları birbirinden ayırt etmekte kullanılabilir. Endemik bölgelerde bruselloz ve tüberküloz, kas-iskelet sistem bulguları olan hastalarda ayırıcı tanıya mutlaka eklenmelidir.

Anahtar kelimeler: Bruselloz, Tüberküloz, Spondilodiskit, Manyetik Rezonans Görüntüleme

Kanıt Düzeyi: Geriye dönük klinik çalışma, Düzey III

dairy products, and less frequently by direct contact with the infected animal (17).

Mycobacterium tuberculosis is one of the pathogens that cause most frequent and prevalent diseases in humans. Percivall Pott first defined spinal tuberculosis in 1779, and it is seen in less than 1 % of all tuberculosis cases (11,15).

Diagnosis of a brucellar and tuberculous spondylodiscitis is sometimes challenging. Delays in the di-

¹ Okmeydanı Training and Research Hospital, Radiology Clinic, İstanbul

² Yenibosna Safa Hospital, Radiology Clinic, İstanbul

Yeniyüzyıl University Medicine Faculty Gaziosmanpasa Hospital, Neurosurgery Clinic, İstanbul

⁴ Dr.Lütfi Kırdar Kartal Training and Research Hospital, Neurosurgery Clinic, İstanbul

agnosis may lead progression of neurological deficits and spinal deformities. Imaging is essential both in diagnosis and guiding surgery. In this study, we have evaluated the contribution of magnetic resonance imaging (MRI) to diagnosis and differentiation of the cases with brucellar and tuberculous spndylodiscitis.

MATERIAL AND METHODS:

This retrospective study included 19 cases that diagnosed with brucellar (13 cases) and tuberculous (6 cases) spondylodiscitis according to clinical, laboratory and MRI findings, between June 2012 and July 2013 in Bitlis State Hospital. Brucellar spondylodiscitis diagnosis was based on clinical and MRI findings, and positive serologic tube agglutination test. Tuberculous spondylodiscitis diagnosis was based on clinical and laboratory (PPD test) tests. In some cases with tuberculosis, diagnosis was also supported by additional positive biopsy results.

MRI evaluations covered fat non-suppressed sagittal T1-T2 weighted, fat non-suppressed axial T2 weighted, and fat suppressed contrasted axialsagittal T1 weighted sequences, which gathered by 1.5 Tesla MRI (Philips, Intera). Vertebral corpuses, intervertebral discs, and paraspinal structures were evaluated for signal changes and pathological contrasts. Decreased signals in T1 weighted images, increased signals in T2weighted images, and contrast enhancement in the vertebral corpuses and discs were regarded as typical findings for spondylodiscitis diagnosis. Additionally, some soft tissue fields that exhibit peripheral marginal contrast enhancement in epidural and paraspinal regions were regarded as accompanying abscess focuses.

Statistical Analyses:

SPSS 18 (IBM Inc., USA) was used for the analyses in the study. Descriptive statistics were presented with percentage, mean, and standard deviation. Quantitative data were compared with independent samples T test between two groups, when the normal distribution assumptions were met. Significance in the results was evaluated as two-sided at the level of p<0.05.

RESULTS:

MRI evaluated spine, paravertebral structures and spinal canal involvement in detail in all cases. Study included 13 cases with brucellar spondylodiscitis (5 female, 8 male, mean age 44.5±16.4) and 6 cases with tuberculous spondylodiscitis (3 female, 3 male, mean age 45.3±16.6).

Involvements in intervertebral disc and adjacent corpus fields were present in all cases. Moderate and/ or high signal intensities on T2 weighted images were seen in vertebral corpuses intramedullary, and in discs.

Signal intensities were significantly decreased in T1 weighted images, and contrast enhancements in various doses were observed according to the clinical stage of the disease, after gadolinium contrast injection.

There was no significant difference between the ages of the two groups. All cases had local clinical symptoms. Involvements were most frequently seen in L4-5 level in lumbar regions in brucellosis cases, and in lower dorsal and lumbar regions at various levels in cases with tuberculosis.

The evaluations regarding multifocal involvement revealed that 23 % of brucellar cases and 50 % of tuberculous cases had multifocal disease. The difference between groups was statistically significant (p<0.05) and tuberculosis cases had higher levels of multifocal involvement.

Bone erosion findings were present in all cases with tuberculosis at different levels. Some patients had decreased vertebral corpus heights, and kyphosis deformity was present in one patient with dorsal involvement. Meanwhile, 5 of the cases with brucellosis had bone erosion.

Epidural extension assessments revealed that 4 brucellar (30 %) and 4 tuberculous (66 %) cases had epidural abscess. Paravertebral soft tissue involvement was present in 2 brucellar (15 %) and 3 tuberculous (50 %) cases. Epidural abscess and paravertebral involvement was significantly higher in cases with tuberculosis. Additionally, one case with brucellar spondylodiscitis had simultaneous infective arthritis findings in coxofemoral joint. This was particularly important because of its osteoarticular localization, which is a rare finding in cases with brucellosis. Psoas abscess, which is regarded as an advanced paravertebral soft tissue involvement, was present in 3 cases (Figure-1,2).



Figure-1. A 53 year-old male patient with brucellar spondylodiscitis. **a.** Hyper-intense views due to involvements on discs and end plateaus at L3-4 level in sagittal T2 weighted images, collapse in L4 vertebral corpus. **b.** Hypo-intense view at this level in sagittal T1 weighted image. **c.** Contrast enhancement accordant with spondylodiscitis, and peripherally contrasted epidural abscess formation extending to L4-5 level in sagittal contrasted T1 weighted image.



Figure-2. A year-old female patient with tuberculous spondylodiscitis. **a.** Spondylitis in L4 vertebral corpus, and hypo-intensity accordant with spondylodiscitis at S1-2 level in sagittal T1 weighted image. **b.** Abscess that extends from right half of S1 vertebral corpus to pedicle and paravertebral area in coronal T2 weighted image; infectious involvement extends to L5-S1 and S1-S2 discs and vertebral corpuses. **c.** Abscess formation that extends to paravertebral area in S1 vertebra level in axial contrasted T1 weighted image.

DISCUSSION:

Brucellous spondylodiscitis is a rare occasion in developed countries due to the eradication of brucellosis from animals. But, brucellosis is still one of the most frequent causes of vertebral osteomyelitis in endemic regions (e.g. Mediterranean countries (9), Central Europe (7), and Latin America (18)). Disease in skeletal system is the most frequent type of involvement, and most frequent forms of musculoskeletal involvement are spondylitis/spondylodiskitis, arthritis, bursitis, and tenosynovitis (16).

Tuberculosis is the bacterial infection that affects millions of people globally each year. It still has importance in all populations in developing countries, and in immunosuppressed patients, homeless people, and increasing number of refugees in developed countries (20,22). Spinal tuberculosis constitutes roughly 20 % of extrapulmonary tuberculosis. Tuberculous spondylodiscitis may cause skip lesions through anterior longitudinal ligament.

Diagnosing the osteoarticular involvements of these diseases is sometimes challenging and treatment may delay due to this (10). But, delays in diagnosis and inadequate treatment may lead to spinal deformities or severe neurological complications (4). Paravertebral soft tissue involvement and epidural abscess may be added to clinical table in disease progression.

Tuberculous and brucellar spondylodiscitis may be seen in all age groups. But majority of the research

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Age	Sex	Vertebral level	Focal involvement	Multifocal involvement	Bone erosion	Epidural abscess	Paravertebral involvement
13	м	L3-4 and L4-5		+	-	-	-
14	м	L4-5	+		-	+	-
43	м	L4-5	+		+	-	-
59	F	L3-4	+		-	-	-
44	F	D12-L1	+		+	-	-
58	м	L2-3 and L5-S1		+	+	+	-
48	м	L4-5	+		-	-	-
59	F	L4-5 and hip arthritis		+	-	-	-
30	F	L4-5	+		-	-	-
40	F	L5-S1	+		-	-	-
58	М	L1-2	+		-	-	-
60	М	L5-S1	+		+	+	+
53	М	L3-4	+		+	+	+

Table-1. MRI findings of patients with brusellar spondylodiscitis (n=13)

Fable-2. MRI findings	patients with	tuberculous	spondylodiscitis	(n=6)
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Age	Sex	Vertebral level	Focal involvement	Multifocal involvement	Bone erosion	Epidural abscess	Paravertebral invovement
17	F	L5-S1, S1-2 and L4 spondylitis		+	+	+	+
53	F	L4-5	+		+	-	-
38	м	D10-11	+		+	+	+
43	м	D11-12 and L1-2		+	+	+	-
63	F	L3-4	+		+	-	-
58	м	L4-5 and L5-S1		+	+	+	+

reported that tuberculous spondylodiscitis is seen in middle-aged adults, and brucellar spondylodiscitis affects people with advanced-decade ages (19). There was no difference between the ages of our patient groups. This may be related with the lower number of our cases when compared with the studies in the literature. This parameter may be evaluated more accurately in more crowded case groups.

Disease involvement generally affects the lumbar part of the spine in brucellous spondylodiscitis cases. Tuberculosis generally affects midthoracic-upper lumbar regions (3). We found no difference regarding this diference, but this may also be related with our narrow sample size. But, one case with tuberculosis had kyphosis deformity in dorsal region, which is specific to this disease.

Paravertebral abscess related with brucellosis is either a less developing, or well-limited situation. Literature data about brucellosis cases generally suggest paravertebral abscess develops at low rates (6,12). Epidural abscess formations may be together with spondylodiscitis and may cause radix pressure related clinical view (13). But, both paravertebral and the epidural abscess formations are more frequent in tuberculous cases. Presence of epidural abscess in consecutive vertebras and presence of wide paravertebral abscess are frequently seen in tuberculosis (2,14). These findings are also more frequent in our cases in accordance with the literature data.

Osteofits formations, namely Parrot beak, may develop in early periods of brucellosis cases, due to bone erosion and following bone healing in vertebral upper end plate (8). Erosion is more focal. But, in tuberculosis cases, erosion is more prevalent and Gibbud deformity may develop due to vertebral collapse (3). In our study, all of the tuberculosis cases, and 38% of the brucellous cases had bone erosion.

Spinal radiographies and computerized tomography may provide limited information for disease involvement. Nonetheless, MRI is the most useful imaging modality in the diagnosis and follow-up of the disease (1,13,23). Contrasted T1A images are important for showing the contrast enhancement in disc and vertebra end plateaus in the early periods of disease (23). MRI is also an outstanding method for allowing multiplan imaging. Sagittal, and coronal assessments, which can be added in a necessity, provide valuable contribution to diagnosis, particularly in the evaluation of multifocal skip lesions of tuberculous spondylodiscitis (24). Since our study is a retrospective one, and lack of fat suppressed T2 weighted images, which are not routinely taken during spinal evaluations in our clinic, the assessments in this sequence could not be performed. But, especially in early periods of the disease, it would show the edema in bone and soft tissues better than fat non-suppressed T2 weighted images, and it should be included in the protocols for patients whom cannot take contrast agents.

As a conclusion; MRI, which is a non-invasive and highly sensitive imaging modality, should be the first choice in early diagnosis of spondylodiscitis. Multifocal involvement, wide paravertebral-epidural abscess, and significant bone destruction should be informative of tuberculous spondylodiscitis; whereas, more focal involvement, well-limited paravertebral involvements, and focal bone destruction may be indicative of brucellous spondylodisicitis. Nevertheless, exact diagnosis should be based on correlations of clinical and laboratory findings with radiological findings, and also additional histopathological verification in some patients.

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Corresponding Author: Selçuk ÖZDOĞAN Address: Kartal Dr.Lütfi Kırdar Eğitim ve Araştırma Hastanesi Cevizli-Kartal İstanbul Türkiye Tel: +90 506 763 71 73 Fax: +90 216 578 49 65 E-mail: drselcukozdogan@hotmail.com Arrival date: 1st August, 2015 Acceptance date: 12th September, 2015

ORIGINAL ARTICLE / ORJİNAL MAKALE

MEASUREMENT OF LUMBAR INTERVERTEBRAL DISC HEIGHTS BY COMPUTED TOMOGRAPHY: MORPHOMETRIC STUDY

LOMBER DİSK ARALIKLARIN YÜKSEKLİKLERİNİN BİLGİSAYARLI TOMOGRAFİ İLE ÖLÇÜMÜ: MORFOMETRİK ÇALIŞMA

Selçuk ÖZDOĞAN¹, Yusuf Emrah GERGIN¹, Ali Haluk DÜZKALIR², Nail DEMIREL³, Murat KÖKEN⁴

SUMMARY

Purpose: We aimed to obtain data from computed tomography of healthy human lumbar intervertebral disc heights.

Materials and Method: We inspected 50 female and 50 male between the ages of 18 and 60 who have admitted to emergency room for minor traumas. Data collected from files of the patients who did not have any history of operations or disease for the lumbar spine rethrospectively.

Results: This study included a total of 100 patients, of whom 50 were female (50 %) and 50 were male (50 %). Mean age was 44.84 \pm 9.9 years for males, and 45.1 \pm 10.7 for females. There was no statistically significant difference between males and females of age (p=0.950). Intervertebral disc heights between L1 and L2 vertebrae were 9.46 \pm 0.86 mm in males, and 9.81 \pm 0.95 mm in females. The L1-L2 intervertebral disc heights were were significantly higher in females (p=0.006). The L2-L3 intervertebral disc heights were 9.68 \pm 0.9 mm, and 9.42 \pm 0.68 mm in males and females, respectively, which were statistically similar (p=0.072). L3-L4, L4-L5, and L5-S1 intervertebral disc heights were significantly higher in males, when compared to females.

Conclusions: This study has been conducted to evaluate lumbar disc heights with morphometric measurements by using computed tomography to support anatomic knowledge for safe surgery performed to intervertebral disc space.

Key words: Lumbar intervertebral disc height, lumbar vertebra morphology, computed tomography measurement

Level of evidence: Retrospective clinical study, Level III

ÖZET

Amaç: Çalışmanın amacı sağlıklı insan lomber vertebral disk aralıklarının bilgisayarlı tomografi ile ölçümünü yapmaktır. Materyal ve metod: Acil servise minör travmalar nedeni ile başvuran ve hikayelerinde lomber bölgeden hastalık veya operasyon bulunmayan 18 ve 60 yaş arası 50 bayan ve 50 erkek hasta retrospektif olarak incelendi.

Sonuçlar: Çalışmada 50 bayan (% 50) ve 50 erkek (% 50) toplam 100 hasta incelendi. Ortalama yaş erkeklerde 44.84 \pm 9.9 ve bayanlarda 45.1 \pm 10.7 olarak hesaplandı. Cinsiyetler arasında yaş bakımından istatistiksel anlamlı fark yoktu(p=0.950). Erkeklerde L1-2 mesafesi disk aralığı yüksekliği ortalama 9.46 \pm 0.86 mm, bayanlarda 9.81 \pm 0.95 mm olarak bulundu ve bayanlarda bu aralık istatistiksel anlamlı olarak daha büyük hesaplandı(p=0.006). L2-3 disk aralığı erkeklerde ortalama 9.68 \pm 0.9 mm, bayanlarda 9.42 \pm 0.68 mm olarak hesaplanmış ve istatistiksel fark bulunamanıştır. L3-4, L4-5 ve L5-S1 disk mesafeleri erkeklerde bayanlarla karşılaştırıldığında daha yüksek olarak bulunmustur.

Çıkarım: Bu çalışmada lomber disk aralıkları yükseklikleri morfometrik olarak bilgisayarlı tomografi ile hesaplanmaya çalışılmış ve disk aralıklarına yapılan ameliyatların daha güvenli yapılabilmesi için anatomik bilgi desteği sağlanmaya çalışılmıştır.

Anahtar kelimeler: Lomber vertebral disk aralık yükseklikleri, lomber vertebra morfolojisi, bilgisayarlı tomografi ile ölçüm

Kanıt Düzeyi: Geriye dönük klinik çalışma, Düzey III

¹ Dr.Lütfi Kırdar Kartal Training and Research Hospital, Neurosurgery Clinic, İstanbul

² Yeniyüzyıl University Medicine Faculty Gaziosmanpaşa Hospital Özel Hastanesi, Neurosurgery Clinic, İstanbul

³ Medical Park Gaziosmanpaşa Private Hospital, Neurosurgery Clinic, İstanbul

⁴ Gazi State Hospital, Orthopedics and Traumatology Clinic, Samsun

INTRODUCTION:

Lumbar degenerative disc disease is the most common cause of low back pain. The exact mechanism of the degenerative process is defined as multifactorial, irreversible and associated with a mechanical dysfunction (1). Progressive disc degeneration will result in a loss of the intervertebral disc space height which depends on the degree of disc degeneration, and it has been shown to have a significant influence on the biomechanics and kinematics of a lumbar motion segment (5).

The use of new technology in the treatment of degenerative disc diseases is updating rapidly. It has been developing in combination with various techniques for spinal stabilization like minimally invasive and instrumental approaches for the treatment of adult degenerative disc disease, stenosis, and deformity of the lumbar spine. Posterior approach to the lumbar disc spaces for posterolateral fusion scan has been technically challenging, frequently requiring the use of an approach surgery for adequate exposure. For successful surgery and suitable instrumental design, well anatomical knowledge of the lumbar vertebra is also needed.

In the present study, we aimed to obtain data from computed tomography of healthy human lumbar intervertebral disc heights. In this context, intervertebral disc heights were evaluated for each lumbar segment for safe surgical intervention by the posterior fixation approach for total disc replacement, prothesis, fusion cages, lumbar discectomy and stenosis.

MATERIALS AND METHOD:

We inspected 50 female and 50 male between the ages of 18 and 60 who have admitted to emergency room for minor traumas. Data collected from files of the patients who did not have any history of operations or disease for the lumbar spine rethrospectively.

Measurement of lumbar intervertebral disc heights were made from computed tomography midline sagittal images. Anterior, center and posterior lumbar intervertebral disc heights were measured and mean values calculated for each level.

Descriptive data were presented by using mean and standard deviation. Mann-Whitney U test was used for comparisons between the independent groups of the study, and statistical significance was evaluated according to a two-sided Type-I error level of 5 %. Statistical Package for the Social Sciences (SPSS) 21 software (IBM Corp. in Armonk, NY) was used for all statistical analyses of this research.

RESULTS:

This study included a total of 100 patients, of whom 50 were female (50 %) and 50 were male (50 %). Mean age was 44.84 \pm 9.9 years for males, and 45.1 \pm 10.7 for females. There was no statistically significant difference between males and females of age (p=0.950).

Intervertebral disc heights between L1 and L2 vertebrae were 9.46 \pm 0.86 mm in males, and 9.81 \pm 0.95 mm in females. The L1-L2 intervertebral disc heights were were significantly higher in females (p=0.006).

The L2-L3 intervertebral disc heights were 9.68 \pm

	Male	Female		
	Mean±SD	Mean±SD	p	
AGE	44.84±9.9	45.1±10.65	0.950	
L1 - L2	9.46±0.86	9.81±0.95	0.006	
L2 - L3	9.68±0.9	9.42±0.68	0.072	
L3 - L4	10.04±0.76	8.53±0.76	<0.001	
L4 - L5	10.38±0.72	9.69±0.79	<0.001	
L5 - S1	11±1	9.84±0.68	<0.001	

Table-1. Mean and p values of age, sex and intervertebral disc heights.

0.9 mm, and 9.42 ± 0.68 mm in males and females, respectively, which were statistically similar (p=0.072).

However, L3-L4, L4-L5, and L5-S1 intervertebral disc heights were significantly higher in males, when compared to females. These values and comparisons between groups are presented in Table-1, which reveals a statistical significance of p<0.001 in all comparisons.

DISCUSSION:

Radiological examinations of the morphologic characteristics of lumbar intervertebral discs, such as height and volume, have been used extensively for biomechanical studies and clinical investigations of the human spine (6,11). Lumbar vertebra anatomy is characterized by wide individual variations as reported in the literature (12,13,16). Height and volume of the intervertebral disc influences the load-carrying capacity of the spinal column. Besides, morphologic abnormalities such as intervertebral disc space narrowing and thinning have been associated with acute or chronic disabilities of the lumbar spine (2).

Lumbar degenerative disc disease is one of the major causes of chronic low-back pain with lumbar segmental instability. Surgery must be suggested when conservative treatments fails. In addition to diagnostic tests or interventional studies, morphometric studies have the potential to help surgical planning and facilitate the design of intervertebral prosthesis and fusion materials (3,17). Artificial total disc replacement as an alternative to spinal fusion has been increasingly applied for the treatment of degenerative disc disease (9,14). It is suggested that the patient's normal intervertebral segment motion might be restored and maintained while the adjacent level was prevented from non-physiologic loading and thus the pain was relieved (4,15,18).

There are various researches and measurement techniques for intervertebral disc morphology. For example Neubert et al suggested a computerized method for the measurement of intervertebral disc heights using Laplace equation and volume using sagittal areas from 2D MR scans of the lumbar spine (10). They compared results with the measurements obtained by manual digitization, and observed strong reliability for both manual and semi-automated methods. Kim et al reported that disc height index and sagittal range of motion showed a significant correlation with the incidence of recurrent lumbar disc herniation, suggesting that preoperative biomechanical conditions of the spine can be an important pathogenic factor in the site of lumbar disc surgery (8). This study has been conducted to evaluate lumbar disc heights with morphometric measurements by using computed tomography to support anatomic knowledge for safe surgery performed to intervertebral disc space.

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Address: Selçuk ÖZDOĞAN, Kartal Dr.Lütfi Kırdar Eğitim ve Araştırma Hastanesi Cevizli-Kartal İstanbul Türkiye

Tel: +90 506 763 71 73 **Fax:** +90 216 578 49 65 **E-mail:** drselcukozdogan@hotmail.com **Arrival date:** 23th June, 2015. **Acceptance date:** 12th September, 2015.

ORIGINAL ARTICLE / ORJİNAL MAKALE

MULTIETIOLOGICAL SYNDROME: LOW BACK PAIN SOME ASPECTS OF PATHOGENESIS AND TREATMENT

MULTİETİYOLOJİJ SENDROM: BEL AĞRISI ÇEŞİTLİ PATOLOJİLER VE TEDAVİ

Yashar Raftaroğlu JALILOV¹, Togrul Yasharoğlu JALILOV², Elckan Mubarizoğlu CHALABIYEV²

SUMMARY

The study presents data of hospital examination and treatment of 405 patients suffering from acute low back pain; in 247 of them have been revealed changes in bone mineral density of the vertebrae the type of osteopenia and osteoporosis. The majority of patients had bulging disc detected during MRI and CT examinations. 340 people have been managed to eliminate pain using conservative orthopedic treatment. Due to the inefficiency of the conservative-orthopedic treatment in 65 patients performed the surgery operations. It was noted the situations requiring different solutions:

- Mono-lateral pain with a large protrusion of one disc and minor protrusions of adjacent discs:

- Bilateral pain caused by large protrusions of 2 adjacent discs and instability or major segments of the protrusion of the 1st disc and moderate protrusion of adjacent disc involved in the creation of the clinical picture of bilateral pain.

In each of these situations, was performed intervention to ensure the ventral and dorsal decompression of spinal canal elements and the elimination of spinal instability.

Back pain is a multi-factorial phenomenon, and therefore the detection at MRI, CT studies of disc prolapse should not serve as a basis for making a hasty decision for surgical treatment. In most cases, conservative orthopedic treatment has a positive effect. In this case, the basis of the treatment should be made using of orthopedic aids in case of the prolonged immobilization and unloading of the spine, as well as measures to normalize bone mineral density. Surgical treatment, followed by a continuation of conservative measures to normalize the mineral density of bone structures.

Keywords: multi-etiological lumbar pain, abnormalities of the lumbosacral area, osteopenia, osteoporosis, orthopedic treatment, surgical treatment.

Level of evidence: Retrospective clinical study, Level III

ÖZET

Bu çalışmada akut bel ağrısı olan 405 hastanın klinik muayene ve tedavi sonuçları sunulmuştur; bu hastaların 275'inde kemik mineral dansite ölçümlerinde osteopeni ve osteoporoz saptanmıştır. Hastaların büyük kısmında disk fitiklasmasını incelemek üzere MR ve BT incelemeler kullanılmıştır. 340 hastada konservatif tedavi uygulanmış, geri kalan konservatif tedavi yetersiz kalan 65 hastada cerrahi girisimler uygulanmışlardır. Hastalarda farklı çözümler gerektiren durumlar saptanmıştır. Bunlar: 1) Tek taraflı ağrıya sahip tek diskin geniş protrüzyonu ve komşu dikste hafif minör protrüzyon hastalar ve 2) Çift taraflı ağrıya sahip biribirine komşu iki diskte geniş fıtıklaşma ve instabilite veya komsu diskteki orta düzey fıtıklasmanın karsı taraf basısından sorumlu olduğu hastalar. Bu hastalarda anterior veya posterior dekompresyon ve spinal instabilitenin ortadan kaldırılması amacı ile cerrahi girişim uygulanmıştır.

Bel ağrısı çok sebepli bir fenomen olup cerrahi tedaviye yönlenmede CT ve MR tek başına yardımcı olmamaktadır. Çoğu vakada konservatif tedavi hastanın yakınmalarının geçirilmesinde olumlu etkide bulunmaktadır. Diğer taraftan konservatif tedavi ve istirahat kemik dansitesindeki düşmeleri düzeltmektedir. Cerrahi tedavi sadece medikal tedavi yetmezliğinde, kemik nineral dansitesinde düzelme olana dek uygulanan medikal tedaviyi takiben uygulanmalıdır.

Anahtar Kelimeler: Multi etiolojiklomber ağrı, lumbosakral bölge anomalileri, osteopeni, osteoporoz, ortopedik tedavi ve cerrahi tedavi.

Kanıt Düzeyi: Geriye dönük klinik çalışma, Düzey III

² Junior researcher of Scientific-Research Institute of Traumatology and Orthopedics of the Ministry of Health of Azerbaijan.

¹ Doctor of Medicine, MD., Research manager of the department of Orthopedics for adults and trauma consequence of Scientific-Research Institute of Traumatology and Orthopedics of the Ministry of Health of Azerbaijan.

INTRODUCTION:

Most people of the world, at least several times in their lives complain of the low back pain and 1.3 % of them undergo relative surgical treatment (1-2). Causes of the low back pain are different – multi-etiology syndrome. There have been defined three category of the back pain in modern medicine (3):

1. Specific, potential severe diseases of spine, spinal cord and visceral organs with irradiation of pain to spine.

2. Sciatic syndrome (Ischialgiya).

3. Non-differentiated pain in the low back.

However, in recent decades there are o lot of data in clinical practice, which allow to joint 2 or 3 categories in one "non-specific" group due to similar clinical manifestation and etiology factors. This issue was one of the main questions, discussed in VIII Interdisciplinary World Congress of back and pelvic pain on 27-31th October, 2013 in Dubai (15). We also prefer to highlight two group of back pain – specific and non-specific. Because of changes in mineral density of the spine bones in majority of the last one are met degenerative osteochondrosis, deformed spondilosis, spondylolistesis and hormonal spondylopathy (11-12).

Back pain problems also are actual in Azerbaijan. Problems of the differential diagnosis, and complex orthopedic treatment and surgical treatment studies of the patients with back pain are organized and performed in the Orthopedics clinic for older by Scientific-Research Institute of Traumatology and Orthopedics - SRITO AR (Research manager Doctor of Medical Science Y. R Jalilov). During recent decades we observed significant increase a number of the patient with lumbodynia and radicular type of pain in older and elderly people, who had osteoporosis different etiology. In addition, in younger people with pathology of discs and instability vertebral segment was often diagnosed mineral density of the bones type of osteopenia and osteoporosis. Therefore, it is important tactically find out which of the etiopathogenetic factors have priority in pain syndrome. Our studies of many years based on ambulatory and stationary observations of the several thousand patients showed that in the majority of the cases low back pain is not only multi-etiologic, but multi-pathogenic. Several factors take part in occurrence of pain, each of them has been find out and considered in the treatment process during examination. For example, if the patient has a prolapse of the disc and mineral density changes of the bones, which create instability of the segments in most cases, so treatment should be directed for elimination of components developed pathology condition of the vertebrae. If consider to eliminate only of the prolapsed, and don't liquidate the osteoporosis and instabilities, so we can't reach a stable recover of the patient.

In recent several decade surgical interventions on herniation of a disc increased o lot, specially, among neuro-surgeons. It is suggested different types of the operations, noted a big intention to economic availabilities and earlier activation of the patients (5,13). It seems that a part of the authors see all problems in presence of the ballooning-out any discs, which compress spinal radices and if to eliminate it, so a person can return to previous life without any restrictions through several weeks. However, the life shows that such simplified approach is wrong and in most cases low back pain doesn't step back so easily. E.V.Spangfort (2) analyzed results of the surgical treatment of 2504 patients after exploration of the discs and detected in nearest post-operation time 30 % of the patients noted low back pain again (failed back surgery syndrome).

Data of the many authorizes and our observations of many years show in most casis of spine osteochondrosis damages take a place in several segments simultaneously. Analyzes many of our MRT studies confirm opinions about different degree of the damage adjacent segments in poli-segmental osteochondrosis. Well-known conceptions about pathological changes in the vertebral segments in case of the osteochondrosis (A.I.Osna 1973; Kirkaldy-Willis W.H., Farfan H.F., 1982; White A.A., Panjabi M.M., 1990), explain more or less surely pathogenesis of the pain syndrome and other their clinical appearances in mono-segmental process. But many and different degree of damage of the adjacent segments in polysegmental osteochondrosis create a lot of questions, which answers to them have not find yet:

1. What is the reason of the poli-segmental type damage of the adjacent vertebral segments of the spine?

2. What is the mechanism of the pain syndrome in case of the poly-segmental osteochondrosis?

3. What is right tactics of the treatment in case of poly-segmental type damage of the spine in osteo-chondrosis?

The goal of the study is analyze the main cause occurrence low back pain considering data of clinicalneurological examinations and investigations, and results of the conservative and surgical treatment of the patients in department for adults of SRITO AR.

MATERIALS AND METHODS:

In this study is presented information about inpatient examination and treatment of 405 patients suffering from severe low back pain (Table-1).

340 people of them received conservative-orthopedic treatment and 65 surgical. It was used χ^2 tetrachoric criteria by Pirson for statistical analyze of the obtained results (12).

Consider the gender (264 men and 141 women), age and using method of the treatment we separated

Number of the patients due to	Age of the patients					
methods of treatment	18-30 age	31-50 age	> 50 age	Total		
Surgical treatment	18 (4.4%)	32 (7.9%)	15 (3.7%)	65 (16.0%)		
Conservative-orthopedic treatment	89 (22.0)	148 (36.5%)	103 (25.4%)	340 (84.0)		
Total	107 (26.4%)	180 (44.4%)	118 (29.1%)	405 (100%)		

Table-1. Placement of the patients by age and methods of treatment.

405 patients. As shown in the table most of the patients were at the capable of working age, 31-50 age (180 people – 44,44 %). 107 people were at the age of less than 30 (26,43%) and 118 people older than 51 age (29,13 %).

In order to diagnose precisely of the diseases is performed radiography of spine to all applied patients, specially, in recent years with digital radiographic devices which give possibilities to detect too deeply structural changes vertebrae, also MRT, CT, clinical-neurological examinations, also DEXA- and sono-densytometric examinations.

MR examinations detected in majority of the patients ballooning-out of the discs L3-4, L4-5 and L5-S1. Ballooning-out size of the discs in radiography films on MRT examinations showed that most of them have a sagittal diameter of 5-12mm. At the same time, in 186 patients were detected ballooning-out (3-7MM) and damage of the adjacent vertebrae discs poly-segmental type. In most cases of the poly-segmental process occurred damage of 2-3 discs, but sometimes it was observed damage of 4 discs different degree.

Roentgen-densitometer is performed by «HO-LOGIC.QDR 4500-A" device. DEXA- densitometer of the spine was performed to 328 and 405 examined and treated patients in a hospital. 60 of patient was

performed roentgen-densitometer of the spine and hip joint, also sono-densitometer of the calcaneal bones.

Except mentioned stationary patients DEXA-densitometer was performed to 635 ambulatory patients, with expressed pain kind of lumbodynia and lumbar ischialgia. At the present time, as known, DEXA- densitometer consider the more precisely method (gold method) of the bone mineral density identification among all known methods.

RESULTS:

It allows differentiate bone mineral density (BMDbone mineral density) and estimate it in T-score. T-value criteria between 1,0 to 2,5 estimate as an osteopenia, and from 2,5 and less as osteoporosis. Table-2 shows the results of the densitometer.

There were 328 patients: 197 men and 131 women. Bone mineral density of 81 patients may be estimated as normal, 69 men and only 12 women. There were no men at all in the T-criteria group less 3,5 Boo6ue, but only. Among the patient with osteopenia prevailed men (94 men and 47 women), but with osteoporosis women (34 men and 51 women). As shown by above data in the most patients (247 people) along with ballooning-out of the discs noted changes bone mineral density – osteopenia and osteoporosis. In

Age of the patients	Results of the roentgen-densitometer by T-score						
	+1:-1	-1:-2,5	-2,5:-3,5	-3,5 и <	TOTAL		
20 -30 age	31	26	12	3	72		
	43,1±5,8%	36,1±5,7%	16,7±4,4%	4,2±2,4%	(22,0±2,3%)		
31-50 age	31	72	43	8	154		
	20,1±3,2%	46,8±4,0%	27,9±3,6%	5,2±1,8%	(47,0±2,8%)		
51-60 age and more	19	43	30	10	102		
	18,6±3,9%	42,2±4,9%	29,4±4,5%	9,8±2,9%	(31,1±2,6%)		
TOTAL	81	141	85	21	328		
	(24,7±2,4%)	(43,0±2,7%)	(25,9±2,4%)	(6,4±1,4%)	(100%)		

Table-2. Placement of the patients by age and the results of the DEXA-densitometer.

Note: Poly-choric value by Pirson related between age and results of the densitometer: $\chi 2=19,82$; p < 0,01. As shown from the table, by increasing of the age the bone mineral density is reducing reliably, which leads to reducing of T-score value.

this studies were identified not only average data mineral density low back region of the spine, but also explicit data for each vertebra (L1-L4). These findings demonstrate, that more extend changes on mineral density were observed in low back vertebrae (often in L4). Most of patients with poly-segmental character of the damage of spine, in this case, is often found out T-value criteriawithin 1,5 – 2,8. It would be noted another fact, which say patients with reduced bone mineral density of the vertebrae during taking medical history – this is combination of the irradiated pain to the lower limbs (radicular pain) with pain occurred in spine in case of rotating the body in horizontal position (instability of the vertebral segments). In our opinion and by some researchers these cases, as called "hormonal spondylopathy", lead to the disturbance of anatomical correlation between nerve roots and bone formation, which results to instability of the segments in consequence of reducing of the volume of the vertebral body and a laxity ligamentous apparatus.

In his studies on contrast myelography hernia ballooning-out of the intervertebral discs Y.R.Jalilov (1987), one of the leaders in this direction, showed the informativeness of the roentgenometer measurement of the spine canal width in diagnosis this disease (7). In recent years for the purpose of measurement of the spine canal width on the medium damaged level of intervertebral discs (D1 value) and medium of the upper vertebral body (D2 value) we perform roentgenometer in MRT films. The ratio of D1 value to D2 gives mathematical index Id (D1/D2=Id) – width of the canal on the degenerated disc level, which ideally should correspond to number 1. The less obtained number, the bigger degree narrow spine canal protruded by the degenerated disc.

Analysis performed by us examining more than two thousand patients in ambulatory condition and spondylogram of 405 patients in stationary condition showed significant number of the patients with low back pain on the lumbosacral segments have also congenital anomalies. So, from 405 patients examined in stationary condition revealed anomalies of the low back vertebrae in 253 cases (62,46 %). These anomalies is result static-dynamic disturbance of the vertebral biomechanics in low back vertebral and lumbosacral segments of the spine and this create the condition for occurrence degenerative process in intervertebral discs. Among them it may be point out sacralization, tropism of the articular process, lumbarization, "spina bifida", diminution of the lumbosacral corner – "acutum sacrum" and etc. (7).

In 340 of 405 patients the pain syndrome was possible to terminate performing complex conservativeorthopedic treatment. Because of continuation of the pain syndrome surgical intervention was performed in 65 patients. Consider the decision about operative intervention we take into account all examinations, but the first place neurological and clinical picture of the diseases, which give the possibility to precise all the pathogenic components of the occurring pain syndrome in the operated patient. Depend on the clinical, neurological and investigated data we defined following situations, which require different decisions:

1. The clinical-neurological examination reveals mono-lateral pain syndrome. MRT examination finds out prolapse of the one disc narrowing space of the spine canal on the one side (id = since 0,44 to 0,55), and compressing root and other elements of the dural sack. MRT examination finds out less sufficient ballooning-out in adjacent segments (id = since 0,75 to



Figure-1. MR and X-ray pictures of the patient A.Y. with prolapsed two discs: *a*) MRT films of the low back region before the operation; *b*) X-ray picture low back region after the operation of implantation in side projection; *c*) X-ray picture low back region after the operation.



Figure-2. MR and X-ray pictures of the patient M.H. (38 years old) with prolapsed two discs:- *a*) MRT films of the low back region before the operation; *b*) X-ray picture low back region after the operation of implantation in side projection; *c*) X-ray picture low back region after the operation of implantation in direct projection.

0,86), which don't leading to disco-radiculitic conflict. In patients with given situation was performed: –approaching (dorsal decompression) for revision of spinal canal and exploration of disc (ventral decompression) extended inter-laminectomy (with economical margin resection of the part of upper vertebral arch), segmental arthrodes junctura zygapophysealis. This situation detected in 38 patients.

2. Bilateral pain syndrome with ballooning-out of two adjacent discs (Id=0,44-0,55) compressing of appropriate roots in different sides with occurrence of instabilities of the segments. In these cases it is performed extended inter-laminectomy on two level in appropriate sides, exploration of the discs (13 patients). If on the level of adjacent segment there is a ballooning-out (Id=0,55-0,60), which takes part in creating clinical picture of the bilateral pain syndrome, we perform inter-laminectomy, revision of the roots in order to decompress them and release from adhesions (14 patients). The operation was completed with segmental artrodes on two level and fixation modified construction by Jalilov. This is very impotent to liquidate more totally of the instability and its prophylactics in the future. (Figures-1 and 2).

DISCUSSION:

In case of degenerative damage of the discs compression in the severe period characterizes with irritative reactions as shooting pain, also as change of feeling in appropriate dermatoms. Irritative process appear in fail of blood microcirculation in nervous root, phlebolytis, edema and fibrosis of connective tissue. In occurrence of pain irritation of the receptors of the posterior longitudinal ligaments and instability take part in case of pathologic rotation movements in spine segment (11-12).

Comparing the results of MRT, densitometer, radiography of spine and clinical-neurological it is possible express the opinion, in the most cases in mechanism of the manifesting of pain in our patients the significant role plays changes of the bone mineral density, which results in increasing the physical load to discs and the disturbance of anatomical correlation between nerve roots and bone formation. It is possible, that this is one of the main cause following occurrence instabilities of the segments due to reducing vertebral body volume and a laxity ligamentous apparatus. Observed by us in part of the patients with reduced a spine mineral density a calcification of the cartilaginous and connective structure in spine segments is a respond compensator reaction of the organism, directed for the stabilization of the spine.

Results of our studies and other authors (6-7,11) show that in occurrence of low back pain syndrome degenerative spondylo-arthrosis plays an important role. Performed the modern MRT, CT and digital spondylographic examinations give possibilities for more detailed research by the computer and therefore, we have chance to detect radiographic details, which could not see before. During performance such studies in some patients except pathology of the discs also was established signs of degeneration of the cartilaginous surfaces in the intervertebral junctions - junctura zugapophysealis of the segments L4-5 and L5-S1, changes composed of subchondral osteosclerosis and ossification of the para-articular tissues. In some patients with spondylo-arthritis during the exacerbation low back pain some time was noted pain of ischialgia type, however, later this pain syndrome was released by conservative methods of treatment, particularly, by blocking with local steroids. We and other authors explain this with anatomical correlation between the indicated joints and spinal roots. It seems, the spinal roots expose to the affect paraarticular inflammation and edema, as they pass near with this joints (12).

Ballooning-out the discs observed during MRT and CT examinations have not been indicated for compulsory surgical operation yet. Our perennial experience shows for a part of majority of the patients it is necessary to implement conservative-orthopedic treatment till surgical intervention. We implement this treatment in condition with possible elimination physical loading affected to the discs. For this reasons the patients are appointed bed rest with a traction load of 10-14 kg. However, a traction with a heavy burden often results to the negative effect and should be implemented with individually and caution. During the conservative treatment we use corsets. The corsets are made by the specialists for each patient individually. We use the combination of the different analgesics, for the maximum reducing of pain syndrome during the treatment complex. In severe period of the disease we use "para-articular" local steroid blockers. In case of densitometer diagnosis of the osteoporosis we use alendronats, bisphosphonats and other preparations from this line in combination with the the treatment dose of calcium and vitamin D. In most cases by the implemented measures it was reached the elimination of pain syndrome. Latter the patients take ambulatory treatment during several weeks till complete restore of the working ability (Figure-3).

The degeneration process leads to the damage of the inter-vertebral disc and loss its main fixation function in case of the osteochondrosis, which results to fail of the supporting and moving functions of the spine segment. In addition, the prolapsed disc leads to ventral narrowing space of the spinal canal. Over a long period of time (usually it is so, rarely any patient in primary symptoms is operated) organism as a respond reaction to these disturbances answers with hypertrophy, hypermineralization (ossification) of the capsular-ligamentous apparatus of the segment for counteraction to the pathology movement in it. Continuation of the unhealthy condition leads to edema and subsequent some induration of the peridural fatty tissue. Thereby, in the results of chronic duration of the process to the ventral compression (from the side of prolapsed disc) elements of the spine canal joint and occur dorsal side compression. Data of many authors and our observations show that in many cases damage of the discs in osteochondrosis has polysegmental character, by other words, process extendsnot to one, but to several prolapsed discs. The surgical intervention should consider all these pathology changes in spine and eliminate them finally. By such way, surgical intervention in cases of the damage of the discs has to provide followings:

- provide whole dorsal (economical, but the sufficient access for the comprehensive revisoin) and ventral (exploration) decompression roots and other elements of spinal canal;

- don't exacerbate existing damage of the supporting and moving functions in case of instability of the segment, restore them in corpore (fixation-stabilization of the segment);

- in case of the poly-segmental damage to provide dorsal and ventral decompression of more damaged and taking part in the formation of pain syndrome segments.

In addition, in elimination of the hernia we don't implement curettage of the disc cavity, because we consider it is dangerous and don't correspond to the goals of the operation manipulation. We could not



Figure-3. The patient Q.N. 55 years: a) MR examination, hernia of the L5-S1 discs 7 мм.; b) DEXA-densitometer of spine – osteopenia (T -1,0).

find in the available literature a theme, where it was convincing confirmed the possibility of strengthening fibrosis formation process of the disc after curettage. This opinion was held by the vertebrelogists taking part in 14th EFFORT IN Istanbul, showing the multiple complications of the curettage of the disc (4).

As shown above for the prophylaxis and treatment of the instability we use modificated by Jalilov Y.R. construction of Kazmin-Jalilov (RU Patent 1326161, 1987) (1,3,9). The modificated construction as opposed to its prototype has the less dimension and accounted for fixation one or two vertebral segments, which have instabilities.

According the works of Movshovich I.A. and Shotemor Sh. Sh. (1979) there was demonstrated that the instability of the vertebrae characterized appearing in its segments, mainly, pathological rotation movements. From this position, for liquidation or prophylaxis these movements, in our opinion, in majority of cases there is no necessity using interbody traspedicular constructions. The multiple news about successful using the spinal constructions like DIAM also confirm that for the liquidation of the instability of the segment a fixation through a spinous process supports a sufficient stability of spine and don't disturb its biomechanics. About 30 years experiments using modificated construction of Kazmin-Jalilov (3) showed its high effectiveness in the treatment of the vertebral segments instability. The technical simplicity establishing of the construction provide possibility its extend use in the clinics, even with minimal availability of equipments.

The long-term results of the surgical treatment with duration of from three till 36 months was followed up in 62 patients.

In the first group 35 patients from 38 patients were followed up. The complete ending of pain syndrome was observed in 30 patients. In 5 patients pain was in the body and limbs, which we attributed already existed osteopenia and osteoporosis, therefore was performed the treatment with alendronats, biphosphonats, calcium medicine and vitamin D, after all observed release the pain.

The complete liquidation of the instability symptoms in patients of the second group was observed the next day after the operation. The pain in the limbs went away in all patients, however, in 4 patients a long time (several months) observed continuing hypoesthesia in the different region of the skin of foots, which was before the operation. Latter these occurrences regressed in 2 patients, and continue to be in 2 patients.

It was performed the analysis of occurrence of the low back pain causes in 405 patients who received the stationary treatment. In most patients MRT detected ballooning out the discs with the sagittal size 5-12 mm. At the same time the poly-segmental character of the damage was observed in 186 patients. 328 patients were undergone to the investigation of bone mineral density (DEXA- and sono-densitometer). In 247 them found out the changes of the bone mineral density type osteopenia and osteoporosis. In majority of the patients with the poly-segmental character of damage was observed diminish of the bone mineral density in vertebral tissue (T-criteria is between from-1,5 to -2,8). In 62,4 % of patients were revealed the develop anomaly of the lumbosacral part of spine, affected to biomechanics of spine, which also may cause the degenerative develop its segments.

The analysis of the examination results and treatments show that in the majority of cases the low back pain is not only multi-etiological, but also multi-pathological. In the development of the syndrome several facts take part. For example, the cause of the radicular syndrome is not only the ballooning out the disc, but also spondyloarthrosis, and the cause of the instability may be not only the damage of the disc, but also the changes of vertebral mineral density in spine, and each of these facts must be revealed and considered in the treatment process.

In 340 of people the pain syndrome was possible to liquidate by the conservative-orthopedic treatment, which the important component was to use the medicines improving the bone mineral density. In 65 patients due to the non-effectiveness of the conservative treatment was performed surgical treatment. The analysis of the follow up surgical treatment results showed a validity of the selected treatment tactic of one-sided and double-sided pain syndrome in ballooning out of the inter-vertebral spine discs. The sufficient ventral and dorsal decompression and also the measures for the stabilization of the spinal segments (segmental spondylodesis and metalofixation) provided releasing of pain syndrome in 30 patients from 35 patients of first group with one-side pain. Using a modernize fixer for the back fixation of spine allows to provide a significant stabilization of the instability segments of spine, about what inform nearest and follow up results of the surgical treatment in patients from second group. The intervention in the several damaged segments simultaneously in polysegmental osteochondrosis with a dorsal and ventral or only a dorsal decompression of the compressed spine roots provided releasing of double-sided (bilateral) pain syndrome in all 27 patients from this group. It is very important, to examine of the bone mineral density in all the patients before the operation with the subsequent implementation necessary measures for normalize the revealed abnormalities.

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Address: Abbas Sahhat Street, 32, AZ-1007, Baki, Azerbaijan. E-mail address: yashardjalilov@mail.ru, yasharjalilov@gmail.com Tel. +994 50 213 43 46 Arrival date: 1st August, 2015 Acceptance date: 4th September, 2015

CASE REPORT / OLGU SUNUMU

NEUROLOGIC DEFICIT SECONDARY TO CEMENT LEAKAGE DURING PERCUTANEOUS VERTEBROPLASTY IN MULTIPLE MYELOMA PATIENT

MULTİPL MYELOMALI HASTADA PERKÜTAN VERTEBRAPLASTİ SONRASI SEMENT KAÇAĞINA BAĞLI GELİŞEN NÖROLOJİK DEFİSİT

> Murat MERT¹, Sinan ERDOĞAN², Bahadır GÖKÇEN², Selahattin ÖZYÜREK³, Çağatay ÖZTÜRK²

SUMMARY

Percutaneous vertebroplasty is defined as the injection of polymethylmethacrylate into the vertebral body under general or local anesthesia with radiological guidance to provide pain relief and structural support. Vertebroplasty was first used in the treatment of vertebral angiomas. However the most common indication of percutaneous vertebroplasty is the osteoporotic fractures of the spine resistant to conservative treatment. Although percutaneous vertebroplasty is a minimally invasive procedure, it has limited complications. Cement leakage is frequent complication of the procedure. In this study, we report a possible complication of the percutaneous vertebroplasty procedure. We aim to emphasize that we should be careful about the treatment of vertebral fractures with percutaneous vertebroplasty for neurological complications.

Key Words: Vertebroplasty, complication, cement leakage

Level of evidence: Case report, Level IV

ÖZET

Perkütan vertebroplasti, spinal kolonun osteoporoza, travmaya ve maligniteye bağlı kompresyon kırıklarında uygulanan bir tedavi yöntemidir. Floroskopi eşliğinde kanül yardımıyla polimetilmetakrilatın (PMMA) etkilenmiş vertebra korpusu içerisine enjekte edilmesi işlemidir. Perkütan vertebroplasti; genel olarak iyi tolere edilebilen, sınırlı komplikasyonu olan bir teknik olmakla birlikte sement kaçağı sık görülen komplikasyonudur. Sement kaçağı nadiren nörolojik defisite, akciğer veya diğer organ sistemlerinde emboliye neden olmaktadır. Perkütan vertebroplastinin major komplikasyonlara açık olabileceği akılda tutulmalıdır. Spinal kaçak sonrası oluşan nörolojik defisitlerde erken dönemde sementin çıkartılmasının klinik iyi leşme üzerine olumlu etkileri olduğunu düşünmekteyiz.

Anahtar Kelimeler: Vertebraplasti, komplikasyon, sement kaçağı

Kanıt Düzeyi: Olgu sunumu, Düzey IV

INTRODUCTION:

Percutaneous vertebroplasty was first performed clinically on vertebral hemangioma in 1980. As lifespan is getting longer and life quality expectancy is increasing with the developing technology and growing experience, practice of percutaneous vertebroplasty has been increasing¹⁰.

Percutaneous vertebroplasty is a minimally invasive technique, in which acrylic cement is used and it is performed on compression fractures related to osteoporosis, trauma and malignancy^{7,11,14}. In vertebral compression fractures, percutaneous vertebroplasty is recommended for the fractures which do not respond to a six weeks conservative treatment and for the ones which occur between T5-L5 vertebrae corpuses with posterior body walls are healthy ^{7,9,11,17}. In this surgical technique, polymethylmethacrylate injection (PMMA) is done by inserting into the affected vertebra corpus with cannulas in company with fluoroscopic x-ray guidance.

¹ Department of Orthopaedics and Traumotology, Gaziosmanpaşa Private Hospital, Gaziosmanpaşa, İSTANBUL

² Liv Hospital, Liv Spine Center, Ulus, İSTANBUL

³ Department of Orthopaedics and Traumotology, Turkish Naval Academy Family Health Center, İSTANBUL

In this case report, we aim to emphasize that we should be careful about the treatment of vertebral fractures with percutaneous vertebroplasty for neurological complications.

CASE REPORT:

Multiple myeloma pre-diagnosis of a 72 year old male patient who had backache and low back pain following an incident of falling down and had a six week conservative treatment with brace and NSAII as a result of compression fractures on T7-8-9-11 and L1 vertebrae. A single level vertebroplasty had been performed on the patient because of an isolated T6 compression fracture in another hospital one year ago. The pain complaints of the patient and local sensitiveness in the examination were matching to the fracture area. Both of the neurovascular examinations on lower extremities were normal. Subacute fractures related to multiple myeloma were seen in magnetic resonance imaging and it was also confirmed with laboratory examinations. Vertebra corpus posterior wall was evaluated intact in computed tomography. Percutaneous vertebroplasty was decided to be done owing to the prolonged pain of the patient in spite of conservative treatment.

Under general anesthesia, the patient was laid down in the prone position. Indirect reduction was tried to be ensured by taking to hyperextension and putting cushions on chest and pelvis in terms of fractured reduction. Accompanied by fluoroscopy, 15 gauge cannulas were placed into the vertebra corpus as a percutaneous by the anterior-posterior, lateral and oblique images. In the lateral graphs, the cannula tip was tried to be placed into the anterior of vertebra corpus or medial 1/3 part. In the process of radiopaque bone cement injection, the risk of cement leakage was tried to be decreased by constant fluoroscopy imaging. Being injected to 5 vertebra in total, 4 cc cement was injected to each vertebra by giving 2 cc to both of the pedicles.

After the surgery, total motor and sensorial neurological deficits were found in the right low extremity of the patient including the hip. In the immediate computed tomography, it was seen that there was a cement leakage in the right side and on the T9 vertebra level towards the spinal canal (Figure-1,2). The patient was taken to the surgery again urgently. Cement piece in the spinal canal was removed by doing hemilaminectomy at T9 level. It was seen that hip flexion motor strength was recessed at the rate of 2/5 after the surgery.



Figure 1.

Figure 2.

DISCUSSION:

Although percutaneous vertebroplasty is a technique which is tolerated well and has limited complications. Complications related to vertebroplasty include cement embolism, neurological deficits, discitis, and dural tears and cement leakage. Cement leakage is frequent complication of the procedure¹⁹. Cement leakage rarely causes emboly and neurological deficit in lungs and other organ systems^{1,8}. The frequency of cement leakage in the literature was pointed out as a rate between 31 % and 96 %¹⁹. Cement leakage could be towards soft tissues in lateral, towards disc space in superior and inferior and towards spinal canal in posterior⁵. The cement leakage towards disc space has been reported very often and fracture in the neighbor segment⁶, disc herniation and radiculopathy have been reported as a consequence of this leakage²⁰. The cement leakage towards spinal canal is observed less often. In a 4547 disease series made as a multiple central study in the literature, major neurological complication was not found and it was reported that venous embolization was the most common minor complication and leakage towards disc level was at the second frequency². Nakano at all have stated that the risk of cement leakage development in spinal malignancy is more than the vertebroplasty performed due to the osteoporotic fractures¹⁶.

There could be cement leakage towards spinal canal from pedicle medial wall, posterior vertebra corpus, end-plate fractures and some vertebral foramens. There could be some injuries as a result of direct pressure or thermal effect of cement on spinal cord and roots^{3-5,12-13,15,18-19,21}. Although it has been stated for many times that cement do not stick on the dura, scraping with a micro neuron coronoid and micro Penfield dissector is suggested in order not to damage neurological system while removing the cement¹⁹. It is also suggested that cement stuck on the

dura can be cleaned by high speed burr and for the intradural cement leakages, duratomy and relevant root should be scraped carefully¹⁹. In our case, cement was not stuck on the dura and it was removed without dura damage. It should be kept in mind that cement could be stuck on the dura and there might be intradural leakage.

It was noted in the literature that the procedure to remove the cement could require instrumentation. Sidhu et al. have suggested instrumentation after removing the cement for the patients especially with moderate osteoporosis if they have instable vertebral injuries and if it causes iatrogenic instability and deformity by decompression ¹⁹. In our case, the cement was removed with limited hemilaminectomy and there did not occurred a need for instrumentation.

Some approaches have been suggested in order to decrease the risk of neurological deficit development. It is highly necessary to guarantee that posterior body wall is intact via imaging techniques¹¹; to make sure that cannula does not go beyond the medial and lateral walls of pedicle in anteroposterior graphy¹²; to wait till the cement comes to toothpaste texture before cement injection³; to stop cement injection when it reaches ¹/₄ posterior part of vertebral corpus²¹. On the other hand, some authors suggest doing the procedure with local anesthesia in order to realize the neurological deficit early¹⁹.

Percutaneous vertebroplasty is a minimally invasive and easy applicable technique which can be used for painful vertebra compression fractures dependent on osteoporosis and malignancy. However, it should be kept in mind that there could be major complications. We believe that removing the cement in the early period of neurological deficit occurred after the spinal leakage has a positive influence on clinical recovery.

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Address: Murat MERT, Özel Gaziosmanpaşa Hastanesi Merkez Mah. Çukurçeşme Caddesi No: 51 Gaziosmanpaşa / İSTANBUL
GSM: 0532 323 28 58
E-mail: sinanerdogan@hotmail.com
Date of arrive: 1st August, 2015
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REVIEW ARTICLE / DERLEME

COMPLICATIONS OF ANTERIOR CERVICAL SPINE SURGERY: REVIEW OF THE LITERATURE

ANTERİOR SERVİKAL SPİNAL CERRAHİ KOMPLİKASYONLARI: LİTERATÜR GÖZDEN GEÇİRİLMESİ

> Ali Haluk DÜZKALIR¹, Selçuk ÖZDOĞAN², Nail DEMİREL³, Cumhur Kaan YALTIRIK⁴

SUMMARY

Anterior cervical spine surgery has long been used as a standard procedure in the surgical treatment of spondylosis, disc herniations, spine tumors, deformities, traumas, ossified posterior longitudinal ligament (OPLL) and vascular diseases. Various procedures for this approach generally have satisfactory outcomes, and low and manageable complication rates. However, life-threatening conditions may occur. Also, as new procedures and technologies develop, new complications are encountered. All of these complications should be considered during surgical planning to avoid catastrophic events and for satisfactory results.

Key words: Anterior cervical spine surgery, cervical spine surgery complications anterior cervical approach

Level of evidence: Review article, Level V

INTRODUCTION:

Anterior cervical spine surgery has long been used as a standard procedure in the surgical treatment of spondylosis, disc herniations, spine tumors, deformities, traumas, ossified posterior longitudinal ligament (OPLL) and vascular diseases. These pathologies affect the stability of spine, which means the protection of integrity in physiological loading limits without pain and neurological deficits. Therefore; the aim of anterior approaches should be providing the reconstruction of spine, eliminating neurologic compression and maintenance of stability.

Since the description of the anterior approach for cervical discectomy and fusion by Robinson and Smith (38) in 1955, anterior cervical approaches have become the most common procedures performed

ÖZET

Anterior servikal omurga cerrahisi; spondiloz, disk hernileri, omurga tümörleri, deformiteler, travma, ossifiye posterior longitudinal ligament ve vasküler hastalıkların tedavisinde uzun zamandır standart bir prosedür olarak kullanılmaktadır. Bu yaklaşım ile gerçekleştirilen çeşitli prosedürlerin genellikle tatminkar sonuçları ve hem az hem de kontrol edilebilir komplikasyon oranları vardır. Bununla birlikte, hayatı tehdit eden durumlar da gelişebilir. Ayrıca, yeni metodlar ve teknolojiler geliştikçe, yeni komplikasyonlarla da karşılaşılmaktadır. Felaketle sonuçlanabilecek durumlardan kaçınmak ve tatminkar sonuçlar elde edebilmek için, cerrahi girişimin planlanması sırasında tüm bu komplikasyonlar göz önünde bulundurulmalıdır.

Anahtar kelimeler: Anterior servikal spinal cerrahi, servikal spinal cerrahi komplikasyonları, anterior servikal yaklaşım

Kanıt Düzeyi: Derleme, Düzey V

by spinal surgeons. In the advancing years, various surgeons have used plate-screw systems with fusion in addition to Robinson and Smith's technique (6). In recent years, dynamic systems such as intervertebral cages and cervical disc prosthesis have been introduced for anterior stabilization. Besides, various minimally invasive interventions were identified that have satisfactory results. In 1996 Jho described microsurgical anterior cervical foraminotomy as a new minimally invasive method in the treatment of cervical disc herniation that protects the disc and allows enough neural decompression (23). Then he reported the results of the same method for cervical spondylotic myelopathy in 1997 (24). In 2000 Saringer et al. modified Jho's technique and described uncoforaminotomy, then reported their series of 34 cases of cervical radiculopathy treated by this technique (39).

¹ Yeniyüzyıl University Medicine Faculty Gaziosmanpaşa Hospital, Neurosurgery Clinic, İstanbul

² Dr.Lütfi Kırdar Kartal Training and Research Hospital, Neurosurgery Clinic, İstanbul

³ Medical Park Gaziosmanpaşa Private Hospital, Neurosurgery Clinic , İstanbul

⁴Yeditepe University Hospital, Neurosurgery Clinic, İstanbul

These procedures generally have satisfactory outcomes, and low and manageable complication rates. However, life-threatening conditions may occur. Also, as new procedures and technologies develop, new complications are encountered.

There are vulnerable important organs anterior to the cervical spine. These are trachea, esophagus, carotid artery, recurrent laryngeal nerve (RLN), and sympathetic nerve trunk anterior to the cervical spine. Also, dura, spinal cord, nerve roots and vertebral arteries are important structures likely to damage during anterior cervical spine surgeries. The complications which cause major morbidity/mortality are the most common ones. They usually occur intraoperative, early postoperative (within 1 week), and intermediate postoperative (1 to 6 weeks) periods and include esophageal injury, vertebral artery injury, dural tear, spinal cord/nerve root injury, airway compromise, epidural hematoma, radiculopathy, dysphagia, dysphonia, wound infection, and bone graft dislodgment. Longer term complications include adjacent segment disease and fusion failure (10). All of these complications should be considered during surgical planning to avoid catastrophic events and for satisfactory results.

INTRAOPERATIVE COMPLICATIONS:

Esophageal injury:

Esophageal perforation is rare but a life-threatening complication. It occurs with an incidence of 0.02-3.4 % (9, 15, 35, 36). Perforation occurs at upper esophagus or pyriform sinus of pharyngoesophageal junction. It is usually due to wrong placement of retractors, trauma by a high-speed drill or sharp instruments and prolonged retraction resulting in an ischemic injury. It is rarely recognized intraoperatively, but diagnosed within 10 days of surgery in many cases. However, in some cases symptoms develop several months/years after surgery (47). Anterior plating increases the risk of delayed esophageal perforation (36) but plate removal is not usually performed. High mortality rates (4-50 %) due to mediastinitis, sepsis or meningitis after esophageal injury have been reported (9, 15, 35). Therefore, early diagnosis and treatment are important.

To avoid this complication, retractor teeth should be placed under the longus colli muscles, and esophagus should be protected by hand-held retractors while using high-speed drill. In case of any clear fluid or air leakage observation intraoperatively, esophagus should be immediately investigated and the tear should be repaired if found. If not, surgeon must be aware of the signs like postoperative sore throat, dysphagia, mis-swallowing, fever, tachycardia and pneumoderma which suggest esophageal injury (9, 15, 35). Rapid contrast imaging and/or endoscopy should be performed in such suspected patients. Feeding tube placement should also be performed for these patients.

Delayed perforations are very rare and may be due to the chronic contact between the pharyngooesophageal wall and the instrument. Repetitive friction leads to successive necrosis, formation of traction-type pseudodiverticulum, perforation and abscess formation from the leaking fluid (16, 55). Some cases with a well-positioned hardware were reported (9, 32, 45) as well as other cases including graft dislodgement, screw migration or plate failure (13, 17, 43, 51, 55). If any anterior migration of instrument or graft detected during follow-up, contrast imaging and/or endoscopy of esophagus should be considered.

Vascular injury:

The vertebral arteries arise from the subclavian arteries, then enter deep to the transverse process of the level of C6, or occasionally at the level of C7. They then proceed superiorly, in the transverse foramen of each cervical vertebra. Once they have passed through the transverse foramen of C1, they travel across the posterior arch of C1 and through the suboccipital triangle before entering the foramen magnum. The mean distance from the uncovertebral joint to the transverse foramen has been re- ported to be 5.5 mm in the subaxial vertebrae, although anatomic variants are common (10). Curylo et al. (8) reported a 2.7% incidence of unilateral artery displacement, with transverse foramen enlargement as far medial as the midvertebral body level.

Vertebral artery injury due to anterior cervical spine surgery is rare with an incidence of 0.1–0.5%, but often results in severe neurological deficit (33). Most of the injuries occurred during the procedures including corpectomy (22). Inter-uncovertebral distance decreases from caudal to cephalad. Therefore, the risk of injury is greater at cephalad vertebra. Excessively wide corpectomy and lateral bone removal, and loss of vertebral midline or orientation are the

main reasons of vertebral artery injury (4).Vertebral artery tortuosity or other anomalies, such as vertebral artery located anterior to the transverse process, may result in intraoperative injury. So, preoperative contrast-enhanced computed tomography imaging is mandatory for the cases requiring uncovertebral joint resection (47).

In case of vertebral artery injury intraoperatively, compression of the bleeding point using gelform or cottonoids should be tried, and threads or vascular closure staples can be used for repair of arterial wall. When these trials fail, ligation of vertebral artery can be considered, but it may lead to cerebellar/brain stem infarction and the mortality rate is as high as 12% (47). Intraoperative angiography before ligation is recommended to ensure adequate cerebral perfusion. Alternatively, injuries that appear to be controllable via direct tamponade may be treatable endovascularly via stent or coagulation, depending on the angiographic appearance of the contralateral circulation (10).

Carotid artery injury during anterior cervical procedures is quite rare (21). Prolonged retraction of the common carotid artery may lead to lethal stroke (52). Preoperative evaluation of the carotid artery should be considered for the patients with a history of previous stroke, and approach side should be discussed and long retraction should be avoided (47).

Dural injury:

Incidence of dural tear due to the anterior cervical spine surgery is 1% or less in many reports (54). Subcutaneous cerebrospinal fluid (CSF) leakage may lead to wound healing failure, infection or dysphagia by mass effect (42).

In some cases dura can be directly repaired depending on the location of the defect. Widening the exposure and primary repairing of the defect with application of fibrin glue or sealant should be attempted. Because of the lack of a closed fascial space, as exists in the lumbar spine, inserting a lumbar CSF drain may be considered even if adequate repairing is done (7). However, it is generally difficult to repair the dura directly because of limited space in anterior cervical procedures. In these cases, synthetic dural substitute and fibrin glue can be just placed on the dura followed by a lumbar CSF drain application (47).

Spinal cord and root injury:

Spinal cord and nerve roots are always at risk of

anterior cervical spine surgery. The incidence of spinal cord injury during anterior cervical spine surgery is reported between 0.2% to 0.9% (10). Patients with myelopathy, cervical kyphosis, spinal cord atrophy, spinal intability or fractures are at increased risk of spinal cord injury. Maintenance of systolic blood pressure over 80 mm Hg and avoidance of excessive extension or distraction of the neck during patient positioning are known precautions to prevent iatrogenic spinal cord injury (10).

Particularly during the surgery of the patients with marked instability or myelopathy, use of intraoperative neurologic monitoring with transcranial electric motor-evoked potential (tceMEP) monitoring and somatosensory-evoked potential (SSEP) seems feasible (28). Hilibrand et al. (20) reported the sensitivity and spec- ificity for detecting evolving motor tract injury with tceMEP was 100%, compared with a 25% sensitivity and 100% specificity with SSEP in their retrospective study of patients undergoing cervical spine surgery.

Interestingly, as a well documented but not clearly understood complication, C5 palsy may occur either after anterior or posterior surgeries of the cervical myelopathy. It is estimated to occur in 0–30% of the patients after the anterior cervical spine surgery, but the etiology is still unclear. There is higher incidence after anterior corpectomy+fusion than anterior discectomy+fusion, especially when surgery involves C3/4 and C4/5 segments (47). Injury to the nerve root during surgery, nerve root traction due to the shift of cervical spinal cord after decompression, and spinal cord ischemia and reperfusion injury have been proposed as mechanisms of postoperative C5 palsy. However, pathogenesis has not been clarified and there is no effective method for prevention (47).

In case of neurological deterioration postoperatively, emergent magnetic resonance and/or computed tomography imaging should be performed to rule out hematoma or misplaced graft or instrument. In the absence of these pathologies, treatment with steroids, controlled hypothermia and maintenance of mean arterial pressure \geq 90 mm Hg should be applied (20).

Recurrent laryngeal nerve injury:

Hoarseness after the anterior cervical spine surgery has been reported to be a consequence of RLN palsy (3). However, vocal cord trauma during intubation, postoperative acid reflux, and laryngeal and vocal cord edema are the other factors causing hoarseness (1, 25).

Right RLN leaves the vagus nerve and loops under subclavian artery, while the left RLN leaves vagus nerve at the mediastinum and passes over the aorta. After branching from vagus nerve, right nerve does not go into the tracheoesophageal groove until it approaches the cricothyroid joint, whereas left RLN ascends within the tracheoesophageal groove (47). Right RLN was thought to be easily injured by right side approach of the anterior cervical spine surgery, because it might cross the operative field (34, 47). However, the incidence of postoperative hoarseness does not differ by the side of approach (26). The incidence of RLN palsy had been reported to be 2–3% (3, 26). Besides, a recent prospective study showed the incidence of hoarseness and subclinical laryngoscopic vocal code paralysis was 8.3%, 15.9% at 3-7 days, and 2.5%, 10.8% at 3 months after surgery, respectively (25). RLN palsy seems more frequent than anticipated.

RLN injury can occur intraoperatively as a result of compression, blunt trauma, nerve division, neurapraxia, or postoperative edema. Apfelbaum et al. (1) found that pharyngeal tissues adjacent to the endotracheal tube were subject to significant compression. They indicated that endotracheal tube cuff pressure reduction to 15 mm Hg after retractor placement reduces the incidence of RLN injury from 6.4% to 1.7%.

Endotracheal tube cuff pressure monitoring and release after retractor placement may prevent injury to the RLN during anterior cervical spine surgery (47). For patients suffering prolonged dysphonia following anterior cervical spine surgery, referral to a speech pathologist or otolaryngologist is appropriate to help determine the cause (10).

POSTOPERATIVE COMPLICATIONS:

Airway obstruction:

Acute airway obstruction after anterior cervical procedures is a life-threatening adverse event which must be evaluated and treated immediately. Airway obstruction is caused by retropharyngeal hematoma, edema of soft tissues, CSF leakage, graft or instrument displacement, or aspiration and the incidence is 1–6% (2, 31). It occurs minutes to 10 days after surgery, but most frequently, in 24–48 hours (47). Recently, local

retropharyngeal steroid administration is reported to reduce prevertebral soft tissue swelling (31), but careful hemostasis and avoidance of prolonged retraction are essential to prevent this catastrophic event (47). Multi-level surgery (> 2 disc-level), surgery cephalad to C4, bleeding more than 300 ml and long operation time (> 90 min or > 5 hours) are risk factors for postoperative airway obstruction (31). Epstein et al. (12) recommended that patients to be kept intubated after multilevel anterior cervical spine procedures until they demonstrate adequate ventilatory weaning parameters while off of sedation, satisfactory air leak around a deflated endotracheal tube balloon, and bronchoscopic evidence of minimal airway swelling.

This adverse event can occur despite placement of a postoperative drain and adequate hemostasis at the time of wound closure due to increased blood pressure, coughing, vomiting, coagulopathy, or the use of an anticoagulant (10). In case of the airway obstruction due to hematoma, early detection and hematoma evacuation are the keys to save patients (47).

Dysphagia:

Dysphagia is the most common adverse event following anterior cervical spine surgery (10). Recent studies reported that a big percentage of patients undergoing anterior cervical spine surgery experience some degree of postoperative dysphagia, with rates ranging from 28% to 57% (30, 44). Risk factors for postoperative dysphagia include a longer duration of preoperative neck or shoulder pain, age >60 years (44), female sex (30), operations on two or more levels (30), involvement of C4–C5 and C5–C6 levels (30), revision surgery (30) and thicker anterior cervical plates (30).

Esophageal denervation, soft-tissue swelling and scar tissue formation are the most common reasons of swallowing difficulty after anterior cervical spine surgery (10). Cervical immobilization, compression of instruments, CSF leakage, hematoma and injury to the nerves involved in swallowing are other possible reasons of swallowing difficulty (14).

Patients with marked postoperative dysphagia should be evaluated with lateral plain radiographs or computed tomography scan for bone graft dislodgement, retropharyngeal abscess, and postoperative edema or hematoma (10). Contrast enhanced imaging and/or endoscopy may be considered to rule out esophageal damage. Use of corticosteroids for dysphagia remains controversial. Patients with persistent dysphagia or with suspected aspiration due to coughing, choking, or atelectatic changes on chest radiographs should undergo speech pathology evaluation and active swallow therapy (30). In the patient with severe dysphagia that persists longer than 1 to 2 weeks, temporary feeding tube placement may be considered (10).

Graft extrusion or displacement:

Bone graft extrusion is a serious complication of anterior cervical spine surgery and generally requires revision surgery. It has been encountered mostly following multilevel cervical corpectomy procedures (40, 50). Wang et al. (50) reported 6.4% rate of graft migration or displacement in their review of 249 patients undergoing cervical corpectomy. They reported an increasing rate of migration with increasing levels of corpectomy, particularly in the procedures ending at C7. Sasso et al. (40) reported a rate of 6% failure after two-level anterior cervical corpectomy, and a rate of 71% failure after three-level corpectomy with fusion despite use of anterior plate. Other risk factors for graft extrusion include previous cervical laminectomy, osteoporosis, and graft overtensioning, all of which may contribute to vertebral body fracture and secondary graft dislodgement (10, 11).

In general, a patient who requires corpectomy of two or more vertebral levels should be considered for simultaneous posterior instrumented spine fusion. Combining one or two-level corpectomy with discectomy allows segmental anterior plate fixation and may avoid the need for adjacent posterior fixation (10). Use of a buttress plate without same-stage posterior instrumented fusion should be avoided because it likely does not reduce the incidence of graft extrusion and may result in air-way compromise (37).

Epidural hematoma:

Postoperative epidural hematoma is a rare but classical complication of cervical spine surgery (18). Patients presenting with a new postoperative deficit should warn the surgeon about epidural hematoma (27). Rapid surgery is a determinant factor of a full neurologic recovery (41). The neurologic signs may be consistent with a lesion at the upper part of the cervical spinal cord rather than at the level of the surgical site. Therefore, an MRI examination should have been performed before any further surgery was undertaken (18). However, postoperative cord dysfunction may also be caused by spinal cord injury during

surgery and incorrect alignment of the spine associated with graft complication (53).

Multilevel surgical procedures and the presence of a preoperative coagulopathy are significant risk factors for epidural hematoma after spinal surgery (27). It may be caused by arterial bleeding or bleeding from epidural veins (29). Adequate hemostasis and drain placement should be applied especially during multilevel procedures. When intraoperative neurophysiologic monitoring is used, it should be continued through wound closure and reversal of anesthesia, as neurologic deficits resulting from hematoma formation can develop at the end of the surgical procedure (29).

Infection:

Infection is quite rare after anterior cervical spine surgery, with an estimated incidence of 0.2% to 1.6% (2). However, the incidence is higher in the instance of esophageal perforation or an immunocompromised patient (10). It rarely resists antibiotics. However, esophageal injury or osteomyelitis should always be kept in mind in case of persistent symptoms. Resistant organisms and persistent infections should be considered for anterior hardware removal and regrafting, with the addition of posterior stabilization and fusion if needed (10).

Adjacent segment disease:

Spondylotic changes occur at adjacent vertebra segments following anterior cervical fusion surgery (5). In the recent systematic review of the articles with an average follow-up of 107 months after anterior cervical discectomy and fusion, the average incidence of asymptomatic adjacent segment degeneration is 47.33% and for symptomatic adjacent segment disease was 11.99% (5). Long-term follow-up studies reported a rate between 2-15% revision surgery due to adjacent segment disease (19, 46, 48).

Cervical disc arthroplasty has been expected to preserve the range of motion of cervical segments and reduce the incidence of adjacent segment degeneration, however, the effect is still controversial (47). A recent meta-analysis of prospective studies compared arthroplasty and single level fusion at 2 years to 5 years of follow-up (49). The rate of adjacent level surgery was 6.9 % after anterior cervical discectomy and fusion and 5.1 % after arthroplasty, with no statistical difference. In conclusion, there is no effective surgical procedure to reduce the incidence of the adjacent segment disease (47).

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Address: Selçuk ÖZDOĞAN, Kartal Dr.Lütfi Kırdar Eğitim ve Araştırma Hastanesi Cevizli-Kartal İstanbul Türkiye Tel: +90 506 763 71 73 Fax: +90 216 578 49 65 E-mail: drselcukozdogan@hotmail.com Arrival date: 22th July, 2015 Acceptance date: 16th September, 2015
REVIEW ARTICLE / DERLEME

ADULT SCOLIOSIS

YETİŞKİN SKOLYOZU

Emre KARADENİZ¹

SUMMARY

Adult scoliosis deformity afflicts a significant portion of the elderly and is increasing in prevalence. Back pain and deformity are major indications for surgery in adult scoliosis. Understanding the pathoanatomy and behavior of this disease would change the patient outcome. When selecting a treatment method, major symptoms and underlying medical disease should be carefully evaluated, not only to relieve symptoms but also to minimize complications. True decision of the surgical option and fusion levels that varies to patient needs evidence based approach. And this will decrease the unexpected results.

Key words: Adult scoliosis, diagnosis, surgical treatment

Level of evidence: Review article, Level V

INTRODUCTION:

Adult scoliosis defines a broad spectrum of deformity that can result from scoliosis in childhood or arise de novo from degenerative changes. Adult scoliosis has different epidemiologic, etiologic and symptomatic patterns then childhood scoliosis. Because of this, approach to adult scoliosis differs significantly from childhood scoliosis. In the child with scoliosis, the primary goal of care is to avoid the consequences of deformity progression. But in adult scoliosis patients characteristically present with pain, functional limitations, neural symptoms and symptomatic deformity resulting quality of life impairment. Improvement of present pain and disability is an important and measurable goal of treatment for adults with scoliosis.

The purpose of this review is to discuss the adult scoliosis that affect the spine and to define specific consideration that are useful in guiding and developing an evidence based approach to care.

EPIDEMIOLOGY:

Presently, a scoliotic curve of more than 10 degrees exists in 1.4 to 12 % of the population (47). Adult sco-

ÖZET

Yetişkin skolyozu; yaşlı populasyonun önemli kısmını etkilemekte ve prevelansı artmaktadır. Bel ağrısı ve deformite yetişkin skolyozunda cerrahi için major endikasyonlardır. Hastalığın patoanatomisini ve davranışını anlamak tedavi sonuçlarını değiştirebilir. Tedavi yöntemi kararını verirken asıl şikayetin ve altta yatan hastalığın dikkatli olarak değerlendirilmesi sadece sikayetleri ortadan kaldırmayı değil komplikasyonlarıda azaltır. Hastadan hastaya farklılık gösteren, cerrahi seçeneğin ve füzyon seviyelerinin doğru seçilmesi kanıta dayalı yaklaşım gerektirir ve bu istenmeyen sonuçları azaltacaktır.

Anahtar Kelimeler: Erişkin skolyozu, tanı, cerrahi tedavi

Kanıt Düzeyi: Derleme, Düzey V

liosis afflicts a significant portion of the elderly and is increasing in prevalence and ranges widely from 8.3 % to 68 % of population, with a higher prevalence occurring among older patients (2,8,34,21). The source of variability is related to differences in definition of scoliosis, methods of defining cohorts, sample size and screening tools. Healey et al. identified curves over 10 degrees in more than 50 % of elderly females with back pain and osteoporosis (20). Robin et al. identified some degree of scoliosis in 70 % of adults, between ages 50 and 83 with 30% of those having curves greater than 30 degrees (30). The incidence of symptomatic adult scoliosis reportedly is 6 %, and the average age of those first seeking medical care is 60 to 69 years. Cosmesis tends to be the primary concern among adolescents with scoliosis.

PATHOPHYSIOLOGY AND NATURAL HISTORY:

Unlike adult idiopathic scoliosis, with its array of curve patterns, the degenerative scoliosis curve typically occurs in the lumbar spine. Degenerative scoliosis is usually seen in elderly adults over the age of 60. The scoliotic curve is caused by degeneration of the intervertebral disks and facet joints. The degeneration of these spinal column segments can cause instability leading to rotation, lateral listesis, spondylolistesis, kyphosis or osteoporosis with vertebral body compression fractures (48). As patients age and develop further degeneration of the vertebrae and surrounding structures, their curves may progress at a faster rate. Adult degenerative curves are typically of smaller magnitude than those seen in adult idiopathic scoliosis (19).

The risk factors of curve progression may be a curve size over 30 degrees, an asymmetric disc above and below the apical vertebra, lateral subluxation of the apical vertebra over 6 mm and L5 vertebra being located above rather than below the intercrestal line (29).

DIAGNOSTIC EVALUATION AND IMAGING:

As in all scoliosis evaluation; during the physical examination of the patient, a three-dimensional assessment of the spine is appropriate to evaluate patient posture, neurological assessment, hip flexion contractures, leg length inequality, the presence of pelvic obliquity, evaluation of body habitus, and nutritional status.

Careful physical examination is important in the assessment of the deformity. Addressing the main complain is paramount. A big curve may be the main cause of symptoms or a big curve without symptoms may be with single root entrapment symptoms. Neural deficit and radicular symptoms are an important clinical presentation of adult scoliosis. Spinal canal stenosis and foraminal narrowing are common findings that may need to be addressed if they correlate with findings on history and physical examination. Surgeon should define if there is a correlation of nerve root's myotome and dermatomes with the pain distribution area.

Radiographic assessment of the adult with scoliosis requires occiput to femoral heads standing posterior anterior and lateral views. The cobb angles should be measured on the PA and side-bending radiographs. The stable, neutral and apical vertebrae should also be identified on the PA and side-bending films to aid with preoperative planning. Inadequate plain film evaluation may lead to an incomplete assessment of the cause and extent of deformity (22).

Advanced imaging with magnetic resonance imaging (MRI) or computer tomography (CT) scan is important to assess the role of decompression of the neural elements. **(Figure-1)** Intrinsic intervertebral disc degeneration is best measured with MRI and facet arthropaty is most apparent with CT scan. In the osteoporotic patient with compression fracture, MRI is also helpful in detecting recent fractures that may be amenable to non-operative or less invasive surgical options (vertebral augmentation). In patients with previous fusions or attempted fusions, CT and bone scans are useful to assess bony union or the presence of a pseudoarthrosis (14,4).



Figure 1 a:

Figure 1 b:

Figure 1 c:

Figure-1. 74 year old female with radicular symptoms and back pain. **a.** PA roentgenogram of the patient with degenerative scoliosis. T12-L3 cobb angle was 18 degree. **B.** Lateral roentgenogram of the patient showing osteophyte formation and disk height reduction. **c:** Sagittal MRI of the patient showing disk degeneration , modic changes and spinal stenosis.

CLASSIFICATION:

The mostly used and simple classification of adult scoliosis is based on the onset of the scoliosis age. Adult idiopathic scoliosis, which begins during the adolescent period and continues throughout adult-hood; and adult degenerative scoliosis, which develops post-adulthood (19,1,13). It is difficult to make a clear differentiation between the two types of scoliosis. If a patient's scoliosis begins in adolescence, it is categorized as adult idiopathic scoliosis. However if the patient does not know exactly when the deformity began, the type may not be definitively determined. **(Table-1)**

Aebi classification divides types based on causes, and helps in planning overall treatment and predicting the natural progress of scoliosis. Type I is primary degenerative scoliosis caused by degenerative changes in the vertebral disc asymmetry and the posterior articulation. Type II is progressive idiopathic scoliosis, which is caused by further development of idiopathic scoliosis that started before adulthood. Type III is secondary adult scoliosis. Type IIIa is caused by extra vertebral causes such as static scoliosis or pelvic inclination. Type IIIb is a type of bone metabolic disease similar to osteoporotic fracture and scoliotic deformity that is caused by weakness of vertebral bone (1).

The Scoliosis Research Society's (SRS) classification system categorizes the form of curvature into six different types and three modifiers, referencing the model of King's classification and Lenke classification for adolescent idiopathic scoliosis. The system focuses on radiographic features of spinal deformity and enables comprehensive categorization with inclusion of not only scoliosis, but also kyphosis (24).

Schwab classification focuses on the relationship between radiological findings and clinical evaluation,

which categorizes the apex of the curve, lumbar lordosis and vertebral body subluxation based on radiological findings. Surgical management is more commonly performed in patients with decreasing lumbar lordosis and higher vertebral subluxation (35).

SRS-Schwab classification considers the relationship between spino-pelvic parameters and sagittal balance. This system consists of four components: curve type, pelvic incidence minus lumbar lordosis modifier, global alignment modifier, and pelvic tilt modifier. Curve type is divided into T: thoracic only, L: TL/lumbar only, D: double curve with T and TL/L curves >30°, N: No major coronal deformity. This classification reflects the severity of disease and suggessts guideline for treatment. But still there is no suggestion of specific treatment like fusion level of the deformity, so surgical methods should be individualized (36).

NONSURGICAL TREATMENT:

Nonsurgical management is offered as the first line of conservative care but its efficacy is not well supported in the literature. In the absence of neurological deficit or significant instability, non-operative care should be initiated with all patients. In the absence of cardiovascular contraindications, physical therapy, stretching, and aerobic conditioning are encouraged in such patients (37). Other treatments for deformity include core strengthening, specifically aqua therapy, walking, cycling, plates, and yoga (31).

Only a few patients can benefit from temporary relief with bracing in combination with exercise as it has been shown to be ineffective in significantly preventing curve progression in adult spinal deformity (37,39,26). Despite the possibility for pain relief, brace discomfort and trunk muscle balancing should be weighed in the decision making to use as a form of non-operative treatment. It is quite reasonable to

Characteristic	Type I	Туре II
Description	Primary degenerative (De novo) scoliosis	Progressive idiopathic scoliosis
Location	Thoracolumbar and lumbar spine	Thoracic, thoracolumbar or lumbar spine
Type of curve	Short, sharp	Long segment
Flexibility	Rigid	Semi- flexible
Predominant pathoanatomy	Asymmetric disk collapse, lateral listesis, wedging of vertebrae	Rotation, tilting of vertebrae
Symptoms	Back pain, radicular pain, claudication pain, fatigue, los of global balance	Back pain, loss of global balance, fatigue

Table-1. Comparison of Type I and Type II Adult Scoliosis

consider the use of alternative treatments including acupuncture, chiropractic care.

Non-steroidal anti-inflammatory drugs (NSAIDs) can often alleviate the arthritic type of symptoms. However, it is critical to counsel the patients about the specific side effects such as gastrointestinal irritation, elevation of blood pressure, thrombocytopenia, and renal toxicity. Vestergaard et al. reviewed the risk of fractures associated with the use of NSAIDs. The study reported an increase in fracture risk associated with low doses of common pain relievers such as ibuprofen, diclofenac, and acetaminophen; they attributed this increase to falls as opposed to weakened bone structure (45).

Other non-narcotic medicines such as antidepressants and anticonvulsants could also be considered. If patients suffer from night pain and difficulty sleeping, tricyclic antidepressants can offer assistance with these problems. Gabapentin and pregabalin may decrease neurogenic pain and assist with sleep. However, the major side effect of such medications is sedation, and it is not well tolerated by some patients. If a patient cannot tolerate the side effects during the day, they often take it only at night for sleep and nerve pain relief (48).

In an acute exacerbation of back pain and radiculopathy, there may be some role for narcotic pain medicine. However, the chronic use of these medicines is not recommended. The long-term side effects and addiction potential should be strongly considered when prescribing these medicines. Vestergaard et al reviewed the risk of fractures associated with the treatment of morphine and opiate therapy. The study reported an increased fracture risk associated with morphine, fentanyl, methadone, oxycodone, nicomorphine, ketobemidone, tramadol, and codeine (46).

Injection therapy is another alternative non-operative option. Although the evidence for injection therapy as a tool to decrease or eliminate pain is not clearly defined in the literature, patients often experience extended pain relief with injection therapy, thus reducing the need for medication in such patients (15). Injection therapy can include epidural steroids, facet blocks, nerve root blocks, and trigger-point injections. Non-operative treatments may be used alone or in any combination.

Glassman and colleagues reviewed the non-op-

erative resource used by 123 adult with scoliosis. Patients treated non-operatively reported no improvement in pain or disability over a 2 year follow-up. This study brings into question the value of non-operative treatment commonly used for adult scoliosis patients (18). Smith et al reported on a total of 317 patients who experienced back pain in adults with scoliosis. From the 317 patients involved in the retrospective review, 147 patients underwent surgery for adult deformity and 170 were treated non-operatively. At the 2-year follow-up evaluation, patients receiving operative treatment demonstrated significant improvement in patient outcomes reporting lower Numerical Rating Scale and Oswestry Disability Index (ODI) scores as compared with patients receiving non-operative treatment. The study concluded that surgical treatment can result in significantly improved back pain in those patients who are symptomatic (40). Li et al reported on 83 patients, 34 of whom were treated operatively and 49 who were treated non-operatively. Compared with the non-operative group at 2-year follow-up, patients in the operative group demonstrated significant improvement in pain, self-image, mental health, health-related quality of life, and overall satisfaction with their treatment (23). As reflected in literature, a lack of evidence exists to support the effectiveness of non-operative treatment (31, 37).

SURGICAL TREATMENT:

The goal of surgery is to relieve back pain, improve radiating pain and claudication and correct deformity (5,25). A combination of surgical options may be carried out to achieve these goals, including decompression, fusion and/or correction of deformity. Long level fusion including deformity correction may induce excessive blood loss and prolonged surgery time, both of which lead to more postoperative complications. If such complications are anticipated, limited surgery can be selected considering the patient's age and general medical condition. However pain usually recurs when limited surgery is selected, and degenerative change may progress in the non-fused area, eventually causing adjacent segment disease.

Surgical options include: decompression alone; decompression and limited short fusion; and decompression and long fusion with correction of deformity. Surgery should be selected with a full understanding of the cause of symptoms while considering the advantages, disadvantages, indications and complications of each surgical option (3).

1. Decompression alone:

Although most patients require decompression surgery for radiating pain, decompression alone is not usually recommended in adult degenerative scoliosis. After wide laminectomy and facet joint resection, deformity and instability may worsen, causing recurrence of spinal stenosis (44). However this method can be applied in elderly patients with poor medical conditions who have a high likelihood of per-operative complications. Nevertheless decompression alone at the apex of curvature is not indicated at which the lateral subluxation is severe. This procedure can be considered in small scoliosis curve without lateral subluxation.

2. Decompression and limited short fusion:

Limited short fusion in which decompression is performed is another option to prevent the spinal instability that arises from decompression alone. Limited short fusion does not involve fusion of the whole curve, but only a decompressed area. This technique is a good choice in moderate scoliosis curve and mild subluxation of the apical vertebra. Adjacent segment disease is a common complication with this method (9). Degenerative changes may be accelerated outside of fusion when fusion stops within the deformity. Thus fusion should not be stopped at the apex of curvature, but should continue above the apex or stop below the apex.

3. Decompression and long fusion with correction of deformity:

When the lumbar scoliosis curve is large and subluxation of the apical vertebra is severe, correction of deformity is required. Improvement of back pain and successful fusion are attributed to the correction of scoliosis as well as restoration of lumbar lordosis and sagittal imbalance. Posterior instrumentation can achieve a correction of scoliosis. However it is difficult to restore lumbar lordosis (13, 9). And this lumbar lordosis usually requires anterior interbody release combined with anterior column support. Restoration of sagittal imbalance is achieved by anterior column support or additional techniques such as vertebral osteotomy (6).

For adult scoliosis surgical treatment, there are a lot of techniques and approaches that has been defined. These techniques include; osteotomy, colon resection, minimal invasive surgery, mini open surgery and etc. Surgical techniques and approaches, are beyond the scope of this review.

GENERAL PRINCIPLES OF SURGICAL TREATMENT:

These points mentioned below should be considered for surgical treatment of adult scoliosis.

1) General condition including medical co-morbidities: Selection of the surgical procedure is highly depends on the general condition of the patient. Patient's cardiopulmonary status, diabetes mellitus presence, increased tromboembolic event risk and etc. affects the procedure selection.

 Osteoporosis: Osteoporosis can weaken fixation strength, causing loss of correction and pseudarthrosis. Segmental fixation and anterior column support may strengthen the fixation, and use of cement around the pedicle screw can enhance screw purchase.

3) Stiffness of curve: In stiff curve it is difficult to achieve optimal correction with surgery. In adolescent scoliosis, the compensatory curve is spontaneously corrected when the major curve is surgically corrected. However spontaneous correction is not as promising in adult scoliosis due to the decreased flexibility of the curve associated with degenerative change.

4) Coronal and sagittal imbalance: Accompanied coronal and sagittal imbalance is common in degenerative scoliosis. Sagittal imbalance leads to poor results in surgery, so that the restoration of imbalance is more critical than correction of scoliosis itself (17).

The fusion level for correction of deformity in degenerative scoliosis has a crucial consideration on the results of surgery. Generally the recognizable criteria to determine fusion level are as follows (19, 1):

1) Fusion should not be stopped at the apex of the curve.

2) The junctional kyphosis is included in the fusion.

3) The severe lateral subluxation is included in the fusion.

4) The spondylolisthesis and retrolisthesis are included in the fusion.

5) The upper instrumented vertebra is better to be horizontal than tilted.

There is debate about the proximal fusion level that it should be extended to T10 or stop at the lumbar spine. Fusion stopped at L1 is likely to cause adjacent segment disease at the thoracolumbar region. To prevent this, fusion up to T10 is recommended since T10 is more stable than T11 and T12 due to true rib attachment on T10. However some surgeons suggest that this cannot prevent adjacent segment disease fundamentally, because it develops as a degenerative process (38). Conversely fusion up to T10 is likely to cause more per-operative complications. Cho et al. reported that fusion to T11 or T12 was acceptable when the upper instrumented vertebra was above the upper end vertebra (10).

It is important to determine whether distal fusion level should be stopped at L5 or extend to the sacrum. The distal fusion usually goes to L5, since the apex of scoliosis is located at L2-4 and the L4-5 disc has degenerative changes. There is no doubt that fusion to the sacrum is performed in patients who have existing pathology at the L5-S1. However there is controversy regarding whether fusion stops at L5 or extends to the sacrum when the L5-S1 segment looks healthy (30,23). Surgery in which the fusion stops at L5 compared to S1 is considered to be relatively small; however this may cause subsequent degeneration at L5-S1. Edwards et al. reported that 61% of patients under fixation at L5 showed degenerative changes, leading to sagittal imbalance and increasing risk of reoperation (16). Accordingly it is preferable to fuse to the S1 in patients with sagittal imbalance, as it is highly likely to cause subsequent degeneration at the L5-S1 segment, even without degenerative change before surgery. Fusion to the sacrum achieve a better correction of sagittal imbalance than fusion to L5. However the complication rate is higher in the fusion to the sacrum. Pseudarthrosis, which is the most common complication at the L5-S1 segment, developed in 42 % of cases of fusion to the sacrum, but 4% of cases of fusion to L5. To prevent pseudarthrosis, interbody fusion and additional iliac fixation are strongly recommended (11). Sagittal decompensation after fusion to the sacrum is not uncommon, and therefore restoration of lumbar lordosis is critical to achieve sagittal balance (12).

COMPLICATIONS:

Complications are associated with all procedures. Surgical treatment for adult deformity, regardless of corrective procedure, is associated with high complication rates (19). Literature-reported complications include pseudarthrosis, infection, neurological deficits, cerebrospinal fluid leaks, failure of implants, catastrophic injury, adjacent segment disease, systemic

complications, and pulmonary embolism (27). Sansur et al reported an overall complication rate of 13.4 % for treatment of adult scoliosis. The study concluded that osteotomies, revisions, and combined approaches resulted in significantly higher complication rates (32). Smith et al retrospectively reviewed the rate of complications associated with surgery for scoliosis in relation to patient age (41). The study concluded that older patients in comparison with younger patients had a significantly greater complication rate at 2-year follow-up. However, despite the greater risk of complications, elderly patients, in comparison to younger patients, demonstrated a greater extent of improvement in standardized measures of disability, pain, and health-related quality of life (43). Smith et al reported a total infection (superficial and deep) rate of 3.7 % from 5801 adult scoliosis patients following surgery. The rate of infection also increased when surgery included a fusion (42). Mok et al reported a reoperation rate of 26% at 2-year follow-up among 89 patients who underwent surgery to treat adult deformity as compared with 65% of patients who did not require a revision procedure (27). Scheufler et al retrospectively reviewed the clinical outcomes and complications of 30 adult scoliotic patients. The study reported a major complication rate of 59.9 % and a minor complication rate of 23.4 %. Despite the high major complication rate, 83 % of patients were satisfied with the treatment at the 1-year follow-up (33).

CONCLUSION:

Adult scoliosis deformity can have a significant and measurable impact on an adult's health-related quality of life. The patient often has an associated comorbidity or osteoporosis. The goals of surgery are to treat pain, relive neurologic symptoms and maintain or restore global balance. The absolute degree of coronal curve correction and cosmesis is less important than the restoration of sagittal balance.

The surgery is technically demanding and associated with significant risk and morbidity. The key questions in surgical planning are the choice of fixation levels, extension of fusion across the thoracolumbar junction, choice of an L5 or sacral end point. The surgical approaches to adult deformity continue to evolve. New techniques and technologies are welcome, but caution is required to determine the indications and safety.

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Address: Site Mah. Cevahir Cad. Soyak Selale Evleri D-3 Blok Daire:4 Umraniye, Istanbul, Turkey e-mail: ekaradenizmd@yahoo.com Phone: +90.532.2816850 Arrival date: 23th June, 2015. Acceptance date: 14th September, 2015.

FRONTIERS OF SPINE SURGERY / OMURGA CERRAHİSİNİN ÖNCÜLERİ

PROF. JÜRGEN HARMS, M.D.

PROF. DR. JÜRGEN HARMS

I. Teoman BENLI¹, Emre KARADENİZ²

SUMMARY

Prof. Jürgen Harms was borned in Darmstadt in 1944. He finished the Medical Faculty of Frankfurt. Jürgen Harms is an internationally renowned specialist in the field of spinal surgery. He has led more than 10,000 spinal surgery and is one of the most experienced spine experts worldwide. He is a pioneer of advanced surgical techniques in scoliosis surgery, tumor surgery, transoral surgery, TLIF technique or the dorsal fixation of the atlanto-axial complex, which are now practiced worldwide.

Key words: Prof. Jurgen Harms, scoliosis, Harms reduction technique, Harms Study Group

Level of Evidence: Biography, Level V

INTRODUCTION:

Prof. Jürgen Harms was borned in Darmstadt in 1944. He finished the Medical Faculty of Frankfurt. Jürgen Harms is an internationally renowned specialist in the field of spinal surgery (12). He has led more than 10,000 spinal surgery and is one of the most experienced spine experts worldwide (27). He is a pioneer of advanced surgical techniques in scoliosis surgery, tumor surgery, transoral surgery, TLIF technique or the dorsal fixation of the atlanto-axial complex, which are now practiced worldwide (11). Many Turkish spinal surgeon had been taken education on spinal surgery from him in Germany.

HISTORY OF LIFE:

Prof. Jurgen Harms was borned in Darmstadt in Germany in 1944. He was attended to the Medical School of Frankfurt University between 1963 and 1968. Than, he finished the residency program of the Orthopaedics and Traumatology in the University of Saarbrücken in 1974 (11-13) (Figure-1).

Focal areas in spinal surgery of him are cervical spine surgery, deformities of the spine, degenerative diseases of the spine, dorsal dynamic stabilization,

ÖZET

Prof. Dr. Jürgen Harms 1944 yılında Almanya'nın Darmstadt kentinde doğdu. Frankfurt tıp fakültesini bitirdi. Jürgen Harms spinal cerrahi alanında dünyaca üne sahiptir. On binden fazla spinal operasyon yapmıştır ve tüm dünyada bu konuda en deneyimli cerrahtır. Omurga cerrahisinin gerçek bir öncüsü ve köşe taşı olup, bir çok gelişmeye imza atmıştır. Anterior cerrahiyi, omurga tümörlerinin cerrahi tedavisini, spondilolistezis redüksiyonunu ve TLIF tekniklerini geliştirmiştir. Bu alanlarda da dünya çapında en çok cerrahi deneyime sahip cerrahtır.

Key words: Prof. Dr. Jurgen Harms, skolyoz, Harms redüksiyon tekniği, Harms Çalışma Grubu

Level of Evidence: Biography, Level V



Figure-1. Prof. Jurgen Harms

¹ Prof. of the Orthopaedics and Traumatology, Director of the Spine Center of the Şişli Kolan International Hospital, Okmeydanı, İstanbul. ² Surgeon of the Orthopaedics and Traumatology, Department of the Orthopaedics and Traumatology of the Ümraniye Teaching and Research Hospital, Ümraniye, İstanbul.

spinal fractures, intervertebral disc prostheses, preservation of mobility, scoliosis, transoral surgery at the craniocervical transition and spinal tumors (12) (Figure-2).



Figure-2. Prof. Harms in the operating room.

In 1978, he was be Professor of Orthopedics in University of Saarland, in city of Saar in Hamburg with the scientific investigations of new surgical techniques as well as new materials and instruments for spinal column and hip surgery (2-7). Since 1980, he has worked as the Medical Director of the Department of the Orthopedics and Spinal Column Surgery in the Academic Teaching Hospital of the University of Heidelberg (11-13) (Figure-3).



Figure-3. Heidelberg University Hospital

Prof. Harms had been set scientific cooperations with spinal column specialists in Europe, America, Asia, Africa and Australia. He had been chairman and speaker at many international congresses worldwide. He also went to teach the experiences of the spinal surgery as a guest professor and guest surgeon in the US, Far East incl. Pacific region, Africa, Europe (27) (Figure-4).



Figure-4. In international spine congress with the contributors.

Prof. Harms is still the consultant on various research projects. He has many publications on new spinal column surgery techniques. He is editor of some orthopedic journals and honorary member of the SRS (27).

In last decade, he has got severe lumbar spinal stenosis. So, he could not attend some international congresses of the spinal surgery. He is operated a few years ago and he can work in the hospital now.

CONTRIBUTIONS FOR THE SPINAL SURGERY:

He is a pioneer of advanced surgical techniques in scoliosis surgery, tumor surgery, transoral surgery, TLIF technique or the dorsal fixation of the atlantoaxial complex, which are now practiced worldwide (12). Many Turkish Spinal Surgeons had been taken education on spinal surgery from him in Germany (Figure-5).



Figure-5. Many Turkish Spinal Surgeons had been taken education on spinal surgery from him in Germany.

Jürgen Harms is an internationally renowned specialist in the field of spinal surgery. He has led more than 10,000 spinal surgery and is one of the most experienced spine experts worldwide (11-13). His transoral approach technique for the odontoid fractures was most popular technique in the cervical spine surgery (22). He determined the new technique for the for the posterior fusion of C1-2 with the screw and rod fixation (10,18,23,26) (Figure-6,7)



Figure-6. The fixation of the odontoid with the transoral approach.

Prof. Harms was determined new technique for the reduction of the olisthesis (8). Necessity of the anterior support of the tricortical bone graft for the best results for the surgery of the spondylolisthesis was established by him (8). He wrote the book named "Pediatric Spine" with Zielke in 1985 (29) (Figure-8.a,b).

In 1994, Dr. Harms contributed for AO Classification of the thoracic and lumbar spine injury (9,16). Prof. Harms also contributed for Lenke classification of AIS in 2003. He designed a new spinal instrumentation system (24-25). Harms Spinal Instrumentation System – HSIS) and titanium cage (Harms cage) (15,17) (Figure-9).

He determined the a new creative technique for posterior resection of the hemivertebrae with posterior spinal instrumentation (20-21)



Figure-7. C1-2 fixation technique of Prof. Harms.



Figure-8.a. and b. Harms reduction technique of the olisthesis (Drawn by Prof. I. Teoman Benli)





The Harms Study Group (HSG) was established in 1995 under the direction of Professor Jürgen Harms and Randal Betz. For the past decade, the Harms Study Group has been internationally recognized for producing the highest quality published research on new spinal deformity surgery techniques and has had over 150 peer reviewed publications in scientific journals. The group has achieved this standard by conducting comprehensive, multi-center prospective research studies aimed at answering important clinical questions regarding treatment approach and techniques. A firm began formally funding HSG in October of 2000, with a grant that covered an administrative budget for Philadelphia, San Diego, and St. Louis. A data reimbursement budget was included for additional study group sites (28) (Figure-10).

In 2001, under the direction of Peter Newton and Randal Betz, the study group advanced with the development of a multi-user, web-driven, scoliosis database. All of the previous data collected by the study group was imported into this secure, multifaceted, comprehensive database. The ability to collect, man-



Figure-10. Harms Study Group (HSG)

age, and extract data was immediately more efficient, as the new database incorporated digital images of radiographs and clinical photographs. To optimize the utility of the new database, formal prospective study protocols were updated for the two main studies of the group: the "Lenke 1 Curve Study", which compared three different surgical approaches in thoracic curves and the "Algorithm Study", which compared approaches for all curve types in order to establish recommended treatment algorithms (28).

In 2002, both prospective studies were underway and the improvements and growth of the group were apparent with the implementation of standardized data collection practices and the organized dissemination of individual member database mining projects. The administration of the group was split between the Philadelphia and San Diego sites (28).

In 2003, additional formalization of the study group occurred with extensive database upgrades. The San Diego site assumed the main administrative tasks of the study group; subcontracting with each site and managing the data verification, invoicing, and data reimbursements. The Harms Study Group grew from twelve to sixteen surgeon members, and the database became the largest Adolescent Idiopathic Scoliosis database in existence (28).

In 2004, the study group continued ongoing prospective data collection and also performed its first multi-center, retrospective study, evaluating the operative management of Scheuermann's Kyphosis. The data for seventy-one patients, including radiographic outcomes, complication tracking, and surgical technique was included. The productivity of the group also grew with a total of nine podium presentations presented at society annual meetings (28).

In 2005, the prospective study of Scheuermann's Kyphosis was launched and three multi-center retrospective studies were developed and implemented by the group:

1) Defining the Incidence of Complications and Risk Factors Associated with the Use of Single Lung Ventilation for Thoracoscopic Surgery in Pediatric Spinal Deformity.

2) Retrospective Cerebral Palsy Scoliosis Study: Quantifying Outcomes and Risks.

3) A Multicenter Retrospective Review of the Results of Three Classes of Surgical Treatment for Congenital Scoliosis Due to Hemivertebrae.

The results of the Retrospective Multi-Center Ky-

phosis Study were presented as a podium presentation in addition to six other podium presentations in 2005(28). In 2006, an additional retrospective study was implemented, comparing severe cases of scoliosis either treated with or without Halo Traction. This study included a peer-to-peer group of surgeons and was facilitated by the HSG. This provided the opportunity for the educational outreach efforts of the HSG to unite with the HSG research endeavors. The HSG also embarked on a medical textbook project relating to the treatment of Idiopathic Scoliosis. In addition, a prospective study of motion preservation following spinal fusion was launched (28).

In 2007, the HSG research infrastructure was launched to sustain the evolution of the group. The infrastructure would be responsible for centralized digital x-ray measurement and storage, data organization and analysis for individual study group member projects, and data quality assurance for all prospective studies. The productivity of the group grew to fifteen podium presentations. The mechanism for digital image transfer was developed and hardcopy films were scanned into digital images for more than half of the 1500 patients in the HSG database. The "Lenke 1 Curve Study" was completed and the "Algorithm Study" was converted into a long-term Database Registry of AIS, in which operative and nonoperative cases were included, with follow-up spanning twenty-five years (28).

In 2008, the HSG research infrastructure activity benefited the group's data integrity and productivity by initiating the conversion of all existing manual xray measurements to digital measurements and creating a new version of the multi-user web-based database. The mechanisms for multi-center study participation were further strengthened by establishing data collection standardization manuals and improved, revised data collection case report forms. To ensure continual communication with all sites, a HSG web-based central folder was established. This central folder housed up-to-date versions of all HSG documents (protocols, CRFs, and manuals) and allowed all remote access to vital study documents. Monthly site coordinator calls were initiated to facilitate site compliance. Two new studies were launched: "The Prospective Study of Scoliosis in Children with Cerebral Palsy" and "The Retrospective Study of Posterior Vertebral Column Resection in Pediatric Spinal Deformity." (28).

In 2009, the Harms Study Group infrastructure focused on migrating the AIS data from the original database application into the improved version of the multi-user web-based database and continued converting all manual x-ray measurements into digital measurements. The study group began a new retrospective study on scoliosis correction in Marfan Syndrome (28).

In 2010, the textbook, <u>Idiopathic Scoliosis: The</u> <u>Harms Study Group Guide to Evaluation and Treat-</u> <u>ment</u>, was published. It was an immediate best-seller for Thieme Publishers. The Harms Study Group Foundation began fund raising efforts and raised over \$100,000 to support HSG research and education outreach (28) (Figure-11).



Figure-11. Harms Study Group Foundation began fund for the research and education.

In 2011, the HSG completed a revised version of "Adolescent Idiopathic Scoliosis: Navigating Your Journey--A Guide for You and Your Family." Twentyfive thousand copies were printed. The group's AIS Database Registry grew to over three thousand patients, and an OREF grant for the Cerebral Palsy in Scoliosis study was awarded, allowing for future funding of this study through 2012 (28) (Figure-12).



Figure-12. OREF grant for the Cerebral Palsy in Scoliosis study was awarded, allowing for future funding of this study through 2012.

The members of the HSG conduct a Cerebral Palsy Scoliosis meeting, made possible by the OREF grant. The patient education handbook was translated into Chinese and Spanish. The productivity of the study group soared to twenty-three podium presentations and twenty-seven poster presentations at scientific meetings (28).

The HSG prospective study of Scheuermann's Kyphosis was completed, as was the prospective study of Post-Operative Motion in AIS, for patients with a two to five year follow-up. The patent education handbook was translated into Turkish and Latin Spanish. The study group's productivity was reflected in twenty-two podium presentations and sixteen poster presentations at annual scientific meetings and conferences (28). Prof. Dr. Jürgen Harms works at the Ethianum Hospital Heidelberg as the medical director and chief physician for spinal surgery. He is widely considered expert in spinal surgery. In 2014 and 2015 he was named as one of Germany's top spinal surgeons by FOCUS magazine. Dr. Harms has also been listed by the Leading Medicine Guide as an expert in spinal surgery (13). He has more than 30 years of experience in orthopedics and spinal surgery. His worldwide renown as a top medical professional is reflected in his international patient list (13,27-28).

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Address: Prof. Dr. İ. Teoman BENLİ, Deparment of Orthopaedics and Traumatology, Director of the Spine Center, Şişli Kolan International Hospital, Kaptanpaşa Mahallesi, Darülacize Caddesi, No:14, Okmeydanı, İstanbul. Tel.: +90 212 222 0 888 GSM: +90 532 205 85 62 E-mail: i.teoman.benli@gmail.com Arrival date: 12th September, 2015 Acceptance date: 30th September, 2015

CME QUESTIONS / STE SORULARI

1- Which animal is preffered in the study of Kazancı et. al.?

- a) Pig
- b) Dog
- c) Cat
- d) Rat
- e) Guina pig

2- Which drug revealed more beneficial results in histopathological evaluations when compared with methylprednisolone in the study of Kazancı *et al*?

- a) Dipridamol
- **b)** Etofenamate
- c) Indomethacin
- d) Diclofenac sodium
- e) Prednisolone

3- Which one morphometric value was used in

the study of Özdoğan *et al*?

- a) Hight of disc
- b) Sagittal index
- c) Spinopelvic inclination angle
- d) Sacral slop
- **e)** SRS24

5- Which sentence of the below <u>is not</u> correct according to the study of Kış *et al*?

a) Brucellosis and tuberculosis must be placed in differential diagnosis of patients with musculoskeletal findings in endemic regions.

b) Multifocal involvement, paravertebral involvement and bone erosion was higher in brucellosis cases

c) This study is included 19 patient

d) Lumbar involvement was present in all of the brucellar, and majority of the tuberculous cases.

e) MRI, which is a non-invasive and highly sensitive imaging modality, should be the first choice in early diagnosis of spondylodiscitis.

6- How many cases with involvements in intervertebral disc and adjacent corpus fields were present in the study of Kış *et al* statistically?

- **a)** 12
- **b)** 8
- **c)** 14
- **d)** 18
- e) All of the patients

4- How many patient was evaluated in the study of Özdoğan *et al*?

- **b)** 100
- **c)** 150
- **d)** 170
- **e)** 190

7- How many cases had been gone to surgery of the patients in the study of Celilov *et al.*

- **a)** 50
- **b)** 55
- **c)** 60
- **d)** 65
- **e)** 70

8- Which complication of the patient with multiple myeloma treated with percutaneous vertebroplasty was presented according to the case report of Özdoğan *et. al.* ?

- a) Dysphonia
- b) Dispne
- c) Pain of neck
- d) Dysphagia
- e) Neural deficit

10- What is the name of the primary degenerative scoliosis according to the review article of Karadeniz ?

- a) Progressive idiopathic
- **b)** De Nova
- c) Spondylopathic
- d) Lower type
- e) Elderly deformity

9- Which complication of the patient cervical pathology treated with surgery was not seen intraoperatively according to the review article of Düzkalır et. al. ?

- a) Vascular injury
- **b)** Recurrent laryngeal nerve injury
- c) Dural injury
- **d)** Dysphagia
- e) Nerural deficit

JTSS 26(2) issue CORRECT ANSWERS OF CME QUESTIONS:

1.	C
2.	c
3.	b
4.	d
5.	d
6.	b
7.	c
8.	d
9.	c
10.	b

The Journal of Turkish Spinal Surgery



18 KASIM 2015 - Çarşamba, Saat: 19.00 / Yer: Özel Hisar Hastanesi, Ümraniye / İstanbul "Vertebral osteotomiler" Dr. Halil BURÇ "Vertebral osteotomi uygulamalarında inciler ve tuzaklar" Dr. Mehmet TEZER "Olgu Tartışması" Dr. Sinan KAHRAMAN, Dr. İsmail OLTULU, Dr. Mehmet Nuri ERDEM Moderatör: Dr. Mehmet TEZER

16 ARALIK 2015 - Çarşamba, Saat: 19.00 / Yer: Özel Şişli Kolan İnternationalHastanesi, Okmeydanı / İstanbul "Spondilolistezis cerrahi tedavisinde inciler ve tuzaklar" Dr. Yener ERKEN "Spinal stenozun cerrahi tedavisinde inciler ve tuzaklar" Dr. İ. Teoman BENLİ "Olgu Tartışması" Dr. Emre KARADENİZ, Dr. Seçkin SARI, Dr. Sinan ERDOĞAN Moderatör: Dr. İ. Teoman BENLİ

13 OCAK 2016 - Çarşamba, Saat: 19.00 / Yer: Kadıköy Sonomed Plaza, Kadıköy / İstanbul

TOD - TND KARDEŞLIK TOPLANTISI-1 Konjenital Spinal Deformiteler" Dr. Ufuk TALU Diastometamyeli ve Gergin Omurilikde Yaklaşımlar" Dr. Tufan HİÇDÖNMEZ Sagital plan deformiteleri ve Scheuermann kifozu" Dr. Cüneyt ŞAR Spinal Deformite Olgu Sunumu" Doç. Dr. Mehmet AYDOĞAN, Dr. Orkun KOBAN Moderatör: Başar ATALAY

20 OCAK 2016 - Çarşamba, Saat: 19.00 / Yer: S.B. Balta Limanı Eğitim ve Araştırma Hastanesi, Baltalimanı / İstanbul

"İdiopatik skolyozun cerrahi tedavisinde inciler ve tuzaklar" Dr. Yunus ATICI "Büyüyen omurga deformitelerinin cerrahi tedavisinde inciler ve tuzaklar" Dr. Bülent BALİOĞLU "Olgu Tartışması" Dr. Engin ÇETİN, Dr. Yunus ATICI, Dr. Akif ALBAYRAK Moderatör: Dr. Mehmet AYDOĞAN

17 Şubat 2016 - Çarşamba, Saat: 19.00 / Yer: S.B. Ruh ve Sinir Hastalıkları Hastanesi, Bakırköy / İstanbul TOD - TND KARDEŞLIK TOPLANTISI-2 "Kranioservikal dejeneratif hastalıkları cerrahisinde inciler ve tuzaklar" Dr. Ender OFLUOĞLU "Kranioservikal bileşkenin travma cerrahisinde inciler ve tuzaklar" Dr. Mehmet AYDOĞAN "Olgu Tartışması" Dr. Uzay ERDOĞAN, Dr. Okan ÖZYURT, Dr. Hande EZERASLAN Moderatör: Dr. Erhan EMEL

16 Mart 2016 - Çarşamba, Saat: 19.00 / Yer: S.B. Fatih Sultan Mehmet Eğitim ve Araştırma Hastanesi, Göztepe /İstanbul "Benign omurga tümörleri cerrahisinde inciler ve tuzaklar" Dr. Sinan KARACA "Primer malign omurga tümörleri cerrahisinde inciler ve tuzaklar" Dr. Nurullah ERMİŞ "Primer metastatik omurga tümörleri cerrahisinde inciler ve tuzaklar" Dr. Yunus Emre AKMAN "Olgu sunumu" Dr. Kerim SARIYILMAZ, Dr. Yunus Emre AKMAN, Dr. Sinan KARACA Moderatör: Dr. Önder OFLUOĞLU

20 Nisan 2016 - Çarşamba, Saat: 19.00 / Yer: Amerikan Hastanesi, Nişantaşı / İstanbul

"İnterbody cage uygulamaları" Dr. Turgut AKGÜL *"PLIF, TLIF ve XLIF uygulamalarında inciler ve tuzaklar"* Dr. Cüneyt ŞAR *"Olgu sunumları"* Dr. Murat KORKMAZ, Dr. Meehmet Nuri ERDEM , Dr. Turgut AKGÜL Moderatör: Dr. Cüneyt ŞAR

4 Mayıs 2016 - Çarşamba, Saat: 19.00 / Yer: GATA Haydarpaşa Askeri Hastanesi , Haydarpaşa / İstanbul "İdiopatik skolyozda konservatif tedavide inciler ve tuzaklar" Dr. Serkan BİLGİÇ "İdiopatik skolyozda konservatif tedavisinde SpineCor uygulamaları" Dr. Ömer ERŞEN "Olgu Tartışması" Ayhan ULUSOY, Dr. Emre KETENCİ, Serhat YANIK Moderatör: Dr. Şevki ERDEM

25 Mayıs 2016 - Çarşamba, Saat: 19.00 / Yer: İstanbul Kemerburgaz Üniversitesi Tıp Fakültesi, Mahmutbey /İstanbul "Torakal vertebra kırıklarının cerrahisinde inciler ve tuzaklar" Dr. Ramazan Erden ERTÜRER "Torakolomber omurga kırıklarında inciler ve tuzaklar"

Dr. Onat ÜZÜMCÜGİL "Alt lomber ve sakrum omurga kırıklarında inciler ve tuzaklar" Dr. Kürsat BAYRAKTAR "Olgu Tartışması" Dr. Emre KARADENİZ, Dr. Sinan ERDOĞAN, Dr. Mehmet Bülent BALİOĞLU Moderatör: Dr. Çağatay ÖZTÜRK

18 Haziran 2016 - Çarşamba, Saat: 19.00 / Yer: MÜV Akamademi Hastanesi, Altunizade / İstanbul "Konjenital skolyoz cerrahisinde inciler ve tuzaklar" Dr. Çağrı KÖSE "Konjenital kifoz cerrahisinde inciler ve tuzaklar" Dr. Murat BEZER "Olgu Tartışması" Dr. Engin ÇETİN, Dr. Yunus ATICI, Dr. Akif ALBAYRAK Moderatör: Dr. Murat BEZER

DÜZENLEME KURULU

Dr. Mehmet AYDOĞAN (Başkan) Dr. Cüneyt ŞAR Dr. İ. Teoman BENLİ Dr. Mehmet TEZER Dr. Murat BEZER Dr. Şevki ERDEM Dr. Çağatay ÖZTÜRK Dr. Onat ÜZÜMCÜGİL Dr. Yener ERKEN Dr. Yunus ATICI (Sekreter)

* Bu toplantılar Türk Ortopedi ve Travmatoloji Birliği Derneği (TOTBİD),

Türk Omurga Derneği (TOD) tarafından desteklenmektedir.