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ADOLESCENT IDIOPATHIC SCOLIOSIS: A BIBLIOGRAPHIC ANALYSIS OF THE 50 MOST CITED ARTICLES

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ABSTRACT

Objective: Although adolescent idiopathic scoliosis (AIS) is the most commonly observed spinal deformity, there is limited bibliographic analysis of AIS in the literature. The aims of this study were to identify and analyze the top 50 most cited articles on AIS.

Materials and Methods: On February 6th, 2020, we searched the Thomson Reuters Web of Science-Science Citation Index Expanded database using the term, "AIS". We listed the articles by their number of citations. The titles of the articles, citation number, citation density, article content, journal of publication, author name, publishing country, institute, publishing specialty, and year of publication were noted.

Results: The mean citation number was 210.4±148 (range: 117-873); the mean citation density was 12.8±14 (range: 3-46). The contents of 25 articles (50%) were related to surgical treatment outcomes. Most of the articles (74%) were published in "Spine", and the total citation number was 6978. Most of the articles (67%, 33 articles) were published from the United States (USA). The first specialty of the primary authors of 46 articles was orthopedic surgery; LG Lenke and YJ Kim had the most citations for AIS-related articles. There was only one level 1 study.

Conclusion: Our bibliographic analysis showed that most studies were based on surgical treatment for AIS in the USA, and that "Spine" had published more than 50% of these studies. Although the number of publications has increased rapidly over the years, prospective randomized trials for AIS treatment are still lacking.

Keywords: Adolescent idiopathic scoliosis, citation analysis, bibliographic analysis, classic papers

INTRODUCTION

The most common type of scoliosis is adolescent idiopathic scoliosis (AIS) that develops in otherwise healthy children, mainly female, around puberty[1]. Epidemiological studies estimate that 2-4% of the at-risk population (10-16-year-old females) will develop some degree of spinal curvature[2]. AIS causes many problems, such as cosmetic, respiratory, and mobilization problems[3]. Bracing for 23 hours per day is the conservative treatment of choice when the Cobb angle is between 20 and 40 degrees with remaining growth potential, whereas spinal fusion is in order when the Cobb angle is >40 degrees with remaining growth potential or >45 degrees at skeletal maturity[4,5]. Studies reporting conservative treatment emphasize the importance of early diagnosis and treatment[6]. Both the indications and procedures used for conservative treatment are clear. However, surgical treatment is complex and requires operative experience in scoliosis surgery. Lenke et al.[7] described a new classification for AIS to guide spinal surgery[7]. There have been many studies describing surgical treatment and techniques, especially the pedicle screw technique and fusion levels according to the type of deformity[7-10].

The number of publications on AIS has continued to increase over the years. Bibliographic analysis can provide access to basic articles on popular topics, such as AIS, and identify the most influential journals, clinics, and authors for a given subject. In addition, it helps to identify the subjects that could inspire young surgeons to contribute to the literature with their own studies.

Examining the most cited articles is a frequently used method for bibliographic analysis[11]. The number of citations of an article is an objective tool that shows how much the article is appreciated by the scientific community and determines the relevance of an article at the academic level[12]. For this reason, bibliographic studies of popular topics have increasingly focused on the top 50 most cited articles in the literature. In orthopaedic literature, analyses of most cited papers have been performed

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for shoulder and hip arthroscopy, knee and hip arthroplasty, wrist surgery, spine surgeries, and some special topics such as anterior cruciate ligament, lumbar spondylolisthesis, and cervical dyspathy[13-21]. In the spine deformity topic, bibliographic analyzes were made with different study protocols such as 100 top-cited Articles on Spinal Deformity and scoliosis research for 10 year period[22-24].

Although AIS is the most common spinal deformity, the aims of this study were to identify and analyze the top 50 most cited articles on AIS in the Thomson ISI Web of Science® Database.

MATERIALS AND METHODS

Study Design

Institutional review board approval was not required given the public availability of the data. On February 6th, 2020, we searched the Thomson Reuters Web of Science-Science Citation Index Expanded database using the term, "AIS" and web of science categories of orthopaedics. Publications were sorted according to the citation numbers. The articles published in the English language between 1970 and 2020 were included in the present study. The articles published in languages other than the English language, before 1970, in the non-orthopaedics journal or with contents not related to AIS were excluded from the present study (Figure 1).

Variables

We noted the titles of the articles, citation number, citation density (citation number/duration of publication), article content, journal of publication, author name, publishing country, institute (institution), publishing branch (speciality), and year of publication.

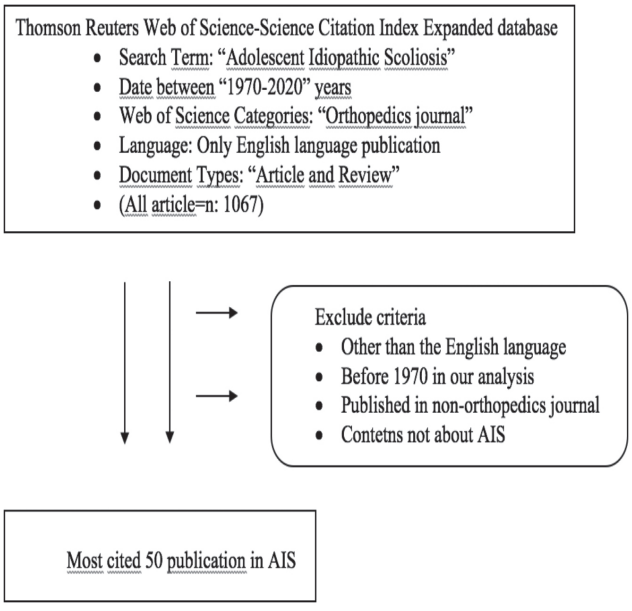

Figure 1. Study flow chart
AIS: Adolescent idiopathic scoliosis

Categorization for Some Variables

Article content: Surgical treatment outcomes, classification score system, radiological imaging, non-surgical treatment brace, surgical technique, progression, and complications.
Author name: For more than two first-author publications.
Institute: Institutes with more than two publications.
Decades between 1970 and 2020: 1970s, 1980s, 1990s, 2000s, and 2010s.
Study design: Randomized controlled, non-randomized controlled, prospective study, case-control, meta-analysis review, retrospective cohort, and retrospective cohort without a control group.
Levels of study: Level 1, level 2, level 3, level 4, and level 5.

Statistical Analysis

Data were analyzed statistically using SPSS v.22 software at a confidence interval of 95%. Qualitative data are described as frequency distributions, and quantitative data are presented as mean, minimum, and maximum values.

RESULTS

Citation Vount and Citation Density

The mean citation number was 210.4±148 (range: 117-873). The mean citation density was 12.8±14 (range: 3-46). The total number of citations and citation density of the articles are listed in Table 1.

Article Contents

The content of 25 articles (50%) was related to surgical treatment outcomes. The contents of other studies were as follows: radiology-imaging (n=6), classification-scoring systems (n=4), progression (n=4), complications (n=4), surgical techniques (n=4), and conservative treatment brace (n=4) (Figure 2).

Journals and Total Citation Number of the Journal

All articles appear to be published in a total of 4 journals (Table 2). The spine was the journal in which most of the articles (74%) were published; the total citation number was 6978. The second-highest number of articles (n=9) was published in the Journal of Bone and Joint Surgery; the total citation number is 2400. The other articles were published in the European Spine Journal (3 articles; total citation number of 1080) and Acta Orthopaedica Scandinavica (1 article; total citation number of 136).

Analysis of Authors

LG Lenke and YJ Kim were the authors who had participated in the highest number of scientific studies on AIS. LG Lenke was the first author in 5 articles and a co-author in 9 articles. YJ Kim was the first author in 7 articles and a co-author in 2 articles.

Countries

Most of the articles (67%, 33 articles) were published from the USA, followed by Sweden (13%, 6 articles), and Canada (8%, 4 articles). The remaining 8 articles were published from other countries (Figure 3).

Table 1. The most cited 50 articles in adolecent idiopatic scoliosis

Rank	Article	Number of cite (cite density)
1	Lenke LG, Betz RR, Harms J, et al. Adolescent idiopathic scoliosis: a new classification to determine extent of spinal arthrodesis. J Bone Joint Surg Am. 2001;83(8):1169-1181.	873 (46)
2	Kim YJ, Lenke LG, Bridwell KH, Cho YS, Riew KD. Free hand pedicle screw placement in the thoracic spine: is it safe?. Spine (Phila Pa 1976). 2004;29(3):333-342.	417 (26)
3	Nachemson AL, Peterson LE. Effectiveness of treatment with a brace in girls who have adolescent idiopathic scoliosis. A prospective, controlled study based on data from the Brace Study of the Scoliosis Research Society. J Bone Joint Surg Am. 1995 Jun;77(6):815-22.	386 (15)
4	Kosmopoulos V, Schizas C. Pedicle screw placement accuracy: a meta-analysis. Spine (Phila Pa 1976). 2007;32(3):E111-E120.	311 (24)
5	Kim YJ, Lenke LG, Cho SK, Bridwell KH, Sides B, Blanke K. Comparative analysis of pedicle screw versus hook instrumentation in posterior spinal fusion of adolescent idiopathic scoliosis. Spine (Phila Pa 1976). 2004;29(18):2040-2048.	285 (18)
6	Cochran T, Irstam L, Nachemson A. Long-term anatomic and functional changes in patients with adolescent idiopathic scoliosis treated by Harrington rod fusion. Spine (Phila Pa 1976). 1983;8(6):576-584.	276 (7)
7	Haher TR, Gorup JM, Shin TM, et al. Results of the Scoliosis Research Society instrument for evaluation of surgical outcome in adolescent idiopathic scoliosis. A multicenter study of 244 patients. Spine (Phila Pa 1976). 1999;24(14):1435-1440.	267 (12)
8	Kim YJ, Lenke LG, Kim J, et al. Comparative analysis of pedicle screw versus hybrid instrumentation in posterior spinal fusion of adolescent idiopathic scoliosis. Spine (Phila Pa 1976). 2006;31(3):291-298	255 (18)
9	Richards BS, Bernstein RM, D'Amato CR, Thompson GH. Standardization of criteria for adolescent idiopathic scoliosis brace studies: SRS Committee on Bracing and Nonoperative Management. Spine (Phila Pa 1976). 2005;30(18):2068-2077.	230 (15)
10	Lee SM, Suk SI, Chung ER. Direct vertebral rotation: a new technique of three-dimensional deformity correction with segmental pedicle screw fixation in adolescent idiopathic scoliosis. Spine (Phila Pa 1976). 2004;29(3):343-349.	229 (14)
11	Pehrsson K, Larsson S, Oden A, Nachemson A. Long-term follow-up of patients with untreated scoliosis. A study of mortality, causes of death, and symptoms. Spine (Phila Pa 1976). 1992;17(9):1091-1096.	226 (8)
12	Glattes RC, Bridwell KH, Lenke LG, Kim YJ, Rinella A, Edwards C 2nd. Proximal junctional kyphosis in adult spinal deformity following long instrumented posterior spinal fusion: incidence, outcomes, and risk factor analysis. Spine (Phila Pa 1976). 2005;30(14):1643-1649.	222 (15)
13	Betz RR, Harms J, Clements DH 3rd, et al. Comparison of anterior and posterior instrumentation for correction of adolescent thoracic idiopathic scoliosis. Spine (Phila Pa 1976). 1999;24(3):225-239.	213 (15)
14	McDonnell MF, Glassman SD, Dimar JR 2nd, Puno RM, Johnson JR. Perioperative complications of anterior procedures on the spine. J Bone Joint Surg Am. 1996;78(6):839-847.	203 (8)
15	Smith JS, Shaffrey CI, Sansur CA,et. al. Rates of infection after spine surgery based on 108,419 procedures: a report from the Scoliosis Research Society Morbidity and Mortality Committee. Spine, 2011; 36(7), 556-563.	199 (22)
16	Hicks JM, Singla A, Shen FH, Arlet V. Complications of pedicle screw fixation in scoliosis surgery: a systematic review. Spine,2010 35(11), E465-E470.	197 (20)
17	Lonstein JE, Winter RB. The Milwaukee brace for the treatment of adolescent idiopathic scoliosis. A review of one thousand and twenty patients. J Bone Joint Surg Am. 1994;76(8):1207-1221.	190 (7)
18	Stokes IA, Spence H, Aronsson DD, Kilmer N. Mechanical modulation of vertebral body growth. Implications for scoliosis progression. Spine (Phila Pa 1976). 1996;21(10):1162-1167.	185 (8)
19	Schwartz DM, Auerbach JD, Dormans JP, et al. Neurophysiological detection of impending spinal cord injury during scoliosis surgery. J Bone Joint Surg Am. 2007;89(11):2440-2449.	184 (14)
20	Coe JD, Arlet V, Donaldson W, et al. Complications in spinal fusion for adolescent idiopathic scoliosis in the new millennium. A report of the Scoliosis Research Society Morbidity and Mortality Committee. Spine (Phila Pa 1976). 2006;31(3):345-349.	183 (13)
21	Goldberg CJ, Moore DP, Fogarty EE, Dowling FE. Adolescent idiopathic scoliosis: the effect of brace treatment on the incidence of surgery. Spine (Phila Pa 1976). 2001;26(1):42-47. doi:10.1097/00007632-200101010-00009	182 (10)
22	Danielsson AJ, Wiklund I, Pehrsson K, Nachemson AL. Health-related quality of life in patients with adolescent idiopathic scoliosis: a matched follow-up at least 20 years after treatment with brace or surgery. Eur Spine J. 2001;10(4):278-288.	179 (9)
23	Lenke LG, Bridwell KH, Baldus C, Blanke K, Schoenecker PL. Cotrel-Dubousset instrumentation for adolescent idiopathic scoliosis. J Bone Joint Surg Am. 1992;74(7):1056-1067.	169 (6)
24	Mac-Thiong JM, Labelle H, Berthonnaud E, Betz RR, Roussouly P. Sagittal spinopelvic balance in normal children and adolescents. Eur Spine J. 2007;16(2):227-234.	163 (12)
25	Horton WC, Brown CW, Bridwell KH, Glassman SD, Suk SI, Cha CW. Is there an optimal patient stance for obtaining a lateral 36" radiograph?: a critical comparison of three techniques. Spine,2005 30(4), 427-433.	159 (10)

26	Reames DL, Smith JS, Fu KM, et al. Complications in the surgical treatment of 19,360 cases of pediatric scoliosis: a review of the Scoliosis Research Society Morbidity and Mortality database. Spine (Phila Pa 1976). 2011;36(18):1484-1491.	151 (17)
27	Lenke LG, Edwards CC 2nd, Bridwell KH. The Lenke classification of adolescent idiopathic scoliosis: how it organizes curve patterns as a template to perform selective fusions of the spine. Spine (Phila Pa 1976). 2003;28(20):S199-S207.	149 (9)
28	Lowenstein JE, Matsumoto H, Vitale MG, et al. Coronal and sagittal plane correction in adolescent idiopathic scoliosis: a comparison between all pedicle screw versus hybrid thoracic hook lumbar screw constructs. Spine (Phila Pa 1976). 2007;32(4):448-452.	148 (11)
29	Dobbs MB, Lenke LG, Kim YJ, Kamath G, Peelle MW, Bridwell KH. Selective posterior thoracic fusions for adolescent idiopathic scoliosis: comparison of hooks versus pedicle screws. Spine (Phila Pa 1976). 2006;31(20):2400-2404.	144 (10)
30	Nuttall GA, Horlocker TT, Santrach PJ, Oliver Jr WC, Dekutoski MB, Bryant S. Predictors of blood transfusions in spinal instrumentation and fusion surgery. Spine, 2000; 25(5), 596-601.	144 (7)
31	Kesling KL, Reinker KA. Scoliosis in twins. A meta-analysis of the literature and report of six cases. Spine (Phila Pa 1976). 1997;22(17):2009-2015.	142 (6)
32	Mac-Thiong JM, Labelle H, Charlebois M, Huot MP, de Guise JA. Sagittal plane analysis of the spine and pelvis in adolescent idiopathic scoliosis according to the coronal curve type. Spine (Phila Pa 1976). 2003;28(13):1404-1409.	127 (7)
33	Little DG, Song KM, Katz D, Herring JA. Relationship of peak height velocity to other maturity indicators in idiopathic scoliosis in girls. J Bone Joint Surg Am. 2000;82(5):685-693.	137 (6)
34	Lenke LG, Betz RR, Bridwell KH, Harms J, Clements DH, Lowe TG. Spontaneous lumbar curve coronal correction after selective anterior or posterior thoracic fusion in adolescent idiopathic scoliosis. Spine (Phila Pa 1976). 1999;24(16):1663-1672.	137 (6)
35	Sahlstrand T, Ortengren R, Nachemson A. Postural equilibrium in adolescent idiopathic scoliosis. Acta Orthop Scand. 1978;49(4):354-365.	136 (3)
36	Kim YJ, Lenke LG, Bridwell KH, et al. Proximal junctional kyphosis in adolescent idiopathic scoliosis after 3 different types of posterior segmental spinal instrumentation and fusions: incidence and risk factor analysis of 410 cases. Spine (Phila Pa 1976). 2007;32(24):2731-2738.	134 (10)
37	Peterson LE, Nachemson AL. Prediction of progression of the curve in girls who have adolescent idiopathic scoliosis of moderate severity. Logistic regression analysis based on data from The Brace Study of the Scoliosis Research Society. J Bone Joint Surg Am. 1995;77(6):823-827.	134 (5)
38	Levy AR, Goldberg MS, Mayo NE, Hanley JA, Poitras B. Reducing the lifetime risk of cancer from spinal radiographs among people with adolescent idiopathic scoliosis. Spine (Phila Pa 1976). 1996;21(13):1540-1548.	132 (5)
39	Barr SJ, Schuette AM, Emans JB. Lumbar pedicle screws versus hooks. Results in double major curves in adolescent idiopathic scoliosis. Spine (Phila Pa 1976). 1997;22(12):1369-1379.	131 (6)
40	Dolan LA, Weinstein SL. Surgical rates after observation and bracing for adolescent idiopathic scoliosis: an evidence-based review. Spine (Phila Pa 1976). 2007;32(19 Suppl):S91-S100.	129 (10)
41	Vora V, Crawford A, Babekhir N, et al. A pedicle screw construct gives an enhanced posterior correction of adolescent idiopathic scoliosis when compared with other constructs: myth or reality. Spine (Phila Pa 1976). 2007;32(17):1869-1874.	129 (10)
42	Nault ML, Allard P, Hinse S, et al. Relations between standing stability and body posture parameters in adolescent idiopathic scoliosis. Spine (Phila Pa 1976). 2002;27(17):1911-1917	129 (7)
43	O'Brien MF, Lenke LG, Mardjetko S, et al. Pedicle morphology in thoracic adolescent idiopathic scoliosis: is pedicle fixation an anatomically viable technique?. Spine (Phila Pa 1976). 2000;25(18):2285-2293.	125 (5)
44	Kim YJ, Lenke LG, Bridwell KH, Kim KL, Steger-May K. Pulmonary function in adolescent idiopathic scoliosis relative to the surgical procedure. J Bone Joint Surg Am. 2005;87(7):1534-1541.	124 (8)
45	Kim YJ, Bridwell KH, Lenke LG, Kim J, Cho SK. Proximal junctional kyphosis in adolescent idiopathic scoliosis following segmental posterior spinal instrumentation and fusion: minimum 5-year follow-up. Spine (Phila Pa 1976). 2005;30(18):2045-2050.	123 (8)
46	Kuklo TR, Lenke LG, O'Brien MF, Lehman RA Jr, Polly DW Jr, Schroeder TM. Accuracy and efficacy of thoracic pedicle screws in curves more than 90 degrees. Spine (Phila Pa 1976). 2005;30(2):222-226.	123 (8)
47	Guo X, Chau WW, Chan YL, Cheng JC, Burwell RG, Dangerfield PH. Relative anterior spinal overgrowth in adolescent idiopathic scoliosis--result of disproportionate endochondral-membranous bone growth? Summary of an electronic focus group debate of the IBSE. Eur Spine J. 2005;14(9):862-873	122 (8)
48	Lehman RA Jr, Lenke LG, Keeler KA, et al. Operative treatment of adolescent idiopathic scoliosis with posterior pedicle screw-only constructs: minimum three-year follow-up of one hundred fourteen cases. Spine (Phila Pa 1976). 2008;33(14):1598-1604.	117 (8)
49	Luhmann SJ, Lenke LG, Kim YJ, Bridwell KH, Schootman M. Thoracic adolescent idiopathic scoliosis curves between 70 degrees and 100 degrees: is anterior release necessary? Spine (Phila Pa 1976). 200515;30(18):2061-7.	117 (8)
50	Moreau A, Wang DS, Forget S, Azeddine B, Angeloni D, Fraschini F, Labelle H, Poitras B, Rivard CH, Grimard G. Melatonin signaling dysfunction in adolescent idiopathic scoliosis. Spine (Phila Pa 1976). 2004 Aug 15;29(16):1772-81.	117 (8)

Institutions

There were 31 institutions that featured in all 50 articles, and 7 institutes were associated with more than 2 articles (Table 3). Washington University School of Medicine ranked first with 11 articles and Columbia University Medical Center followed with 4 articles each, Göteborg University with 3 articles and 4 institutes each associated with 2 articles.

The speciality of the primary authors

The highest number of publications (46) was by orthopaedic surgeons. The remaining 4 articles were associated with the following specialities: Neurosurgery (n=2), anaesthesia (n=1), and health care research (n=1).

Decade-wise number of citations

The articles were spread over a total of 40 years (1978-2011) despite cumulative to the 2000s (Figure 4).

Study design of the articles

A total of 7 study designs were observed in the articles in this analysis (Table 4): Meta-analysis review (n=6), randomized controlled (n=2), non-randomized controlled (n=2), prospective cohort (n=6), retrospective cohort (n=20), retrospective without control group cohort (n=13), and case series (n=1).

Level of evidence of the articles

Most studies had level 3 (n=19) and level 4 (n=18) evidence, other studies one study level 1, 12 studies level 2, none study level 5 (Figure 5).

DISCUSSION

Although AIS is the most discussed topic among scoliosis deformities[15], in this study, we listed the most cited 50 articles on AIS and determined the citation number, citation density, article count, country, institution, author, journal, study design, and level of evidence. In addition, we found that the most of the contents of these articles on AIS were based on surgical treatment outcomes and had been published by institutions in the USA; more than 50% of the articles had been published in "Spine".

Scoliosis is a 3D spinal deformity and has the following subtypes: congenital, juvenile, adolescent idiopathic, neurogenic, and adult scoliosis. Two studies on spinal deformities had the highest number (100) of citations[22,23]. The study by Zhang et al.[22] had examined deformity types in detail, including sagittal deformities; among its 100 citations, 37 articles were on AIS and 20 articles on adult scoliosis. In the other study, Tao et al.[24] presented a 10-year bibliographic analysis of scoliosis.

In our analysis, the mean number of citations was 210.4±148 (range: 117-873) for AIS. A higher mean citation count was observed for spondylolisthesis (range: 68-586) and thoracolumbar fracture (range: 81-267) compared to similar lumbar disease analyses[17,18]. In contrast, there were fewer citations for sports surgeries related to the anterior cruciate ligament (range: 315-1670) and rotator cuff tear (range: 137-677).

Most of the articles' contents were related to surgical treatment outcomes. In contrast, the most cited article title described AIS classification. For an article to be appreciated, it must fill a knowledge gap in the literature.

The most cited study was the study that described the classification developed by Lenke et al.[7] in 2001 to determine the level of spinal arthrodesis[7]. Before the Lenke classification, the King classification presented in 1983 was used for AIS[25]. The most important difference in the Lenke classification is its 2D examination of the deformity, which provides a better understanding of the deformity without having sharp limits for fusion levels.

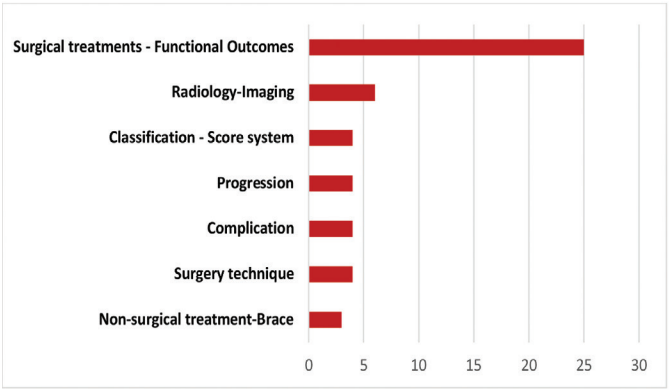

Figure 2. Frequences of the article contents

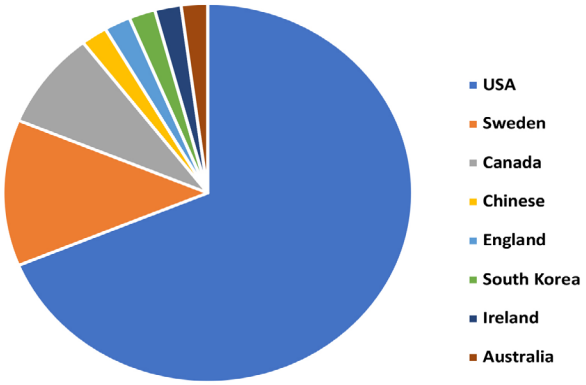

Figure 3. List of the countries of publication

Table 2. List of the journal with article number and total citation counts

Journal name	Article number	Total cite counts
Spine	37	6978
The Journal of Bone and Joint Surgery	9	2400
Europian Spine Journal	3	1080
Acta Orthopaedica Scandinavica	1	136

The second most cited study was by Kim et al.[8] published in 2004 wherein the authors described free pedicle screw placement in the thoracic spine for which they used anatomical marks and specific entry points in 3204 patients over 10 years. In addition, Lenke and Kim were the most prolific authors in AIS research.

In our study, each of 3 countries-USA, Sweden, and Canada-was associated with more than 2 publications, with USA being more active with more than 50% of the publications in our analysis. The scientific leadership of the USA was also evident in other bibliographic analyses of lumbar and non-lumbar pathology[15-20]. Washington University School of Medicine was affiliated with 11 studies. More than 50% of the institutions were English-speaking institutions. For AIS and other lumbar pathologies, "Spine" was the journal that had published the most number of articles in our analysis;[18-20] it was followed by the Journal of Bone and Joint Surgery and the European Spine Journal. Less and specific journals came to the fore for lumbar pathologies. From our analysis, it would appear that for an article to be highly cited, it is most likely to be published from an English-speaking institution in the USA in a subject-specific journal.

Similar to the findings of many bibliographic studies, very few articles in our analysis contained level 1 evidence[16,17], with only four randomized controlled studies in our study.

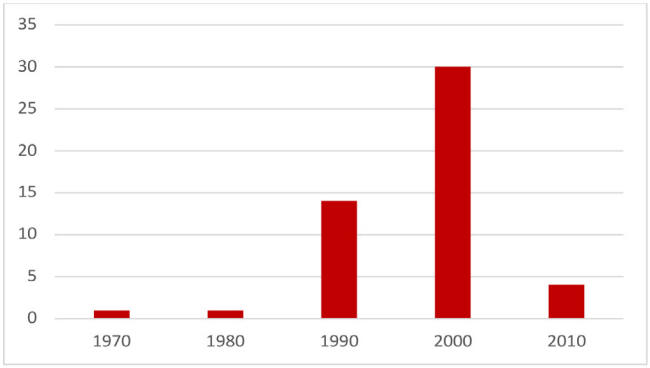

Figure 4. Number of most cited article according to decade of publication

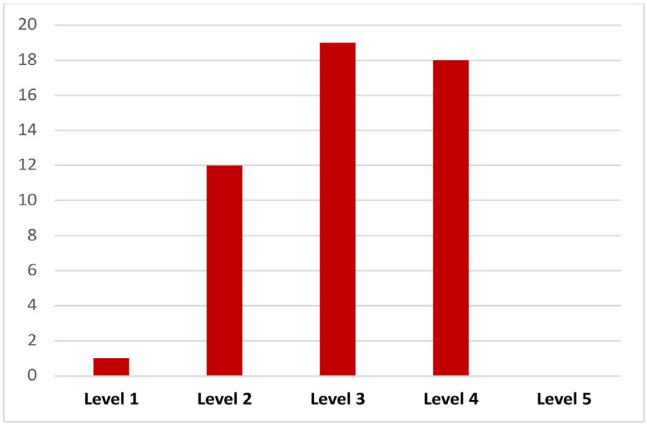

Figure 5. Level of evidence in the articles

Table 4. Study design of articles

Clinical articles of study type	Number of articles
Meta-analyses and review	6
Non-randomize controlled	2
Randomize controlled	2
Prospective cohort	6
Retrospective cohort	20
Retrostective cohort without control group	13
Case series	1

Study Limitation

Our bibliographic analysis has some limitations, as stated in similar studies[26]. The search term used in such bibliographic analyses needs to be clearly identified, and the content of the articles should be checked. Although we used a specific search term, "AIS" in our study, 9 studies were still excluded because of their unsuitable content. On the other hand, some of the publications published in prestigious journals such as Lancet and The new England Journal of Medicine and receiving high citation are excluded from the evaluation because they do not meet the study criteria[27,28]. Another limitation was that as older studies have an advantage with respect to the number of citations, mean citation number (total number citations/years

Table 3. Institutions with 2 or more publications

Name of Institution	Number of articles
Washington University School of Medicine	11
Columbia University Medical Center	4
Göteborg university	3
University of Virginia	2
Hopital Sainte-Justine	2
Sahlgrenska University Hospital	2
University of Iowa	2
Others*	24

*: Hospital Orthopedique de la Suisse Romande, St. Vincent's Hospital Medical Center, Texas Scottish Rite Hospital for Children, Seoul Spine Institute, Renströmska and Sahlgrenska Hospitals, Shriners Hospital and Temple University Hospital, University of Louisville School of Medicine, University of Virginia Medical Center, Emory Orthopaedics and Spine Center, Morgan Stanley Children's Hospital of New York Presbyterian, MAYO clinic, Triple Army Medical Center, Royal Alexandra Hospital for Children, Maisonneuve-Rosemont Hospital, Harvard Medical School, Penn State College of Medicine, Laboratoire d'E´ tude du Mouvement Research Center Sainte-Justine Hospital, *University of Colorado and Woodridge Orthopedic and Spine Clinic, Walter Reed Army Medical Center, The Chinese University of Hong Kong, Walter Reed Army Medical Center

since publication) must be calculated. The level of evidence and study design were difficult to find for some articles.

CONCLUSION

In this bibliographic analysis of AIS, most articles described the surgical treatment and had been published from the USA; more than 50% of the articles were published in "Spine". Although the number of publications has increased rapidly over the years, we found that there were few prospective randomized trials.

Ethics

Ethics Committee Approval: Institutional review board approval was not required given the public availability of the data.
Informed Consent: The study does not contain patient data by design.
Peer-review: Internally peer-reviewed.

Authorship Contributions

Concept: Y.U.Y., B.H., Design: Y.U.Y., B.H., Data Collection or Processing: Y.U.Y., B.H., Analysis or Interpretation: Y.U.Y., Literature Search: B.H., Writing: Y.U.Y.
Conflict of Interest: No conflict of interest was declared by the authors.
Financial Disclosure: The authors declared that this study received no financial support.

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