Full length article

India contribution to Spine Surgery: 15 most influential articles

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ABSTRACT

Objective: To determine the number of articles published by Indian authors related to spine surgery and to enumerate the 15 most influential articles from India published in the field of spine surgery in national & international journals based on the citations they have received both in pubmed and google scholar.

Material and methods: A retrospective study using Pubmed database was performed for the years between 1960 and 2015, for the articles published from India in the field of spine surgery in various national and international journals. A total of 3181 citations were received for top 15 most influential articles in the field of spine surgery from India.

Results: A total of 885 papers from India were identified which were published by Indian authors related to spine surgery between year 1960 to 2015. The largest numbers of papers were published in International journals such as Spine (82) and in European Spine Journal (47).

Conclusion: There are an increasing number of papers from India in the field of spine surgery literature. Most of the highly cited papers were related to tuberculosis. We expect further contributions from our country to the medical literature in the future.

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1. Introduction

There has been tremendous advancement in the orthopaedics in the last 50 years especially in the field of spinal surgery, and in turn, an increase in the number of spine-related studies. These studies are published in older and relatively new spine related journals, including Asian Spine journal, European Spine Journal, the Spine Journal, and the most rated orthopaedic Journals such as JBJS and CORR. There are many other journals apart from these journals which publish such studies. However, the contribution of India to spine surgery literature is not known. The aim of this study was to determine the number of spine-related publications written by Indian authors over last 60 years and to highlight the top 15 most influential articles based on their citations.

2. Materials and methods

A Retrospective study using PubMed database was performed for the years between 1960 and 2015 for the literature in the field of spine surgery in various national and international journals. Various Keywords were used to identify articles published by Indian authors related to spine surgery such as spine, scoliosis, tuberculosis, tumor, cervical spine, dorsal/thoracic spine, lumbar

spine, surgery, cord. Two authors (SB) and (VD) independently reviewed all the articles and in case of any disagreement; senior author (BG) was consulted. We checked for the institution where the study was being conducted and included studies of India origin.

After determining the titles of papers originating from India, these articles were analysed in detail with the following aims: 1. Determine the number of spine-related publications written by Indian authors over last 60 years. 2. Determine the distribution in various spine sub-specialities, and 3. Determine the citations received by the publications both in the Pubmed and Google scholar.^{16–18} Google scholar also includes the citations of Scopus.

3. Results

There were a total of 885 papers from India in field of spine surgery between (1960–2015). The number of publications has increased over the time (Fig. 1) and it has been seen there is increase in the publications in the international Journals over last few years (Fig. 2).

1. The largest numbers of papers were published in Spine (82) and in European Spine Journal (47) (Table 1).
2. Contribution of different states to the spine surgery literature (Table 2).
3. Majority of the papers were found to be either on infection or scoliosis. A total of 180 and 76 articles were related to infection and scoliosis respectively (Fig. 3).

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Fig. 1. Number of articles published over period of time.

Fig. 2. Articles published in various journals over period of time.

Table 1
Distribution of Publications in various journals.

Journals	Number of publications
The Spine	82
European Spine	47
Asian Spine Journal	23
JBJS(Am +Br)	21
CORR	15
Other journals	697

4. The gross citations (Pubmed + Google scholar)^{16,17} received by the publications were divided into four categories: <25, between 25 and 49, 50–99 and >100 citations (Fig. 4).

Table 2
State Wise contributions to spine related publications.

S.No.	State	Contribution
1.	Maharashtra	172
2.	Tamilnadu	159
3.	New Delhi	159
4.	Karnataka	75
5.	Uttar Pradesh	72
6.	Andhra Pradesh	32
7.	Kerala	21
8.	West Bengal	16
9.	Gujarat	16
10.	Madhya Pradesh	12
11.	Punjab	10
12.	Rajasthan	08
13.	Orrisa	06
14.	Rest States	127

Fig. 3. Distribution of infection and scoliosis publications over period of time.

Fig. 4. Number of publication with different citations.

4. Discussion

There has been tremendous increase in the number of publications especially over last decade. So we would like to enumerate top 15 most influential articles based on the citations followed by brief description about these articles (Table 3).

5. Highlights and brief description of the articles

1. The first article (Rajasekaran S., 1989)¹ is based on the progression of kyphosis in tuberculosis of the spine in patients treated by anterior arthrodesis. 81 patients who had tuberculosis of the spine were treated by debridement and anterior arthrodesis and were reviewed 8 years or more post operatively and progression of the kyphosis and the fate of the bone grafts were evaluated. The article concluded that it is unwise to rely solely on the graft to prevent vertebral collapse in patients in whom the length of the graft exceeds two disc spaces. Additionally, non-weight-bearing, posterior arthrodesis after six to twelve weeks, and prolonged use of a brace until complete consolidation may also be beneficial.
2. The article (Jain A.K., 2010)² describes the evolution in the field of diagnosis and treatment of tuberculosis from pre-antibiotic era to current status. The author discussed the treatment, complications and indications of surgery in active and late stage of disease and risk factors associated with poor outcome of disease.
3. This article (Rajasekaran S., 2007)³ was a randomized study to compare the accuracy of navigated and non-navigated thoracic pedicle screws in deformity correction surgeries. This study included 27 patients both with scoliosis (N = 27) and kyphosis

Table 3

Most influential articles in Spine surgery.

S.No	Description	Gross Citation (Pubmed + Google scholar) ^{16,17}
1.	Rajasekaran S, Soundarapandian S. Progression of kyphosis in tuberculosis of the spine treated by anterior arthrodesis. J Bone Joint Surg Am. 1989 Oct;71(9):1314–23. <i>Journal impact factor: 5.280</i>	312
2.	Jain AK. Tuberculosis of the spine: a fresh look at an old disease. J Bone Joint Surg Br. 2010 Jul;92(7):905–13. <i>Journal impact factor: 2.425</i>	291
3.	Rajasekaran S. Randomized clinical study to compare the accuracy of navigated and non-navigated thoracic pedicle screws in deformity correction surgeries. Spine (Phila Pa 1976). 2007 Jan 15;32(2):E56–64. <i>Journal impact factor: 2.439</i>	267
4.	Desai SS. Early diagnosis of spinal tuberculosis by MRI. J Bone Joint Surg Br. 1994 Nov;76(6):863–9. <i>Journal impact factor: 2.425</i>	250
5.	Sundararaj GD, Behera S, Ravi V, Venkatesh K, Cherian VM, Lee V. Role of posterior stabilisation in the management of tuberculosis of the dorsal and lumbar spine. J Bone Joint Surg Br. 2003 Jan;85(1):100–6. <i>Journal impact factor: 2.425</i>	219
6.	Rajasekaran S. The problem of deformity in spinal tuberculosis. Clin Orthop Relat Res. 2002 <i>Journal impact factor: 2.765</i>	199
7.	Suri A et al. Effect of intramedullary signal changes on the surgical outcome of patients with cervical spondylotic myelopathy. Spine J. 2003 Jan-Feb;3(1):33–45. <i>Journal impact factor: 2.439</i>	198
8.	Kulkarni V, Rajshekhar V, Raghuram L. Accelerated spondylotic changes adjacent to the fused segment following central cervical corpectomy: magnetic resonance imaging study evidence. J Neurosurg. 2004 Jan;100(1 Suppl Spine):2–6. <i>Journal impact factor: 3.737</i>	195
9.	Jain AK. Treatment of tuberculosis of the spine with neurologic complications. Clin Orthop Relat Res. 2002 May;(398):75–84. <i>Journal impact factor: 2.765</i>	194
10.	Jain AK, Dhammi IK. Tuberculosis of the spine: a review. Clin Orthop Relat Res. 2007 Jul;460:39–49. <i>Journal impact factor: 2.765</i>	187
11.	Pandey CK et al. Evaluation of the optimal preemptive dose of gabapentin for postoperative pain relief after lumbar discectomy: a randomized, double-blind, placebo-controlled study. J Neurosurg Anesthesiol. 2005 Apr;17(2):65–8. <i>Journal impact factor: 2.828</i>	186
12.	Garg RK, Somvanshi DS. Spinal tuberculosis: a review. J Spinal Cord Med. 2011;34(5):440–54. <i>Journal impact factor: 1.578</i>	180
13.	Tuli SM. Tuberculosis of the spine: a historical review. Clin Orthop Relat Res. 2007 Jul;460:29–38. <i>Journal impact factor: 2.765</i>	177
14.	Parthasarathy R et al. Short-course chemotherapy for tuberculosis of the spine. A comparison between ambulant treatment and radical surgery—ten-year report. J Bone Joint Surg Br. 1999 May;81(3):464–71. <i>Journal impact factor: 2.425</i>	164
15.	Mehta JS, Bhojraj SY. Tuberculosis of the thoracic spine. A classification based on the selection of surgical strategies. J Bone Joint Surg Br. 2001 Aug;83(6):859–63. <i>Journal impact factor: 2.425</i>	162

(N=6) were studied on the basis on insertion of thoracic pedicle screws under navigation approach and fluoroscopic control methods by random allocation. The results were observed by two independent blinded observers and they looked for the accuracy using postoperative computed tomography (CT). The article concluded that use of Iso-C navigation leads to increased accuracy, reduced radiation exposure and surgical time in spinal deformity correction surgeries.

4. This article (Desai S.S., 1994)⁴ emphasized about the role of MRI for early diagnosis of tuberculosis in cases with normal radiograph. Depending on the stage of the disease, 3 different patterns of infection were revealed: osteitis, osteitis with an abscess, and osteitis with or without an abscess plus discitis. It was found that detection of tuberculosis of spine is earlier with MRI than other techniques and is reliable and reduce bone destruction and deformity and thus mitigate the need for surgical intervention. However, biopsy is recommended during the stage of osteitis to confirm the diagnosis.
5. This article (Sundararaj G.D. et al., 2003)⁵ discuss the role of posterior stabilisation in the management of tuberculosis of the dorsal and lumbar spine. The objective of this study was to study the progress of interbody union, the extent of correction of the kyphosis and its maintenance with early mobilisation, and the incidence of graft and implant-related problems as well. Maximum correction of the kyphosis was observed in the dorsolumbar spine, maximum loss of correction in the

lumbosacral spine. Adjuvant posterior stabilisation helps in early mobilisation and rehabilitation.

6. This article (Rajasekaran S., 2002)⁶ describes about the progress of deformity in spinal tuberculosis and the factors which influence the progress of deformity. Surgery must be done early to prevent deformity in spine at risk radiograph with use of both anterior and posterior instrumentation to obtain good clinical outcome.
7. This article (Suri A. et al., 2003)⁷ focus on evaluation of clinical parameters and MRI in patients operated for cervical spondylotic myelopathy. The intramedullary signal changes on MRI indicates poor prognosis in patients with cervical myelopathy.
8. This article (Kulkarni V., 2004)⁸ looked at accelerated degenerative changes at adjacent motion segments to fused cervical segments using MRI. They found that adjacent segments show more degenerative changes as compared with remote levels in 75% of patients who had undergone one- or two-level central corpectomy.
9. This article (Jain A.K., 2009)⁹ stressed towards role of surgical treatment in cases of spinal tuberculosis with neurological dysfunction even in the early active stage of disease to prevent disability due to Pott's paraplegia. Late onset paraplegia can be prevented by not allowing development of severe kyphosis.
10. This article (Jain A.K., 2007)¹⁰ is a comprehensive review about the tuberculosis of spine where the author analysed 124 articles of the tuberculosis of spine indicating the timing of

surgery in spinal TB, role of early surgical decompression in patients with neurological dysfunction and evaluated the outcomes of various surgical procedures for kyphosis, and prevention of kyphosis progression as well.

11. This article (Pandey C.K. et al., 2005)¹¹ is based on the role of gabapentin preoperatively in decreasing post operative pain and fentanyl consumption following lumbar disc surgery. They reported that there was no beneficial effect on VAS score if we increase the dose of gabapentin from 600 to 1200 mg. They also found that increased gabapentin dose had no significant effect on fentanyl consumption. The authors recommended gabapentin 600 mg as optimal dose.
12. This article (Garg R.K., 2011)¹² a review on spinal tuberculosis describe spinal tuberculosis occurs more commonly in children and young adults than older population. The article described the main characteristic features such as formation of cold abscess around the lesion. Genetic susceptibility to spinal tuberculosis and the utility of various diagnostic modules in spinal tuberculosis has also been discussed. The author concluded that surgery may be considered in selected cases only. These indications may include large abscess formation, severe kyphosis, a progressive neurological deficit, or failure of medical treatment. The article concluded stating the early diagnosis and early treatment is generally good for prognosis.
13. This article (Tuli S.M., 2007)¹³ also a review about the tuberculosis of the spine includes the history antitubercular drugs, their role in pre and post operative management of spinal TB. The article also described the complications including nonresponding neural deficit, prevention or correction of severe kyphotic deformity. The article also discussed the time and appropriate mode of surgery during the course of illness. The article emphasised the real control of tuberculosis disease through public health measures
14. This article (Parthasarathy R. et al., 1999)¹⁴ was a controlled clinical trial to compare the ambulant short-course chemotherapy with anterior spinal fusion plus short-course chemotherapy for spinal tuberculosis without paraplegia. Ambulant chemotherapy for a period of six months with daily isoniazid plus rifampicin was found an effective treatment for spinal tuberculosis except in patient's aged <15 years with an initial angle of kyphosis of >30°.
15. This article (Mehta J.S., 2001)¹⁵ is based on the classification of surgical strategies for the treatment of tuberculosis of thoracic spine based on MRI studies. An understanding of the extent of vertebral destruction can be obtained from MRI studies.

Articles from this study comprise all the levels of evidences i.e. from evidence level I to VII. However majority of the articles were belongs to evidence **Level IV**. We noticed that, there has been increase in the Morphological and Navigated based publications but publications related to Pott's Spine still rules among all.

6. Limitation

This study did not make an attempt to find out type of paper (i.e., letter, original study, experimental and biomechanical studies). Therefore, the quality of the published studies was not studied in this study.

7. Conclusion

There is an increasing interest in field of spine surgery in India which has led to an increase in the number of publications in this

field. There has been increasing trend in the publications in various international Journals. The main aim of this study was to reveal the current state of scientific publication in India in the field of spine surgery and it shows that there is a significant contribution to literature from India.

Conflict of interest

None.

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This study does not receive any funding of any nature.

Compliance with ethical standards

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

This is a full length article and does not involve any human being.

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