Registered Under Act 28, 1958 No. 1331/02-03 Jaipur

ROSA VOICE

Vol. 16 | No. 4 www.rajortho.org Oct. - Dec. 2020

IOA President Theme

Excellence and Perfecting in Orthopaedic Education and Patient Care : An Achievable Vision

President 's Message

Dear ROSA Members & Respected Seniors,

Warm greetings !!

We all have witnessed a marred year due to Covid 19 pandemic. I congratulate you all for being safe & healthy. It has taught us many lessons in every sphere of life. Use of digital tools came into practice like " Baptism by fire" and those reluctant also adapted with this change quickly. With this, naturally knowledge from the global platform became more accessible to satisfy the academic appetite of our colleagues.

"UBANTU" is a word of African culture that means "I am because you all are". It fits well in ROSA. We were not only able to overcome difficult times but also excel in various academic activities through several webinars and in fact, lead the way for other states too.

We have crossed the mark of 500 as IOA members, claiming 2 state representatives. During the pandemic, despite several hurdles, we continued on a progressive path with landmark changes in ROSA.

I have been fortunate to get tireless support from our Hon Secretary and the Editorial team with their continued efforts to uplift the academic standard of ROSA-VOICE.

As we bid adieu to 2020, I also look forward to handing over the presidential office to our dynamic incoming President Dr Arun Vaishy.

I am sure he would take It further and make ROSA more vibrant under his leadership.

With folded hands, I thank you for all your support and wish you all good health, academic excellence & progressive normal life in the year 2021.

Jai ROSA.

ROSA President Theme

Excellence the Artificial intelligence, because skill is strength

Dr Rajesh Goel
President ROSA

Editor's Note...

Dear ROSA Members and Friends,

Warm greetings !!

As we are coming to an end of this dreadful year and looking forward with hope to a better year ahead, we also intend to shape ROSA voice with a new look, yet keeping up with the tradition.

When our team took over the editorial task,we already had a legacy of painstaking efforts by Dr Jayant Sen while bringing it so far.

The challenge to upgrade and refine had several hurdles during the lockdown including communication with the previous printer and getting across new ideas. However, we gradually managed to define the font size, eliminate variations, define colour scheme for the year, initiate subspecialty dedicated issues and include invited articles to update knowledge of our members. We are grateful to Dr Shiv Bali from Jodhpur and Dr Chirayu Pamecha from Udaipur for their assistance during the publication of last and current issues.

Looking forward to 2021, we intend to come up with a new cover page design and layout to enhance it further. We also intend to involve new talent and members in editorial assistance and hopefully add a few more features like brain teasers, competitions etc.

We hope that all members shall take active interest in this endeavour and contribute with their knowledge, experience and hidden talents.

Wishing you all a healthy 2021 filled with Happiness and Progress..

Jai ROSA.

Dr S B Solanki
Jaipur

Dr Sumit Banerjee
Jodhpur

Dr Akshat Vijay
Kota

Editorial Team

Message from the Secretary

Respected Seniors and Dear Friends,

Greetings from the Secretariat of ROSA!

2020 has been a difficult and challenging year. COVID-19 upended our lives and plunged the world into suffering and grief. There have still been signs of resilience, ingenuity and dedication. We have negotiated new ways to manage our lives and personal and professional relationships. But with the new year comes ray of hope towards vaccination to control the disease and return to normalcy soon.

I am grateful to all executive committee members for their relentless support and cooperation throughout this year. I wish to extend my deepest respect and appreciation to our President Dr. Rajesh Goyal for his strong support and guidance.

To organize events with the growth is always a challenge and we need support of members. I request and encourage everyone to find the positive energy and blend it to build a stronger foundation for ROSA for today and tomorrow.

We are trying to reboot the academic contents of ROSA Voice, Our editorial team headed by Dr S.B. Solanki is working hard on it. We applaud all the contributors, without them the publication of ROSA Voice issues could not have been accomplished. We also express our appreciation to all helping hands in compiling this quarterly newsletter.

Benefits of being a member of the association are increasing and we shall continue to expand our offerings to members where they feel it as value addition for their commitment towards the association. We are always looking for more opportunities that may entice our colleagues, especially those who enter the profession after their post graduation to join the ROSA.

In next year, I shall strive to protect our core values and also advance by

- Increasing the ROSA fellowship programs
- Structural advancement of all the committees, with special emphasis on education & membership
- Augment the interactions among all members and with masters
- Providing increased opportunities to young surgeons in the sessions of our meetings

We plan meticulously for the year ahead and pledge to rededicate ourselves to the cause of quality education and open new vistas in the arena of learning and research.

I have a satisfying sense of pride and happiness in being the Secretary of ROSA.

I wish you all a happy and peaceful New Year

LONG LIVE ROSA!

Rahul Katta

Dr Rahul Katta
Hon. Secretary, ROSA

ROSA Best Publication Award

ROSA Best Publication Award (Ganpat Rai ji Gold Medal) for ROSA Voice

[From Jan. to Dec. 2021]

Please send scientific articles for publication. Preference shall be given to original work.

Case reports Conducted trials, scientific research, views based on individual experience supported by evidence etc.

Please send all your inputs to editor.rosavoice@gmail.com

Minimally Invasive Spine Surgery: Review

Abstract: Minimally invasive spine surgery (MISS) is a relatively new tool used by spinal surgeons. It has continued to evolve over the past few decades and become increasingly feasible, efficient and popular for the management of a wide range of spinal disorders with significant advancements in technology and technical skills. MISS's goals of reducing soft-tissue trauma, reducing the morbidity of surgery, more rapid recovery, lower infection rates, and higher cost savings compare to traditional open approach are being realized. In this article, we review the technologies and innovations that are expanding the perspective of minimally invasive spine surgery (MISS).

Keywords: minimally invasive, spine surgery, percutaneous, endoscopic, navigation, robotics

Abbreviations -

MISS: Minimally invasive spine surgery

MED: Microendoscopic discectomy

PELD: Percutaneous endoscopic lumbar discectomy

MI-TLIF: Minimally invasive transforaminal lumbar interbody fusion

LLIF: Lateral lumbar interbody fusion

OLIF: Oblique lumbar interbody fusion

XLIF: Extreme lateral interbody fusion

ALIF: Anterior lumbar interbody fusion

CT: Computed Tomography

MRI: Magnetic resonance imaging

Introduction: Minimally invasive spine surgery (MISS) was introduced in the 1990s, since than it has been increasingly applied and drained much attention in the treatment of spinal disorders.[1] There has been a higher demand to conduct this surgery, and the traditional open spine surgery has gradually been replaced with MIS surgery. The definition of MIS procedures was described as ''one that by virtue of the extent and means of surgical technique results in less collateral tissue damage, resulting in measurable decrease in morbidity and more rapid functional recovery than traditional exposures, without differentiation in the intended surgical goal.''[1] This broad definition has been used to describe a large variety of spine surgeries for a spectrum of diagnoses.

There are several strengths often cited to support the widespread adoption of MIS techniques including enhanced retraction, fixation, biologics, visualization, monitoring, and navigation, further disrupting the landscape.[2, 3] MIS surgery does show its merits including a smaller skin incision, less trauma to paravertebral soft tissues, reduced blood loss during operation, and a faster functional recovery in these as compared with traditional open procedures.[4] There are limitations to the widespread use and adaptation of MIS techniques like significant learning curve, radiation exposure, length of surgery and initial high complication rates.[5]

There are three techniques employed today that deserve special consideration: (1) Mini-Open/ Percutaneous, (2) Tubular, and (3) Endoscopic.[6] While each confers its own merits and demerits, all three continue to evolve and expand their indications. The present review aims to consolidate current literature on the modern state of MISS for Neural Decompression, MISS for Spinal Fixation and Fusion, Minimally Invasive Deformity Correction and current state of Navigation and Robotics addressing their strengths and shortcomings in different settings.

1. MISS for Neural Decompression: Open decompression for lumbar spinal stenosis and disc herniations has been an established practice for decades, and recently several minimally invasive treatment options have expanded the available clinical treatment options. The emergence of tubular retractors and endoscopic minimally invasive techniques has allowed surgeons to perform decompression surgeries with the added benefit of reduced perioperative complications (i.e. length of stay, blood loss, infections).

A. Microdiscectomy: Microscopic discectomy introduced by Williams[7], was the forerunner to the modern technique in use today. An MIS microdiscectomy involves the use of serial tubular retractors to dilate the paraspinous musculature, using the operating microscope allowed narrowing of the surgical corridor with enhanced

illumination. Reducing muscle disruption and soft-tissue dissection, gentle manipulation of the dura/nerve roots, which lowered surgical complications such as durotomy, nerve root injury, and discitis.[8]

Wiltse and Kambin laid the groundwork and philosophical basis for MISS. Wiltse innovated a unique approach that involved muscle splitting[9] between the multifidus and longissimus to bluntly gain access to the posterior elements of the spine. They continued to apply this principle of muscle-sparing technique to perform far-lateral discectomy, insertion of pedicle screws, and ipsi-contralateral decompression in lumbar spine. Parviz Kambin (1973), first described the transforaminal corridor to the lumbar spine, which is frequently used by spine surgeons, interventional radiologists, and pain physicians. This corridor has been the route for tackling a variety of procedure like transforaminal epidural injection, far lateral disc and endoscopic procedure.[10]

B. Tubular Retractor System: Microendoscopic discectomy (MED) system was introduced in 1997, which allowed the surgeons to use both endoscopic images and direct surgical images to be viewed under a microscope. METRx system (Medtronic Sofamor Danek, Memphis, TN) was the first commercially available product as a tubular retractor system**.** METRx system splits the muscle instead of cutting it which minimize postoperative back pain by reducing muscle damage. With integration of the microscope and METRx tubular system, a paramedian tubular approach gained popularity with minimally invasive spine surgeons, and a flurry of reports emerged for lumbar discectomy, ipsi-contralateral central canal decompression, thoracic discectomy, tumor removal, infection treatment and fusions with instrumentation.[11] Fessler and Khoo later applied these microendoscopic techniques to cervical foraminotomy in cadaveric specimens and subsequently in clinical settings in 2002.[12]

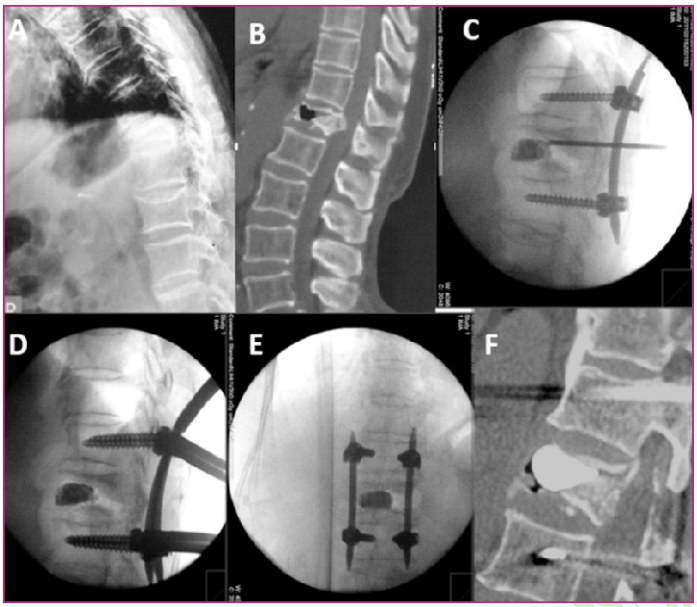
The space needed for decompression is anywhere between 15 to 20 mm. Therefore, most surgeries can be carried out successfully with a 20-mm cylindrical tube. The narrower the tube's diameter and the longer the tube, the more difficult it is to use surgical tools and to obtain sufficient space. However, if too wide tube is used, the more potential there is to damage muscles. In general, a tube with the diameter of 20 mm and a length of 40 to 50 mm is used. Despite the benefits, there are some drawbacks; First, appropriate surgical tools and manual skills are required since surgeons must work in a narrow space. Second, there may be confusion regarding anatomical structures. Third, limitations of effective decompression.

C. Endoscopic Techniques : Endoscopic spine surgery was first attempted by Kambin et al. in 1988[13] and has the same advantages as other forms of MISS. Improvements in glass-rod endoscope technology, digital image processing, and high-definition video all helped fuel these advancements. The obvious benefit was the reduction of the surgical corridor to less than 10 mm. Endoscopic spinal surgeries are carried out for discectomies and decompression, expanding beyond the lumbar region, and now are performed on the cervical as well as thoracic spine. The transforaminal and interlaminar approach are currenly in use; the transforaminal approach refers to a posterolateral percutaneous approach to the disc but limitations to central canal access persisted. Thus, the interlaminar route was developed,[14] which allowed for paracentral and central (midline) access.

There are three generations of endoscope most commonly used currently; 1) Percutaneous endoscopic (full-endoscopic) system 2) Microendoscopic system 3) Biportal endoscopic system. The most commonly used system in endoscopic spine surgery is the percutaneous (full-endoscopic) endoscopic system. It is a monoportal approach with continuous saline irrigation with working channel, endoscope and the optics in the same tubular device. The second most commonly used system is microendoscopic system which uses a rigid endoscope attached to a tubular retractor. The third category is biportal endoscopic system similar to arthroscopic joint surgery with separate optical and working channels. [14] Percutaneous endoscopic lumbar discectomy (PELD) is less invasive to other endoscopic techniques (micro-endoscopic discectomy and unilateral biportal endoscopic discectomy) and to conventional micro-discectomy.[15] Endoscopic spine surgery is also faced with the challenge of surgical technique mastery. The complications, arising from early operations seem to diminish with consecutive cases, however are significant enough to consider.

2. MISS for Spinal Fixation : Pedicle screw fixation provides three-column support to the vertebrae that provide rigid construct for fusion at the intended levels.[16]

MISS Spine Surgery Cases Illustration



Case 1 (OVCF): Fig. 1 A : (X-ray-Lateral view) & Fig. 1 B : (CT scan) D12 Osteoporotic vertebral compression fracture,

Fig. 1 C - E : showing placement of a pedicle screw into the vertebra adjacent to the fractured one by using a minimally invasive technique and injection of cement after minimally invasive pedicle screw-and-rod reduction and fixation.

Fig. 1 F : (CT scan) Post op CT scan showing good reduction with cement position.

Open pedicle screw require wide posterior extensive exposure for the optimal screw trajectory that may result in muscular denervation, facet capsule disruption and damage to the adjacent facet joints.[17] Percutaneous implantation uses Wiltse plane to avoid wide disruption of the paraspinal muscles. Magerl was the first who described the percutaneous screw placement technique in 1982. The earliest commercially successful percutaneous screw system was the Sextant system (Medtronic Sofamor Danek) used an arc-shaped rod to have a predefined rod passage trajectory to be inserted through a small stab incision in a standard submuscular plane.[18] However, the system was limited to short-segment constructs. Subsequent systems have been developed by many manufacturer, and current systems are largely based upon the following:1) targeting pedicles with fluoroscopy, navigation, or robotics; 2) placement of a cooks needle 3) using the Seldinger technique to pass instruments and then a cannulated pedicle screw and 4) rod passage and connection is then achieved freehand using these extension posts to assist in rod insertion.

3. MISS for Thoracolumbar Interbody Fusion -

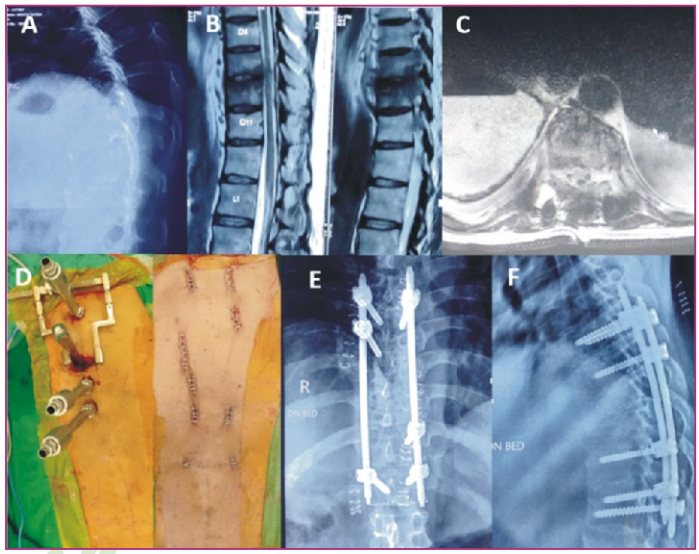


Fig. 2 (Infection) A : (X-ray-Lateral view) greater than 50% collapse of the central vertebral body of D9 and D10,

Fig. 2 B and C: (MRI) showing D9 - D10 spondylodiscitis with an epidural abscess,

Figure C and D : intra-operative image

Fig. E and F : percutaneous placed pedicle screw instrumentation.

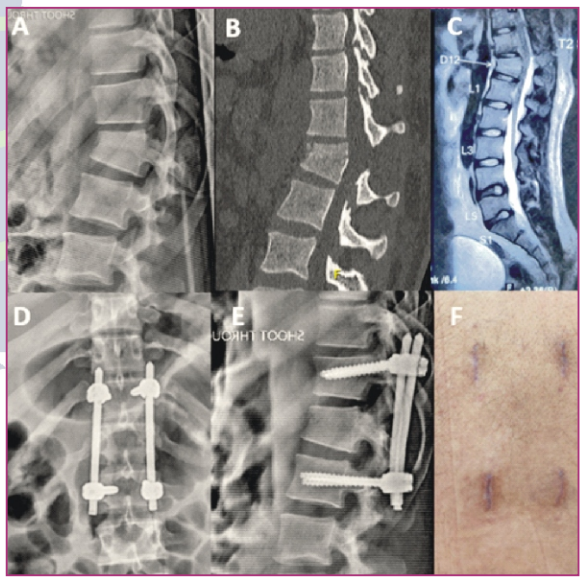


Fig. 3 (Trauma): Case of 24-year-old that presented with a flexion distraction injury and T12 burst fracture; Fig. A : (X-ray), Fig. B (CT scan) & Fig. C (MRI)- Mid-sagittal showing flexion-distraction injury of T11 posterior elements and a T12 burst fracture, Fig. D and E - Post-operative AP & lateral X-ray of thoracolumbar spine, Fig, F - Clinical photograph displaying the scars.

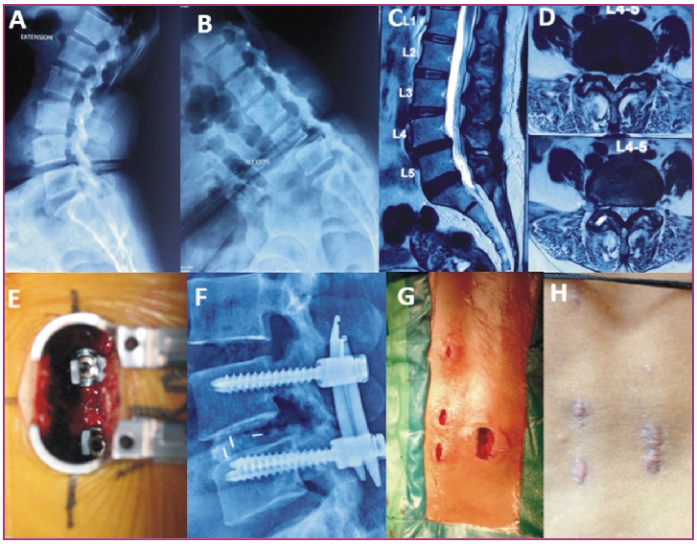


Fig. 4 (Degenerative): (A) and (B) lateral standing dynamic x-rays showing instability and Grade 1 spondylolisthesis at L4L5, (C & D) - MRI; Showing severe canal stenosis and grade I spondylolisthesis of L4L5, (E) Intraoperative image of tubular system, (F) Postoperative X-ray lumbosacral spine showing MISS fixation of L4L5 vertebral body by pedicle screw rod system and fusion by cage, (G & H) showing skin incision with post-operative scar.

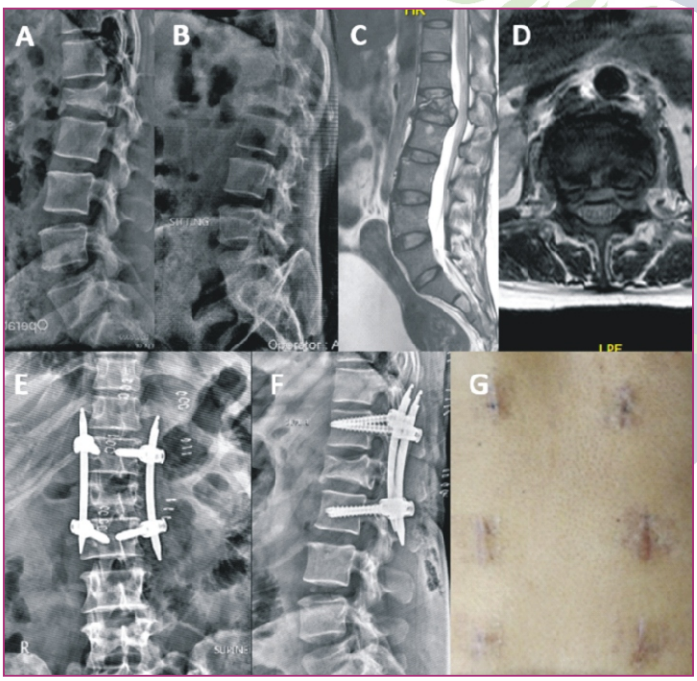


Fig. 5 (Metastasis): Figure A & B (X-ray-Lateral view) - greater than 50% collapse of the central vertebral body of L1, Figure C and D (MRI) Bilsky grade 1c epidural cord compression, Figure E and F - percutaneous placed pedicle screw instrumentation, Figure G - Clinical photograph displaying the scars.

A. Posterior Approach : Minimally invasive spine (MIS) fusion approaches continues to grow due to advancements in interbody devices, tubular retractor system, better visualization with microscope and endoscope and use of navigation and robotics. Harms and Rolinger (1982) developed the open transforaminal lumbar interbody fusion (TLIF) technique aimed to improved ability to restore foraminal height, restore segmental alignment, and reduce the amount of thecal sac and nerve root retraction which has since become one of the most effective procedures for lumbar spinal fusion.[19] Foley and Lefkowitz first described the MIS-TLIF in the early 2000s.[20] Holly et al. and Schwender et al. reported successful outcomes with MIS-TLIF through a tubular retractor, obviating the need for bilateral tubular access.[21] Over the past decade, MIS-TLIF through a tubular retractor has become the posterior approach workhorse for contemporary minimally invasive spine surgeons. Since its introduction, MIS-TLIF has demonstrated fewer complications, less intraoperative blood loss, faster mobilization, shorter hospital stay and recovery time, and less postoperative narcotic use with similar clinical outcomes and fusion rates compared to open TLIF. [22]

B. Lateral Approach: A minimally invasive anterolateral approaches that has substantially decreased the morbidity of posterior approach surgery to the lumbar spine. These approaches utilizes tubular retractors and allowing wide exposure of the disc space. Three of the most widely used procedures include anterior lumbar interbody fusion (ALIF), transpsoas lateral lumbar interbody fusion (LLIF), and a prepsoas or anterior to the psoas oblique lumbar interbody fusion (OLIF). The primary surgical goal of all three procedures is to implant the largest possible interbody graft to facilitate fusion rates, maximize segmental lordosis, and provide indirect neural decompression by expansion of the bony neuroforamen, distraction of ligamentous stenosis of the central canal and deformity correction.[23]

Surgeons utilizing this procedure, however, do need preoperative advanced imaging (CT and/or MRI) to help visualize vulnerable vasculature upon approach as well as assess for high-riding iliac crests when treating the lower lumbar disc spaces (i.e. L4-L5, L5-S1).[24] However, ALIF, LLIF, and OLIF differ considerably regarding patient selection, operative planning, surgical execution, and potential risks and complications. The lateral approach to the lumbar spine has been growing in popularity as it is adapted for a variety of indications, including: neuroforaminal stenosis, grade 1 or 2

spondylolisthesis, spinal stenosis with instability, and adult degenerative scoliosis.[25] Furthermore, in contrast to an oblique lateral interbody fusion, neuromonitoring is required in LLIF to ensure minimal disruption of the lumbar plexus on dissection of the psoas and placement of retractors. These approaches played a key role in MIS adult spinal deformity.

4. Minimally Invasive Deformity Correction: Adult spine deformity (ASD) refers to a set of conditions involving abnormal sagittal and coronal spinal alignment leading to a range of symptoms including pain, neurologic dysfunction, and gross physical deformity.[26] With regard to surgical management of adult spinal deformity (ASD), surgical goals include restoration of sagittal and coronal balance, construction of a solid fusion foundation, and decompression of the neural elements.[27] One of the hopes of MISS is based on the concept of achieving the same surgical goals while minimizing dissection or utilizing smaller operative corridors. However, given that extensive tissue dissection and release has been traditionally essential to achieve ASD goals especially with a minimally invasive approach. Thus, initial research has focused on proving the feasibility of new minimally invasive techniquessuch as transforaminal lumbar interbody fusion (TLIF), lateral lumbar interbody fusion (LLIF), MIS anterior lumbar interbody fusion (ALIF), MIS placement of iliac screws, MIS placement of percutaneous screws, MIS rod rotation and reduction techniques, as well as MIS posterior pars-facet complex fusion.

Anand et al. (2013) studied an adult deformity correction and fusion using all or a combination of 3 MISS techniques: segmental multilevel percutaneous pedicle screw fixation (posterior instrumentation), direct lateral interbody fusion (DLIF), and axial lumbar interbody fusion (AxiaLIF) resulted in excellent functional outcome. They classified MISS into three broad categories: 1) MIS decompression (direct or indirect) - It involves minimally invasive decompression with or without single level/ short segment fusion in patients with mild spinal deformity and symptoms primarily of neural element compression 2) multilevel circumferential MIS surgery (cMIS)- It involves 360° deformity correction with anterior column support (interbody graft placement) and posterior segmental instrumentation through an entirely MIS approach 3) Hybrid surgery (combination of MIS and traditional posterior open approach) - It involves the incorporation of lateral MIS techniques with a traditional "open" posterior surgery, which includes segmental osteotomies and instrumentation. There are certain limitations to the procedure including inadequate sagittal balance as well as chances of proximal junctional kyphosis and adjacent segment disease; however, the overall benefits of MIS including decreased operative time, blood loss, and hospital stay could tilt the balance in its favor.[26]

5. Navigation and Robotics: The field of minimally invasive spine surgery is ripe for innovation, especially in the area of three-dimensional printing, medical imaging and computational sciences have allowed for navigation and robotic-assisted (RA) spine surgery. These technologies have gained popularity among spine surgeons and accepted due to advantageous improvements in preoperative surgical planning, incision planning, and placement of spinal instrumentation.[28]

The first frameless stereotactic navigation spine surgery using the StealthStation (Medtronic, Memphis, Tennessee, USA) was reported in 1999. [29] The O-arm (Medtronic, Dublin, Ireland) was introduced in 2005 which has an O-shaped gantry with flat-panel detectors that allows for 2-dimensional fluoroscopy or 3D volumetric imaging through a cone-beam CT method.[30] The CT images produced by the O-arm have improved image quality and provide a larger field of view than fluoroscopic images. Originally, the O-arm could only capture 4 spinal segments, so multiple scans were required. However, in the second-generation systems (O-arm II), the stacking of multiple images allows longer segments (40 cm) to be captured. The U.S. FDA approved Airo (Brainlab, Feldkirchen, Germany) in 2013, a mobile intraoperative CT-based spinal navigation system. Similar to the O-arm, it allows for 360 scanning. However, it is a true 32-slice CT scanner with less scatter radiation and purportedly better image quality.[31] Despite concerns regarding ionizing radiation exposure to the patient, use of CT navigation systems was found to reduce radiation exposure by more than 90% compared to traditional fluoroscopic guided percutaneous surgical techniques. The cost of navigation systems remains one of its prohibitive factors. However, the increased accuracy, the reduced cost of reoperations and management, and the reduced radiation exposure are all factors that can balance out the increased upfront cost.

Robotic surgical devices can work seamlessly with navigation systems and integrate well into minimally

invasive spine surgery (MISS). The first spinal surgical robot, Spine-Assist (Mazor Robotics Ltd., Cesarea, Israel), was introduced in 2004, and its successor Renaissance Guidance System (Mazor Robotics Ltd.) in 2011.[32] The Mazor X (Mazor Robotics Ltd.), launched in 2016, was the first stand-alone robotic platform that relied on preoperative CT imaging for instrumentation planning.[33] The integration of Stealth navigation allowed for real-time visual anatomic navigation, a 3D volumetric scan of the operative field is attained and integrated into the navigational system so that the system is aware of the surgical tools in relation to the robotic arm. The Mazor system allows for 2 registration work flows. Traditional preoperative planning utilizes preoperative CT images to optimize screw size and trajectory on all 3 planes and an intraoperative 3D-CT scan is attained through the O-arm and uploaded to the Mazor system to allow for real-time intraoperative planning.[34] The relevance to MISS is 1) the reduction in radiation exposure 2) accurate percutaneous screw placement and 3) assistance with 3D planning. The use of robot has largely been limited to assistance with pedicle screw placement, it may soon be possible to perform more complex surgical tasks. Unfortunately, the issue of cost still prevails in the realm of robotic spine surgery, as currently the added benefit of robotics is limited, and although accuracy is higher than free hand PS insertion, it is at best equivalent to computer assisted navigation.

MISS Limitations: There are limitations to the widespread use and adaptation of MIS techniques like steep learning curve, limited visualization of the surgical field, need for high level of manual dexterity, need of advanced imaging technology, healthcare costs and increased radiation exposure.

Conclusions: To maximize the principle of a minimally invasive approach without compromising the goals of open surgery, surgeons must be selective in choosing which cases are amenable to an MIS approach. There has been a shift towards minimally invasive surgical techniques since last two decades due to availability of biologics and customizable implants, advancements in imaging and navigation technologies and refinement of operative techniques as demonstrated by the current literature. The benefits of MIS are becoming increasingly obvious; however, surgeons must remember to exercise judgment when electing to use these techniques over more traditional open procedures.

Conflict of interest : The authors declare that they have no conflict of interest related to the publication of this manuscript and no funds were received in support of this work. No benefits in any form have been or will be received from a commercial party related directly or indirectly to the subject of this manuscript.

Reference:

1. McAfee PC, Phillips FM, Andersson G, et al. Minimally invasive spine surgery. Spine (Phila Pa 1976) 2010; 35: S2713.
2. Taylor H, McGregor AH, Medhi-Zadeh S, et al. The impact of self-retaining retractors on the paraspinal muscles during posterior spinal surgery. Spine (Phila Pa 1976) 2002; 27: 275862.
3. Eck JC, Hodges S, Humphreys SC. Minimally invasive lumbar spinal fusion. J Am Acad Orthop Surg 2007; 15: 3219.
4. Foley KT, Lefkowitz MA. Advances in minimally invasive spine surgery. Clin Neurosurg. 2002; 49: 499-517.
5. Perez-Cruet MJ, Fessler RG, Perin NI. Review: complications of minimally invasive spinal surgery. Neurosurgery 2002;51: S2-263.
6. Patel PD, Canseco JA, Houlihan N, Gabay A, Grasso G, Vaccaro AR. Overview of Minimally Invasive Spine Surgery. World Neurosurg. 2020 Oct; 142: 43-56.
7. Williams RW: Microlumbar discectomy: a conservative surgical approach to the virgin herniated lumbar disc. Spine (Phila Pa 1976) 3:175182, 1978.
8. Koebbe CJ, Maroon JC, Abla A, El-Kadi H, Bost J: Lumbar microdiscectomy: a historical perspective and current technical considerations. Neurosurg Focus 13(2):E3, 2002.
9. Wiltse LL, Bateman JG, Hutchinson RH, Nelson WE: The paraspinal sacrospinalis-splitting approach to the lumbar spine. J Bone Joint Surg Am 50:919926, 1968.
10. Kambin P, Brager MD: Percutaneous posterolateral discectomy. Anatomy and mechanism. Clin Orthop Relat Res (223):145154, 1987.
11. Yoon, J. W., & Wang, M. Y. (2019). The evolution of minimally invasive spine surgery, Journal of Neurosurgery: Spine SPI, 30(2), 149-158.
12. Fessler RG, Khoo LT: Minimally invasive cervical microendoscopic foraminotomy: an initial clinical experience. Neurosurgery 51 (5 Suppl): S37S45, 2002.
13. Kambin P, Nixon JE, Chait A, et al. Annular protrusion: pathophysiology and roentgenographic appearance. Spine (Phila Pa 1976) 1988; 13: 671-5.
14. Ahn Y. Current techniques of endoscopic decompression in spine surgery. Ann Transl Med. 2019;7(Suppl 5):S169.
15. Choi KC, Shim HK, Hwang JS, Shin SH, Lee DC, Jung HH, Park HA, Park CK. Comparison of Surgical Invasiveness Between Microdiscectomy and 3 Different Endoscopic Discectomy Techniques for Lumbar Disc Herniation. World Neurosurg. 2018 Aug;116: e750-e758.
16. Vaccaro AR, Garfin SR: Pedicle-screw fixation in the lumbar spine. J Am Acad Orthop Surg 1995; 3(5): 263-274.
17. Wiltse LL: The paraspinal sacrospinalis- splitting approach to the lumbar spine. Clin Orthop Relat Res 1973; 91: 48-57.
18. Foley KT, Gupta SK, Justis JR, Sherman MC: Percutaneous pedicle screw fixation of the lumbar spine. Neurosurg Focus 10(4):E10, 2001.
19. Harms J, Rolinger H: A one-stage procedure in operative

treatment of spondylolisthesis: Dorsal traction-reposition and anterior fusion. Z Orthop Ihre Grenzgeb 120:343347, 1982 (In German)

20. Hyeong-Jin Lee, Jin-Sung Kim, Kyeong-Sik Ryu, "Minimally Invasive TLIF Using Unilateral Approach and Single Cage at Single Level in Patients over 65", BioMed Research International, vol. 2016, Article ID 4679865, 10 pages, 2016.
21. Schwender JD, Holly LT, Rouben DP, Foley KT. Minimally invasive transforaminal lumbar interbody fusion (TLIF): technical feasibility and initial results. J Spinal Disord Tech. 2005 Feb;18 Suppl:S1-6.
22. Lee LY, Idris Z, Beng TB, Young TY, Chek WC, Abdullah JM, et al: Outcomes of minimally invasive surgery compared to open posterior lumbar instrumentation and fusion. Asian J Neurosurg 12:620637, 2017.
23. Xu DS, Walker CT, Godzik J, Turner JD, Smith W, Uribe JS. Minimally invasive anterior, lateral, and oblique lumbar interbody fusion: a literature review. Ann Transl Med. 2018;6(6):104. doi:10.21037/ atm.2018.03.24
24. Grasso, G. Avoiding lumbar segmental arteries injury in oblique lateral interbody fusion procedure. World Neurosurgery. June 2020;138: e778-e786.
25. Salzmann, S. N., Shue, J. & Hughes, A. P. Lateral Lumbar Interbody FusionOutcomes and Complications. Current Reviews in Musculoskeletal Medicine 10, 539546 (2017). 79.
26. Anand N, Baron EM, Khandehroo B, Kahwaty S. Long-term 2- to 5-year clinical and functional outcomes of minimally invasive surgery for adult scoliosis. Spine (Phila Pa 1976). 2013 Aug 15;38(18):1566-75.
27. McAfee, P. C. et al. Multilevel extreme lateral interbody fusion (XLIF) and osteotomies for 3-dimensional severe deformity: 25 consecutive cases. Int. J. Spine Surg. 7, e8 (2013).
28. R. Härtl, K.S. Lam, J. Wang, A. Korge, F. Kandziora, L. Audigé Worldwide survey on the use of navigation in spine surgery World Neurosurg, 79 (2013), pp. 162-172.
29. Girardi FP, Cammisa FP, Sandhu HS, Alvarez L.The placement of lumbar pedicle screws usingcomputerised stereotactic guidance. J Bone JointSurg Br. 1999;81-B:825-829.
30. U.S. Food and Drug Administration. 510 (k) Sum-mary O-armÔImaging System with 1-D DisplayControl Mouse; 2005. Available at: https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfpmn/pmn.cfm ID¼K151000; 2005. Accessed March 31, 2020.
31. Scarone P, Vincenzo G, Distefano D, et al. Use ofthe Airo mobile intraoperative CT system versusthe O-arm for transpedicular screwfixation in thethoracic and lumbar spine: a retrospective cohortstudy of 263 patients.J Neurosurg Spine. 2018; 29: 397-406.
32. M. Hoeckelmann, I.J. Rudas, P. Fiorini, F. Kirchner, T. Haidegger. Current capabilities and development potential in surgical robotics. Int J Adv Robot Syst. 2015; 12: 61.
33. Malham, G., & Wells-Quinn, T. (2019). What should my hospital buy next Guidelines for the acquisition and application of imaging, navigation, and robotics for spine surgery. Journal Of Spine Surgery, 5(1), 155-165.
34. A. Khan, J.E. Meyers, I. Siasios, J. Pollina. Next-generation robotic spine surgery: first report on feasibility, safety, and learning curve. Oper Neurosurg (Hagerstown). 2019; 17: 61-69.

Dr Pratik Patel
DNB(Orth.) Fellow

Dr Samir Dalvie, Mumbai
MS Orth. Consultant Spine Surgeon

Dr Porwal Trust Service to Mankind

Dr Vinod Jaskaran Porwal Trust donated a "Orthopaedic Cottage Complex" to RNT Medical College, Udaipur, in Memory of Late Sh. Jaskaran Porwal, on 1st November 2020. The inauguration was done by Hon. Mother Smt. Jatan Devi Porwal with Dr S K Kaushik and Dr D P Singh (Both Ex-Principles) as well as Dr Lakhan Poswal, Principal RNT Medical as Chief Guests. The Guest of Honour Dr A K Mehra HOD Orthopaedics, Dr Vinay Joshi, Ex President ROSA, Dr B L Kumar, President UOS and Dr Anurag Talesra, Secretary UOS also graced the occasion.

The trust has also started "Dr. Vinod Jaskaran Porwal Gold Medal" for best postgraduate paper presentation in ROSACON every year in order to motivate young postgraduate orthopaedic surgeons to improve their presentation skills and achieve academic growth in their career.

Evaluation of Back Pain in Pediatric & Adolesdcent Cohort

Introduction: Low back pain (LBP) is a relatively common complaint among children and adolescents.[1] The one year prevalence rate of low back pain in children has been reported from 7% to 58%.[2]

Possible risk factors for LBP among children and adolescents are sedentary life style, psychosocial difficulties, sports participation , obesity, family history of LBP and heavy back packs.[3,4,5] {Table - 1}

This article will review the pertinent evaluation, differential diagnoses, and treatment of low back pain in the pediatric & adolescent population.

History: A detailed history and physical examination are critical to making an accurate diagnosis of the source of back pain in children and adolescents. Questions about the onset, duration, frequency, severity, and location of pain (including radiation to the extremities) are important. History of trauma or illness should be documented. Potential warning signs, including night pain, constant pain, fever, weight loss, malaise, pain lasting more than several weeks, or back pain in children younger than 10 years, require further diagnostic investigation.

Acute onset pain is often indicative of trauma or infection while insidious onset pain may herald an inflammatory etiology or longstanding altered biomechanics.[6] Non-localizable back pain is often secondary to muscular or inflammatory etiologies while focal back pain may indicate a stress fracture or bony lesion.[7,8] Sharp or burning pain is characteristic of a neurologic etiology. Inflammatory back pain starts insidiously, improves with exercise, is associated with more than 30 minutes of morning stiffness, and alternating buttock pain.[7,8]

Physical examination: The patient's back should be examined for midline cutaneous lesions that may indicate intraspinal abnormalities. The back should be palpated for midline, paraspinal, and/or sacroiliac joint tenderness, palpable masses, or a step-off in the posterior elements.

Table - 1: Etiology of back pain in children & adolescent.

(I) More Common Musculoskeletal and mechanical etiologies

A) Nonspecific low back pain
- Muscular strain

B) Special diagnosis
- Spondylolysis/ spondylolisthesis
- Malalignment
- Scheuermann disease
  - ❏ Scoliosis
  - ❏ Intervertebral disk herniation

II. Other etiologies

A) Vertebral column fractures

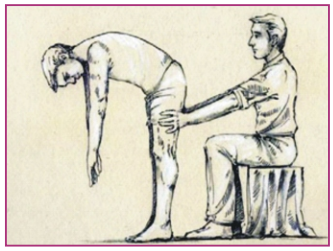
B) Infectious diseases

C) Inflammatory
- Ankylosing spondylitis
- Juvenile idiopathic arthritis
- Arthritis

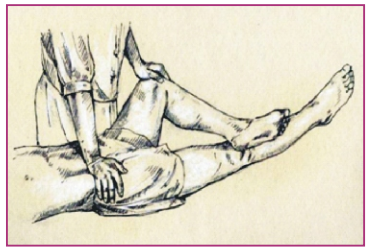
D) Neoplastic disorders
- Spinal column
  - ❏ Primary neoplasms
  - ❏ Secondary neoplasms
- Spinal cord
  - ❏ Intramedullary
    - ✦ Extradural tumors
    - ✦ Intradural-extramedullary

E) Congenital and heamatologic diseases
- Sickle cell crisis, Takasayu arteritis

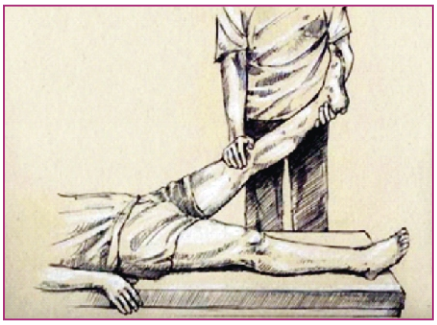
A forward bend test is helpful to evaluate the patient for deformities, such as kyphosis and scoliosis, and the patient should be assessed in the standing position for pelvic obliquity and truncal shift. Back pain with the hip placed in flexion, abduction, and external rotation (FABER) or pain with Gaenslen maneuver can also suggest sacroiliac joint pathology.[9]



Adams forward bending test



FABER test



Straight leg raise test

Straight leg raise test can indicate radiculopathy related to nerve root compression. The patient's gait should be assessed for any abnormalities and the active range of motion (ROM) of the lumbar spine should be measured. A complete neurologic examination is essential and should include assessment of motor and sensory function, deep tendon and abdominal reflexes, and upper motor neuron signs.

Table - 2 : Clinical tests that should be performed in children with the complaint of low back pain

Clinical Tests	Description
Adams forward bending test	While the feet are together and knees are straight, the child should bend forward, the test is positive if any asymmetry in rib cage or curvature of spinal column were observed.
Straight Leg Raise (SLR) or Lasegue test	In supine position, patient's leg should be raised while the knees are straight. The test is positive if pain was felt by the patient in range of 30 to 70 degree of hip flexion.
Patrick or FABER test (Flexion Abduction External Rotation)	In supine lying position, while the knee is 90 degree flexed and hip is abducted and externally rotated, the pelvis should be fixed by one hand and the flexed knee should be pushed toward in a way to externally rotate the leg on hip joint. The test is positive when the pain was felt buttock, groin or sacroiliac joint.
Trendelenburg	While the patient has been asked to stand on one leg the position of the pelvis should be checked. The test is positive when the pelvis of the other side drops.

Imaging: Radiographs of the entire spine with the patient in the erect, standing position are indicated when the history or physical examination reveals localized pain, a neurologic deficit, or a clinical deformity.

Advanced imaging like MRI scan is recommended when radiography is inadequate to define the pathology (eg, neoplasm) that is causing pain or when a soft-tissue problem is suspected (eg, infection, tumor, dural compression, radiculopathy)on the basis of the patient's history or examination

The use of advanced imaging studies such as bone scan, CT, and MRI has been controversial, and recommendations for their use have evolved in the past 10 years. Feldman et al[10] used an algorithm to evaluate 87 pediatric patients with back pain and found that it had a high diagnostic specificity and sensitivity for detecting an abnormality, making it a useful tool that can be used to guide treatment without unnecessary advanced imaging (Figure 1). No cause for symptoms was found in 64% of patients with a single report of low back pain; they were diagnosed with nonspecific back pain and were managed conservatively.

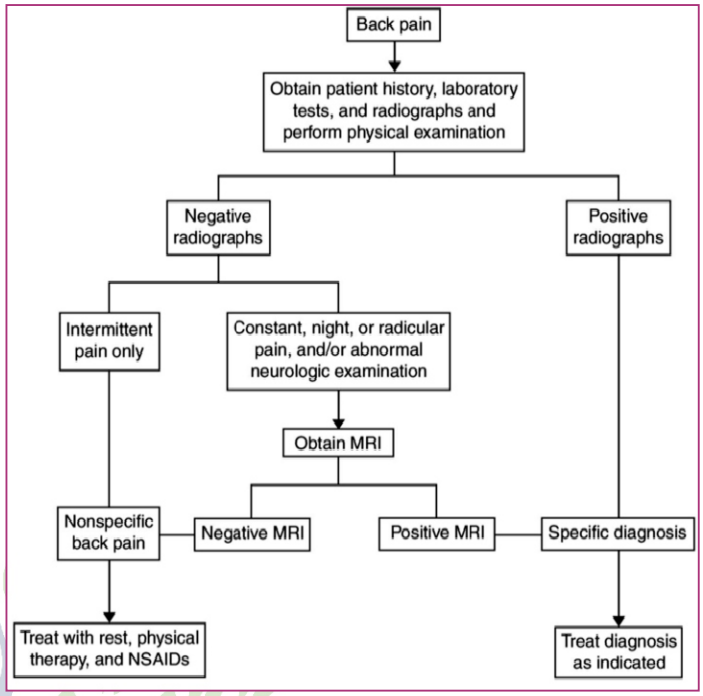


Fig. 1: Algorithm for detecting an abnormality resulting in back pain that can be used without unnecessary advanced imaging.

Differential Diagnosis –

Table - 3 : Differential diagnosis of back pain in children & adolescent

Presentation	*Possible diagnoses*	*Associated symptoms*
Nighttime pain	Tumor, infection	Fever, malaise, weight loss
Pain with fever or other generalized symptoms	Tumor, infection	Nighttime pain
Acute pain	Herniated disk, slipped apophysis, spondylolysis Vertebral fracture Muscle strain	Redicular pain, positive straight leg raising test result Other injuries, neurologic loss Muscle tenderness without radiation
Chronic pain	Scheuermann's kyphosis Inflammatory spondyloarthropathies Psychological problems	Rigid kyphosis Morning stiffness, sacroiliac joint tenderness —
Pain with spinal forward flexion	Herniated disk, slipped apophysis	Radicular pain, positive straight leg raising test result
Pain with spinal extension	Spondylolysis, spondylolisthesis, lesion or injury in the pedicle or lamina (posterior arch)	Hamstring tightness
Pain with spinal onset scoliosis	Tumor, infection, herniated disk, syrinx Idiopathic scolicsis	Fever, malaise, weight loss, positive straight leg raising test result Symptoms most common in patients 15 years and older
Other	Pyelonephritis, sickle cell crisis	Abnormal urinalysis findings, dysuria, fever, other bone pain, history of sickle cell disease.

Note: *The items in this table are tested by acuteness of symptoms.*

Illustrative Case Examples:

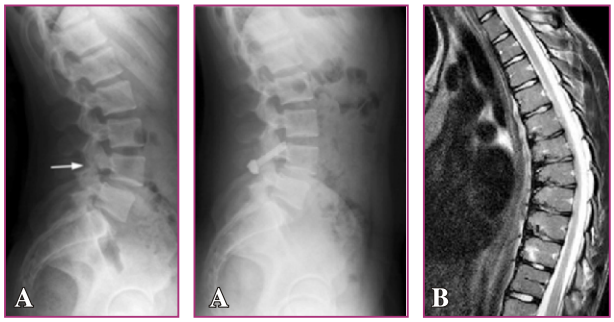


Fig. 2 A : LYTIC SPONDYLOLISTHESIS : Symptomatic L4 pars defect in 16 years old male managed by debridement of pars defect, bone grafting and internal fixation.

Fig. 2 B : SCHEURMANS DISEASE: MRI of 17 year old male patient depicting wedging $>5^{o}$ of 3 contiguous vertebrae, Schmorls node, end plate irregularity and kyphotic deformity.

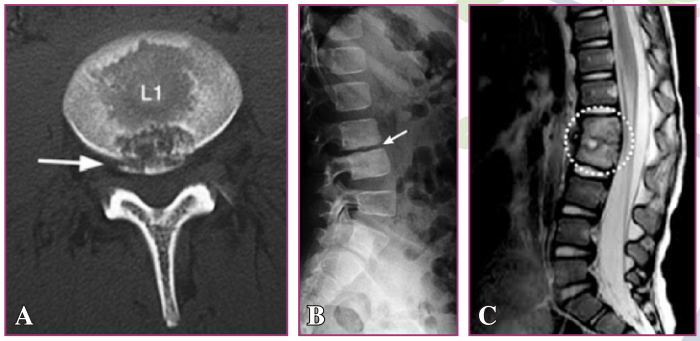
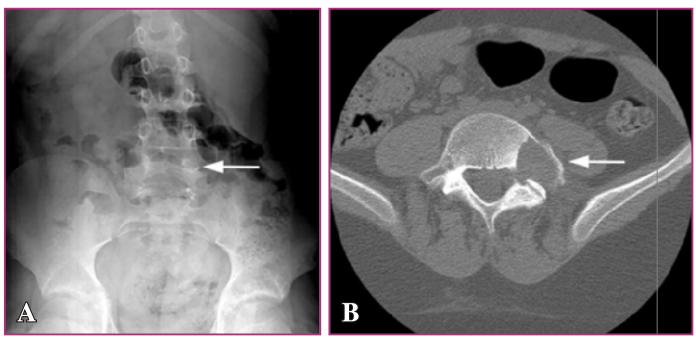


Fig. 3 A : L1 – L2 DISC PROLAPSE: Axial CT of the spine demonstrating an apophyseal ring fracture (arrow).

Fig. 3 B : L3 – L4 SPONDYLODISCITIS : 10 year old symptomatic boy with lateral radiograph showing sclerosis and end plate irregularity, consistent with discitis.

Fig. 3 C : T2 MR sequence depicting increased signal in L1, L2 vertebral body and corresponding disc consistent with infective Spondylodiscitis.



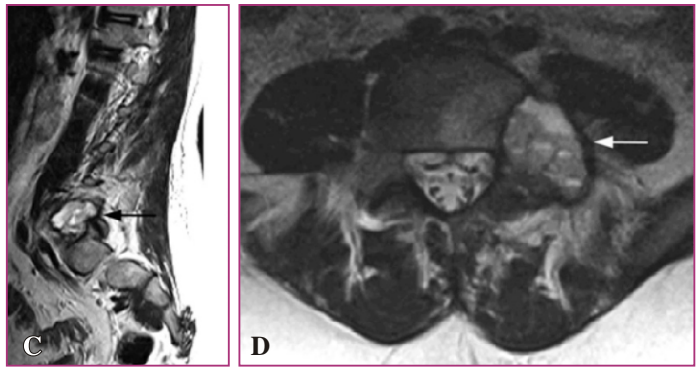


Fig. 4 A : AP radiograph of the lumbar spine demonstrating a radiolucent lesion (arrow) involving the right pedicle in an 11 - year - old boy with a 2-month history of low back pain with radicular leg pain and pain at night. A biopsy confirmed osteoblastoma with a secondary aneurysmal bone cyst within the lesion.

Fig. 4 B : Axial CT demonstrating an aggressive radiolucent lesion (arrow).

Fig. 4 C : Sagittal T1 - weighted magnetic resonance image demonstrating a multilobulated lesion (arrow).

Fig. 4 D : Axial T2 - weighted magnetic resonance image demonstrating fluid levels (arrow).

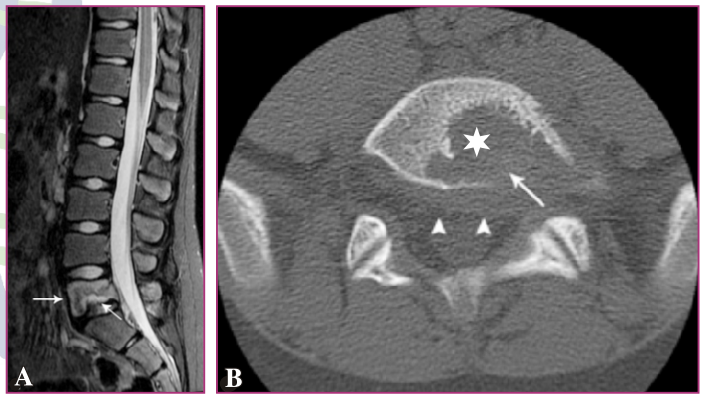


Fig. 5 A : Langerhans Cell Histiocytosis. (A) Sagittal fluid-sensitive MR image of the lumbar spine in a 12 year old boy with back pain demonstrates edema within the L5 vertebral body (thick arrow) with bone destruction of the inferior aspect of the vertebra (thin arrow).

Fig. 5 B : Noncontrast CT axial image in bone algorithm shows a lytic lesion (*) with destruction of the cortex along the posterior aspect of the L5 vertebral body (arrow). There is abnormal soft tissue extending into the epidural space (arrowheads).

Summary: Back pain in children and adolescents is rather common now a days with nonspecific back pain

being more prevalent, especially in adolescents. Radiography is indicated in most cases of such pain, and a careful history and physical examination can help the clinician to identify signs that warrant advanced imaging for diagnosis to establish the source of pain. Knowing the clinical and radiographic features of the most common etiologies of pediatric back pain can help the clinician to effectively identify and treat the conditions causing this pain. If deemed necessary opinion of spine specialist should be sought.

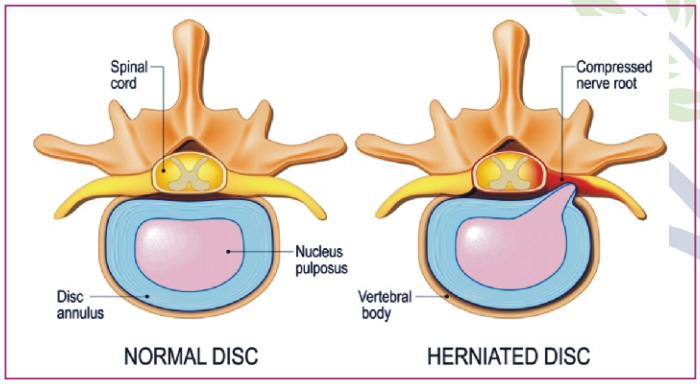
References :

1. Jones G, Macfarlane G. Epidemiology of low back pain in children and adolescents. Arch Dis Childh2005;90(3):312-6.
2. Smith DR, Leggat PA. Back pain in the young: A review of studies conducted among school children and university students. Cur PediatrRev 2007;3(1):69-77.
3. Jones GT, Watson KD, Silman AJ, et al. Predictors of low back pain in British schoolchildren: A population-based prospective cohort study.Pediatrics 2003; 111(4):822-28.
4. Davis PJC, Williams HJ. The investigation and management of back pain in children. Arch Dis Childh Edu Pract Ed 2008;93(3):73-83.
5. Lynch AM, Kashikar-Zuck S, Goldschneider KR, Jones BA. Psychosocial risks for disability in children with chronic back pain. J Pain 2006;7(4):244-51
6. Haus BM, Micheli LJ. Back pain in the pediatric and adolescent athlete. Clin Sports Med. 2012 Jul;31(3):423440.
7. Rudwaleit M, van der Heijde D, Landewe R, et al. The development of Assessment of Spondylo Arthritis international Society classification criteria for axial spondyloarthritis (part II):validation and final selection. Annals of the rheumatic diseases. 2009 Jun; 68(6):777783.
8. Rudwaleit M, Metter A, Listing J, Sieper J, Braun J. Inflammatory back pain in ankylosing spondylitis: a reassessment of the clinical history for application as classification and diagnostic criteria. Arthritis and rheumatism. 2006 Feb; 54(2):569578.
9. Purcell L, Micheli L. Low back pain in young athletes. Sports Health. 2009 May; 1(3):212222.
10. BeutlerWJ, Fredrickson BE, Murtland A, Sweeney CA, Grant WD, Baker D: The natural history of spondylolysis and spondylolisthesis: 45-year follow-up evaluation. Spine (Phila Pa 1976) 2003;28 (10): 1027-1035.
11. Beck NA, Miller R, Baldwin K, et al: Do oblique views add value in the diagnosis of spondylolysis in adolescents? J Bone Joint Surg Am 2013;95(10):e65.
12. Murray PM, Weinstein SL, Spratt KF: The natural history and long-term follow-up of Scheuermann kyphosis. J Bone Joint SurgAm 1993;75(2):236-248.
13. Dang L, Liu Z: A review of current treatment for lumbar disc herniation in children and adolescents. Eur Spine J 2010; 19(2):205-214.
14. Spencer SJ, Wilson NI: Childhood discitis in a regional children's hospital. J PediatrOrthop B 2012;21(3):264-268.
15. Dormans JP, Moroz L: Infection and tumors of the spine in children. J Bone Joint Surg Am 2007;89 (suppl 1):79-97.
16. Chandrasenan J, Klezl Z, Bommireddy R, Calthorpe D: Spondylodiscitis in children: A retrospective series. J Bone Joint Surg Br 2011;93(8): 1122-1125.
17. Haidar R, Saad S, Khoury NJ, Musharrafieh U. Practical approach to the child presenting with back pain. Eur J Pediatr. 2011 Feb; 170(2): 149156.
18. Erlemann R. Imaging and differential diagnosis of primary bone tumors and tumor-like lesions of the spine. Eur J Radiol. 2006 Apr; 58(1):4867.
19. Patel AJ, Fox BD, Fahim DK, et al. A clinicopathologic correlation in osteoblastoma of the spine in a child. J ClinNeurosci. 2011 Dec; 18(12):17281730.
20. Gebauer B, Collettini F, Bruger C, et al. Radiofrequency Ablation of Osteoid Osteomas: Analgesia and Patient Satisfaction in Long-term Follow-up. RoFo : Fortschritte auf demGebiete der Rontgenstrahlen und der Nuklearmedizin. 2013 Aug 23.
21. Huang WD, Yang XH, Wu ZP, et al. Langerhans cell histiocytosis of spine: a comparative study of clinical, imaging features, and diagnosis in children, adolescents, and adults. Spine J. 2013 Apr 18.
22. Riccio I, Marcarelli M, Del Regno N, et al: Musculoskeletal problems in pediatric acute leukemia. J PediatrOrthop B 2013; 22(3):264-269.
23. Marco RA, Gentry JB, Rhines LD, et al: Ewing's sarcoma of the mobile spine. Spine (Phila Pa 1976) 2005;30(7):769-773.
24. Kim HJ, McLawhorn AS, Goldstein MJ, Boland PJ: Malignant osseous tumors of the pediatric spine. J Am AcadOrthopSurg2012;20(10):646-656.
25. Huisman TA. Pediatric tumors of the spine.Cancer Imaging. 2009; 9(Spec No A):S45S48.
26. Smith AB, Soderlund KA, Rushing EJ, Smirniotopolous JG. Radiologic-pathologic correlation of pediatric and adolescent spinal neoplasms: Part 1, Intramedullary spinal neoplasms. AJR Am J Roentgenol. 2012 Jan; 198(1):3443.

Dr Gaurav Mehta
MS, DNB, FMISS
Assistant Professor, GMC, Kota

Management of Prolapsed Intervertebral Disc What is Gold Standard Today ?

Introduction: Prolapsed intervertebral disc is a common ailment and debilitating spinal pathology. Nearly 80% of the population sustains an episode of low back pain (LBP) once during their lifetime . Due to its high prevalence and significant contribution to disability, LBP incurs an heavy annual cost on health expenditure worldwide. Within the vast differential of LBP, the most common source is intervertebral disc degeneration leading to degenerative disc disease and lumbar disc herniation (LDH). Thus, an effective understanding of LDH, its origins, and how to appropriately treat LDH is of substantial importance.



Clinical Presentation: The primary signs and symptoms of LDH are radicular pain, sensory abnormalities, and weakness in the distribution of one or more lumbosacral nerve roots. Focal paresis, restricted trunk flexion, and increases in leg pain with straining, coughing, and sneezing are also indicative. There is increased pain when sitting due to increase disc pressure by nearly 40%.The affected dermatome varies based on level of herniation as well as herniation type. In paracentral herniations, the traversing nerve root is affected versus in far lateral herniations,the exiting nerve root is affected. For example, a paracentral herniation at L4-5 would cause L5 radiculopathy whereas a far lateral herniation at the same level would cause L4 radiculopathy. Pain that is relieved by forward flexion is more consistent with lumbar spinal stenosis (LSS). Rainville et al. recently compared signs of LDH with LSS and found that LSS patients are more likely to have increased medical comorbidities, lower levels of disability and leg pain, abnormal Achilles reflexes, and pain primarily in the posterior aspect of knee.

Diagnostic Guidelines: In 2014, The LDH with Radiculopathy Work Group of the North American Spine Society's (NASS) Evidence-Based Guideline Development Committee recommended manual muscle testing, sensory testing, and supine SLR test (and its crossed leg variant) as the gold standard for clinical diagnosis of LDH. Other tests such as the cough impulse test, hyperextension test, femoral nerve stretch test, lumbar range of motion, and absence of reflexes were not found to be as clinically helpful. A recent meta-analysis concluded that initial screening by the SLR test in conjunction with three of the following four symptoms in a nerve root distribution is sufficient for clinical diagnosis of LDH with radiculopathy: dermatomal pain, sensory deficits, reflex deficits, and/or motor weakness. Cauda Equina Syndrome (CES) is a rare but devastating consequence of LDH. Krishnan et al. identified diabetes, acute onset of symptoms, L3-L4 involvement, sequestrated discs, superiorly migrated discs, posterior herniation, primary canal stenosis, and greater canal compromise as risk factors for CES . The presence of ≥ 4 of these factors produced a significantly higher chance of CES.

Imaging -

Radiographs: Plain radiographs are the first-line imaging modality used in low back pain. Radiographs should be obtained only after 6 to 12 weeks in the absence of neurologic compromise. Radiographs provide only a static understanding of the spine, we recommend that in addition to anteroposterior (AP) and lateral images, flexion and extension sequences are obtained to evaluate the role of instability in the patient's symptoms. Findings suggestive of LDH in this modality include compensatory scoliosis, narrowed intervertebral space, and the presence of traction osteophytes.

Magnetic Resonance Imaging: Magnetic resonance imaging (MRI) is the gold standard for imaging to confirm suspected LDH with a diagnostic accuracy of 97% and high inter-observer reliability. MRI findings of increased T2-weighted signal from the posterior 10% of the disc diameter are highly suggestive of disc herniation. Relative indications for MRI in the early period of LDH ($<$ 6 weeks) include neurologic motor deficits and CES.Diffusion tensor imaging (DTI) is a type of MRI that can be used to detect microstructural changes in the nerve

roots in patients with LDH. Wu et al. assessed these changes and suggests that DTI may be able to be used to better understand the changes that occur in nerve roots due to compression in LDH, and differentiate patients between surgical and nonsurgical intervention.

Treatment -

Non-operative: More than 80 % cases with lumbar disc herniations have favourable outcome when left untreated. This fact underlines the role of non-operative treatment in the management of lumbar disc herniations. Conservative treatment is recommended to reduce pain and improve function in this time period while the body hopefully will resorb the disc material. Several conservative options exist, but the data is unclear as to which are truly efficacious. Numerous medications, including acetaminophen, non- steroidal anti-inflammatory drugs (NSAIDs), muscle relaxants, steroids, narcotics, neuroleptics, and anti-depressants, are used to treat back pain and radicular symptoms that result from lumbar disc herniation. NSIADs are often utilized as a first-line treatment, but there is limited data supporting their benefit. Oral corticosteroids are also commonly prescribed for acute disc herniations and lower back pain, but data regarding their efficacy is limited. Membrane-stabilizing agents such as gabapentin and pregabalin show modest benefit.

Non-operative management of symptomatic LDH is the treatment of choice for the majority of patients. Nonoperative management should consist of a multimodal approach including anti-inflammatory medications, education, and physical therapy. Local corticosteroid injections (CSI) are a commonly used technique for both the diagnosis and treatment of LDH, due to its effect that reduces local inflammatory cytokine concentration. Prior data has shown that transforaminal injections produce superior results compared to caudal or interlaminar approach. Physical therapy (PT) focused on exercise, core strengthening, and joint mobility are known to improve symptoms related to LDH. Using the SPORT trial data on multivariate analysis, those patients receiving early formal PT were more likely to have higher baseline ODI scores and prefer nonoperative treatment, despite associated neurological deficit. The regenerative effects of mesenchymal stem cell (MSC) therapy and wound healing benefits of platelet-rich plasma (PRP) injection for LDH are increasingly reported.However, the number of patients with outcomes reported in the literature is still too low for widespread clinical implementation.

Operative: The absolute indications for surgical treatment in patients with lumbar disc herniations are worsening neurological deficit and cauda equina-syndrome. Latter is a surgical emergency and is characterized by perianal sensory deficit, bowel and bladder incontinence and either a new or progressive deficit. More often the herniations are central and presents more frequently in men in the fifth decade of life. It is commonly found in L4-L5 disc. Relative indications for surgical treatment vary and are surgeon as well as patient dependent. There are certain prerequisites that we follow before deciding on surgical treatment. Patient should have demonstrable pathology on radiology and correlative physical examination in displaying motor and sensory symptomatology in addition to failure of non-operative treatment. Operative treatment for lumbar disc herniations include endoscopic microdiscectomy, micro lumbar discectomy, interlaminar discectomy with or without foraminotomy, conventional open laminectomy and discectomy with or without instrumented fusion and disc replacement. Whatever surgical option being chosen, the aim of surgery should be thorough decompression of nerve roots. It has been always the matter of debate regarding amount of disc to be removed during discectomy. Spengler, in 1990 in a case control study concluded that results of radical discectomy were comparable to limited discectomy. Conventional open laminectomy and discectomy is preferred in patients with co existent lumbar canal stenosis. Another important question to address is to do fusion or not do fusion along with decompression as there are advocates for both. Proponents of fusion describe discectomy as the destabilizing procedure and thus fusion is required to stabilize the spine. However, the other school of thought believes in just adequate lumbar decompression. We belong to the second group and do not believe in prophylactic fusion. Frymoyer et al. in 1978 gave the guidelines for fusion in lumbar disc herniation surgeries. Fusion was indicated in patients with acute disc herniations and protracted significant component of back pain, symptomatic and radiologically demonstrable segmental instability and presence of neural arch defects along with disc disease. Pedicle screw fixation along with Transforaminal Lumbar Interbody Fusion (TLIF) is preferred method for fusion. Other options are like PLF, PLIF, OLIF and ALIF. Factors recently predicting successful outcome after discectomy include preoperative higher leg pain severity,better mental health

status, shorter symptom duration, younger age, increased preoperative physical activity, and severe preoperative low back pain.

Minimally Invasive Surgery: Minimally invasive approaches are associated with less soft tissue and bony trauma, lower acute care charges, decreased length of stay in hospital though has a higher learning curve. Surgeon experience can be modified by preoperative planning software which demonstrated an ability to reduce mean operative and fluoroscopic time.

Microscopic and endoscopic are two standard techniques of lumbar disc herniation surgery. In microscopic technique we use operating microscope for procedures. For endoscopic discectomy different angle endoscopes are used. Transforaminal and interlaminar are two approaches for endoscopic discectomy. Minimally invasive surgeries for LDH are associated with decreased operative time and less blood loss with no increase in overall complications, reoperation rates, or wound infection when compared to open discectomy. Choi et al. evaluated the outcomes of 149 patients undergoing percutaneous endoscopic lumbar discectomy (PELD) for migrated disc herniations. They found a 90% good or excellent outcome rate and improvement of 45 ODI points at 1-year follow-up. However, high grade disc herniation's with upward migration demonstrated a 13% rate of remnant disc fragment and 3% revision surgery rate. The interlaminar approach has the advantage of direct insertion under endoscopic guidance. However, compared to the transforaminal approach, interlaminar resection requires nerve root and thecal sac retraction which may present a particular challenge in large LDH .

Open Discectomy: As aforementioned, over the last decade, large studies including the SPORT and Maine trials have demonstrated the efficacy of open discectomy in LDH. Approaches for discectomy vary based on herniation type (paracentral versus far lateral). While the paracentral approach has robust utility LDH, it is associated with longer incisions, increased muscle stripping, and more difficulty in far lateral discectomy. Given these difficulties, the Wiltse paraspinal approach between the multifidus and longissimus muscles is a well-recognized method of discectomy in far lateral herniation. Much of the current data regarding open discectomy for LDH involves infection risk as outcome data has been well published over the last several decades. Predictors of infection following microdiscectomy include absence of prophylactic antibiotic dosing and duration of surgery > 68 min. Single-level discectomy without closed suction drains (CSD) has demonstrated significantly higher rates of epidural hematoma and fibrosis compared to the non-CSD group.

Complications: There are several complications associated with discectomy for LDH. The rate of dural tears following LDH ranges from 1 to 17% and is increased particularly with advanced age, obesity, and revision procedures. Other complications include post-operative infection (15%), worsening of functional status (4%), and nerve root injury (0.2%). Risk factors for recurrent herniation include pre-operative disc height index, trauma, older age, smoking, disc protrusion, disc sequestration, longer duration of sick leave, workers' compensation, greater preoperative symptom severity, and diabetes. With a substantial increase in perioperative complications in revision LDH discectomy, minimizing risk factors for recurrence are critical; however, activity restriction has not demonstrated improvement in LDH recurrence rate.

Conclusion: To conclude, lumbar disc herniation is a major cause of lower back-related disability in working-age group. Fortunately, around 80 % of patients do well with non-operative treatment while surgery is reserved for a small and specific fraction of patients. There is a wide range of modalities in non-operative management of lumbar disc herniation inspite of lack of evidence for any specific modality better than other. In cases of clinico radiological mismatch epidural steroids is preferred modality of treatment. Whenever an operative treatment is opted we don't believe in prophylactic fusion. Instability should be given a chance. Fusion is performed only in limited and specific patients. Pedicle screws fixation along with inter body fusion is a preferred modality of fusion. Every patient is different in terms of clinical presentation and imaging, so we need to customise treatment for each patient as per the presentation. Surgeon's experience, availability of resources and patient's clinical condition decide the procedure of choice for that particular patient. Lastly, what works best in your hands remains to be a gold standard to deliver satisfactory outcome.

Dr Mahednra Singh Tak
Assistant Prof., Dr. S. N. Medical College, Jodhpur

Tuberculosis of Spine - A Review of Current Concepts

Introduction: Tuberculosis (TB) is one of the top 10 causes of death worldwide and the leading cause of death from a single infectious agent (ranking above HIV/AIDS). About a quarter of the world's population is infected with M. tuberculosis and thus at risk of developing TB disease. Globally, an estimated 10 million (range 9 to 11 million) people fell ill with TB in 2018. India (27%) accounted for one fourths of the global total.[1]

Bone and joint TB makes up around 10% of all extrapulmonary TB cases, with spinal TB being the most common form. Spinal tuberculosis was first reported by Pott in 1782 hence commonly known as Pott's spine. It accounts for approximately 50% of all bone and joint tuberculosis.[2-3] The most commonly affected spinal segments are thoracic (48.03%) and lumbar vertebrae (42.36%), followed by thoraco-lumbar vertebrae (29.58%), while cervical (5.39%) and sacral vertebral (4.22%) involvement is relatively rare.[4]

Clinical Presentation: Patient may present with localized back pain, fever and weight loss(constitutional symptoms), with or without signs of spinal cord compression. Patients with advanced disease may have severe pain, spinal deformity, paraspinal muscle wasting and neurological deficit. In addition in children, failure to thrive, night cries, inability to walk/ cautious gait, and use of hands to support the head or trunk are important signs.[5]

Pathology: Spinal TB is usually secondary to hematogenous spread from a primary site of infection (most commonly the lungs / bowel). Most common site of vertebral involvement is paradiscal. The other relatively rarer patterns of involvement include central (with predominant vertebral body involvement with disc sparring), posterior (involving the posterior structures primarily) and non-osseous involvement (presenting with the abscess).[6] Progressive vertebral destruction often leads to spinal kyphotic deformity and instability.The abscess present in tuberculosis is called cold abscess because these abscesses typically lack all the inflammatory signs.

Owing to the predominant involvement and collapse of the anterior spinal column (with preservation of posterior elements) in TB, the spinal column progressively develops a kyphotic orientation; especially in the thoracic and thoracolumbar spine. The clinical appearance of kyphotic deformity has been classified as knuckle (one vertebral involvement), gibbus (two vertebrae) and rounded kyphus (more than three vertebrae).

A neurological deficit can occur either at the active stage of the disease (secondary to compression from an abscess, inflammatory tissue, sequestrum or spinal instability) or during the healed stage (usually secondary to mechanical traction over the internal gibbus or spinal instability).[7] The initial compression in TB is secondary to vertebral body collapse, leading to anterior spinal tract involvement (exaggerated deep tendon reflexes and Babinski sign, further progression on to UMN-type motor deficit). Further on, the lateral spinal tracts are progressively involved (with loss of crude touch, pain, and temperature); followed by posterior column deficit (sphincter disturbances and complete sensory loss).

Pediatric Spinal TB: Owing to the immaturity, higher flexibility and remaining growth potential of the spine in children, they are particularly prone to developing severe deformity progression. Such worsening of deformity in children can also occur after the disease has completely healed, and therefore the need to follow-up this patient population until skeletal maturity cannot be understated. Rajasekaran et al. described 4 signs of "spine at risk" in children, which include:

1. Retropulsion of the posterior aspect of the involved vertebra.
2. Facetal subluxation (separation of facets on lateral radiographs)
3. Lateral translation of vertebrae (as observed on anteroposterior radiographs)
4. The toppling of one vertebra over the other (defined by a line along the anterior surface of caudal normal vertebra crossing the mid-point of the anterior surface of the cranial normal vertebral bone).

Rajasekaran et al. purported a formula to predict the final kyphosis in adult population afflicted with spinal

TB: y = a + bx, where y is the final kyphosis, a and b are constants equal to 5.5 and 30.5, respectively, and x is the initial loss of vertebral body height.[9] Jain et al. observed that kyphotic deformity greater than 60 degrees leads to significant disability and can potentially inflict neurological deficits.[8]

How to approach a patient with suspected spine tuberculosis:

- Clinical examination
- Radiological examination
- Lab examination

Confirmation of diagnosis :

- Biopsy /aspiration

Imaging Modalities: *Plain radiographs* can appear normal in early stages; however, in advanced stage,findings of disc space reduction, endplate rarefaction, vertebral body destruction, instability, and spinal deformity may be obvious.. The chest x-ray is also an important investigation, as up to thirds of these patients with spinal TB can also have a concomitant pulmonary disease.[9] *Magnetic resonance imaging (MRI)* is the most useful modality in the diagnosis of spinal TB. MRI best detects the extent of soft tissue enhancement, the location of the abscess and spinal canal compromise. Gadolinium-enhanced MRI may provide additional information regarding the diagnosis. Screening sequences involving the whole spine can also help us in identifying non-contiguous vertebral involvement.The typical MRI findings including multi-segment sub-ligamentous collection, the occurrence of well-defined para/pre-vertebral mass or abscess with relatively thickened abscess walls, relatively spared disc space until the later stages of the disease and heterogeneous enhancement of vertebral body.[10] MRI is also used to access response to treatment[11] but it should be remembered that there is lag period between clinical improvement and radiological improvement. *Computed tomography (CT)* is far less sensitive and specific than MRI. CT should be used only in cases where MRI is contraindiacated. CT scans can also aid in image-guided biopsy for establishing the diagnosis.

Laboratory examination: Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) (71% sensitivity) are usually elevated.[12] Serological examination of IgG and IgM antibody levels against TB antigen cannot effectively distinguish between active or healed disease; natural TB infection or vaccinated persons; and is raised in both active and chronic stages of infection and shouldn't be used.[13][14]

Microbiological Diagnosis: As MRI/Xrays will usually reveal changes of spondylodiscitis or spondilitis but can't differentiate between pyogenic or tubercular etiology with certainty, a microbiological diagnosis is usually required to ascertain the pathological organism. Tissue biopsy / aspiration of abscess should be considered standard of care before any antibiotic or ATT is started. Sample is usually sent for Acid-fast bacilli (AFB) using the Ziehl-Neelsen technique, TB culture, molecular testing and polymerase chain reaction (PCR), Gene Xpert MTB/RIF [15], Histopathological evaluation.[16]

Treatment -

Chemotherapy: The mainstay of treatment in TB is chemotherapy (antitubercular treatment [ATT]). Tubercle bacilli may exist as intracellular or extracellular forms or as dormant or rapidly multiplying forms.[17] Therefore, multi-drug treatment is essential to attack the bacilli in various stages or forms and reduce drug resistance. The duration (6, 9, 12, or 18 months) and frequency (daily versus alternate-day regimen) of administration of ATT for spinal TB have been controversial.[18] WHO recommends 6 months of multidrug anti-tubercular therapy, including 2 months of four- or five-drug treatment (isoniazid, rifampicin, pyrazinamide, ethambutol, and/or streptomycin) constituting the initiation" phase, followed by 4 months of "continuation" phase therapy with a two-drug regimen including isoniazid and rifampicin. The American Thoracic Spine Society recommends a regimen involving 9 months of treatment. It is very important to give drugs in proper dosage adjusted as per weight. Main adverse reactions that need regular follow up and monitoring are hepatotoxicity, ocular toxicity and hyperuricemia.

Multidrug Resistance: MDR-TB is defined as TB infection resistant to INH and rifampicin. Extensively drug-resistant TB (XDR-TB) is defined as infection resistant to INH and rifampicin, along with resistance to a fluoroquinolone and at least one injectable second-line medication.these cases should be managed with second line drugs in consultation with TB specialist.

Surgical Management of Spinal Tuberculosis: Tuberculosis is a medical disease and should be treated

with ATT. Surgical treatment is required for specific indication only (see table), and should be considered an adjunct to medical management.

Surgical indications for spinal tuberculosis:

1. **Neurological deficit**
   - Severe neurological deficit at presentation (power < grade III)
   - Rapidly worsening deficits
   - New-onset or deterioration of deficits during chemotherapy
   - Unimproved deficits after 6 to 8 weeks of chemotherapy
2. **Spinal instability**
   - Mechanical back pain due to instability
   - Radiological evidence of instability/abnormal mobility, e.g. AAD
3. **Kyphosis**
   - Significant kyphosis (>30 degrees) at presentation
   - More than one vertebral body destruction within thoracic spine and > 1.5 vertebral bodies within lumbar spine
4. **Large paraspinal abscess**
   - Resulting in pressure symptoms dysphagia, respiratory difficulties
   - Resulting in hip flexion deformity
5. **Children**
   - More likely to develop instability and progressive kyphotic deformity
   - Presence of radiological signs of "spine-at-risk"
6. **Response to chemotherapy**
   - Lack of clinical response after 6 weeks of chemotherapy
   - Recurrence of disease despite chemotherapy
7. **Late deformity**
   - Severe kyphosis with late-onset neurological deficits

In general, the goals of surgery in spinal tuberculosis include debridement, decompression, correction / prevention of deformity, reconstruction of anterior column and stabilization.

Debridement & Decompression: Excision of dead and diseased tissue, including abscesses, dead bone, sequestrated disc, granulation tissue, caseous material, in order to extirpate the disease focus are the primary goal of surgery. This is postulated to help by reducing the disease load and encouraging neovascularization. The presence of a sclerotic wall may sigificantly reduce the drug penetration inside the lesion and thus reduces the therapeutic effect signicantly. When the sclerotic wall exists in the lesion, it needs to be completely removed because a walled off lesion may not allow anti-tuberculosis drugs to enter the lesion to kill tuberculosis bacteria.

Correction of Deformity, Anterior Column Reconstruction & Stabli-zation: Tuberculosis is predominently a disease of anterior column. Collapse of anterior column with preservation of posterior column height results in developement of kyphotic deformity. Correction/ Prevention of deformity is an important part of surgical treatment. This is achieved by anterior column reconstruction (by metal cages or structural bone graft like fibula) with or without Posterior column shortening with Instrumentation. Stabilization of disease area with instrumentation provides pain relief, promotes neurological recovery, minimized graft related complication, enhances fusions rates, helps correction of deformity, and allows early mobilization and rehabilitation. There have been concerns regarding use of metal in active disease but long clinical experience has proved it to be safe and efficacious. Oga et al evaluated the adherence capacity of *Mycobacterium tuberculosis* to stainless steel and concluded that adherence was negligible and the use of implants in regions with active tuberculosis infection may be safe. [19].

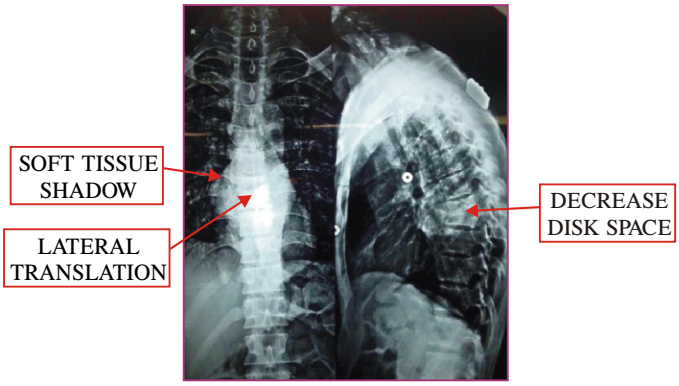


Fig. 1: (A) X ray picture AP & LAT View

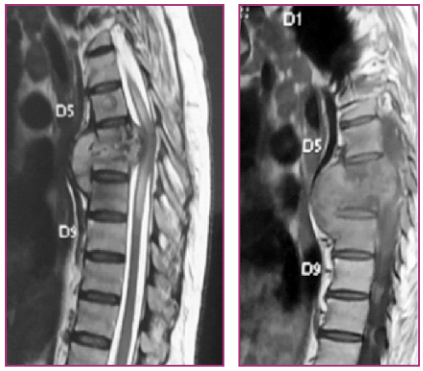


Fig. 1: (B) MRI T2W, T1W

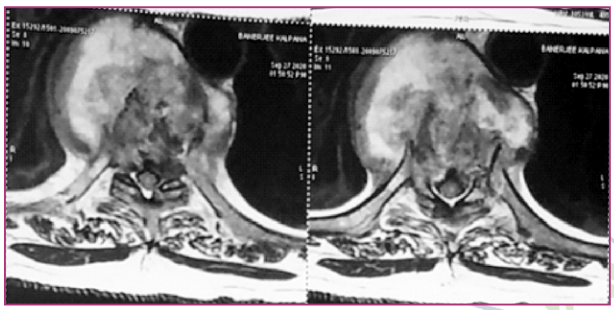


Fig. 1: (C) Axial MRI

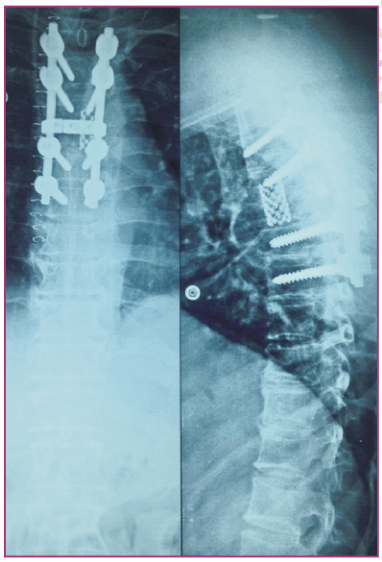


Fig. 1: (D) POST OP X RAY AP/lateral view

Surgical Approach: The goals of surgery, as described above, should be fulfilled with minimal surgical morbidity. The surgery should be planned meticulously keeping factors like age of patient, presence of medical comorbidities, location of disease, degree of kyphosis, region of the spine involved, and experience and preference of the surgeon in mind. Though anterior approach provides maximum exposure for adequate debridement of affected area with reconstruction of defect, the recent trend is for all posterior global reconstruction, especially in the thoracic and lumbar spine.

Anterior approach: Spinal Tb mainly affects the anterior column, and therefore an anterior approach gives direct access to the disease pathology for debridement, decompression, anterior column reconstruction, and instrumentation. Besides, the vertebral bodies offer a large surface for fusion, and the graft being under compression heals more readily.

Posterolateral Approach: Currently, the most popular approach to the thoracic and lumbar spine is the posteolateral approach and most familiar to the surgeon.The anterior column of spine is approached through a posterolateral transfacetal, transpedicular, or costotransevectomy, transforaminal portal. This allows anterior debridement, circumferential decompression of spinal cord, anterior column reconstruction, deformity correction, and posterior instrumented fusion. So, all goals of anterior surgery can be achieved, while morbidity of anterior surgery can be avoided [20]

Combined Approach: The combined approach originated when posterior instrumented stabilization was performed following the anterior radical surgery as a means to reduce graft related complication and progressive deformity. The combined approach involves two different surgeries with two scars and all the attendant complication of both of approach. [21]

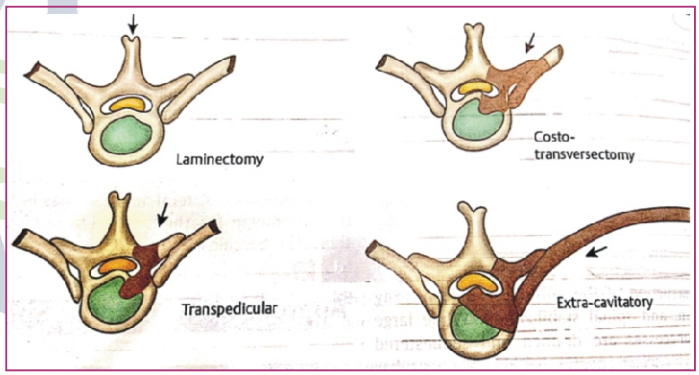


Fig. 2 : Diagramatic representation of various posterior and posteriolateral approaches.

CONCLUSION: Antitubercular chemotherapy is extremely effective in healing the infection hence, uncomplicated spinal tuberculosis is a medical disease that can be effectively treated with chemotherapy alone. surgery is warranted for spinal TB complicated by significant neurological deficit, moderate to severe kyphotic deformity,or spinal instability.

The principal objectives of the surgery are debridement of infective focus,decompression of neural elements, prevention and correction of deformity,

reconstruction of anterior column and instrumented stabilization of the region.

Surgeon's adherence to the surgical principles and patient compliance in chemotherapy are the two major determinants for success in management of spinal TB .

References:

1. WHO global tuberculosis report 2020.
2. Gorse G J, Pais M J, Kusske J A, Cesario T C. "Tuberculous spondylitis. A report of six cases and a review of the literature". Medicinen 62 (1983): 178-193.
3. Rasouli M R, Mirkoohi M, Vaccaro A R, Yarandi K K, Rahimi-Movaghar V. "Spinal tuberculosis: diagnosis and management". Asian spine journal 6 (2012): 294.
4. Shi T, Zhang Z, Dai F, Zhou Q, He Q, Luo F, et al. "Retrospective Study of 967 Patients With Spinal Tuberculosis," Orthopedics 39 (2016): e838-e843.
5. Index TB guideline for extra pulmonary tuberculosis -2016.
6 Rajasekaran S, Kanna RM, Shetty AP. Pathophysiology and Treatment of Spinal Tuberculosis. JBJS Rev. 2014 Sep 23;2(9) [PubMed
7. Hodgson AR, Skinsnes OK, Leong CY. The pathogenesis of Pott's paraplegia. J Bone Joint Surg Am. 1967 Sep;49(6):1147-56. [PubMed]
8. Jain AK, Aggarwal PK, Arora A, Singh S. Behaviour of the kyphotic angle in spinal tuberculosis. Int Orthop. 2004 Apr;28(2):110-4. [PMC free article] [PubMed]
9. Dharmalingam M. Tuberculosis of the spine-the Sabah experience. Epidemiology, treatment and results. Tuberculosis (Edinb). 2004;84(1-2):24-8. [PubMed]
10. Gouliamos AD, Kehagias DT, Lahanis S, Athanassopoulou AA, Moulopoulou ES, Kalovidouris AA, Trakadas SJ, Vlahos LJ. MR imaging of tuberculous vertebral osteomyelitis: pictorial review. Eur Radiol. 2001;11(4):57
11. Kim NH, Lee HM, Suh JS. Magnetic resonance imaging for the diagnosis of tuberculous spondylitis. Spine (Phila Pa 1976). 1994 Nov 01;19(21):2451-5. [PubMed]
12. Guo LX, Ma YZ, Li HW, Xue HB, Peng W, Luo XB. [Variety of ESR and C-reactive protein levels during perioperative period in spinal tuberculosis]. Zhongguo Gu Shang. 2010 Mar;23(3):200-2. [PubMed]
13. Jain AK, Jena SK, Singh MP, Dhammi IK, Ramachadran VG, Dev G. Evaluation of clinico-radiological, bacteriological, serological, molecular and histological diagnosis of osteoarticular tuberculosis. Indian J Orthop. 2008 Apr;42(2):173-7. [PMC free article] [PubMed]
14. Chen CH, Chen YM, Lee CW, Chang YJ, Cheng CY, Hung JK. Early diagnosis of spinal tuberculosis. J Formos Med Assoc. 2016 Oct;115(10):825-836. [PubMed]
15. Maynard-Smith L, Larke N, Peters JA, Lawn SD. Diagnostic accuracy of the Xpert MTB/RIF assay for extrapulmonary and pulmonary tuberculosis when testing non-respiratory samples: a systematic review. BMC Infect Dis. 2014 Dec 31;14:709. [PMC free article] [PubMed]
16. Alothman A, Memish ZA, Awada A, Al-Mahmood S, Al-Sadoon S, Rahman MM, Khan MY. Tuberculous spondylitis: analysis of 69 cases from Saudi Arabia. Spine (Phila Pa 1976). 2001 Dec 15;26(24):E565-70. [PubMed] 17.Bodapati PC, Vemula RCV, Mohammad AA, Mohan A. Outcome and management of spinal tuberculosis according to severity at a tertiary referral center. Asian J Neurosurg. 2017 Jul-Sep;12(3):441-446. [PMC free article] [PubMed]
18. Jawahar MS. Current trends in chemotherapy of tuberculosis. Indian J Med Res. 2004 Oct;120(4):398-417. [PubMed]
19. Oga M, Arizono T, Takasita M, Sugioka Y.Spine (Phila Pa 1976). 1993 Oct 1;18(13):1890-4
20. Zhang HQ, LiJS, Zhaoss, Surgical management for thoracic spinal tuberculosis in elderly Arch orthopaedics trauma surgery 2012;132(12):1717-1723.
21. Chen wj, Wucc, Chen LH combined anterior and posterior surgery in spinal tuberculosis spondylodiscitis. clin orthop related research 2002; 398(398):50-59.

Dr Alok Aggarwal, Dr Lalit Sharma

ROSA on Social Media

You Tube Channel - Rajasthan Ortho
https: //m.youtube.com/channel/UCdvXxYnS-u7D3PK5B_Q_2UQ please subscribe.

Face book -
https://www.facebook.com/Rajasthan-Orthopaedic-Surgeons-Association-102577384775693/ please follow.

Twitter -
https://twitter.com/rosarajasthan/status

Management of Spinal Injuries, Guidelines, Tips and Tricks.

Abstract: Spinal cord injuries and its long-term outcome carry serious disability and socio-economic impact therefore its timely identification and proper management is of utmost importance. Despite a lot of published literature there remains controversy regarding the management of these injuries. Management starts at the site of injury with proper immobilization, transportation, and imaging with high grade of suspicion for spinal injury.

A review of articles on spinal injuries was done to conclude the best classification system which is reproducible and can guide the treatment plan. TLICS score for thoracolumbar injuries and SLIC for sub-axial cervical spine injuries appear to be the most suitable systems for routine practice. Identification of the PLC (Posterior ligamentous complex) and DLC (Discoligamentous complex) injuries, that are often missed, is critical to quantify the severity of the injury. In addition to plain radiographs, MRI with STIR sequences is a must to identify these soft tissue injuries. The aim of surgery in spinal injuries remains stabilization of the spine for better rehabilitation and decompression of the neural elements for optimal neurological recovery.

Key words - spinal injuries, classification, management, TLICS, SLIC.

Introduction: According to the national spinal cord injury database annual incidence of spinal cord injuries is 54 cases per one million of population.[1] According to indian demographic study the most common modes of these injures are RTA (45%), followed by fall from height (40%), assault (5%), sports and recreational activities (6%).[2] Assessment and management of vertebral column and spinal cord injury is complex and demanding due to complex anatomy and spinal biomechanics. Comorbidities and coexisting injuries make this process even more difficult in a poly-trauma patient. These injuries most commonly affect the younger age group (68% patients with age < 40 years) creating a large social-economic burden. Broadly these injuries can be classified into 4 categories according to region of the spinal column involved, cervical (36%), thoracic (27%), lumbar (5%), junctional [CV junction, Cervico-thoracic junction, TL junction (30%)]. D12 and C5 are the most commonly affected isolated levels. Predominantly males are affected with these injuries (85% males, M:F - 6:1). Approximately 34% of these patients have concomitant injuries which include orthopedic injuries (23%), chest injury (11%) and head injuries (6%). Neurological involvement is complete in 71% of these patients having either paraplegia or tetraplegia.[2] Management of these injuries begins at the site of the trauma. Important aspect of the management are transportation, primary survey, diagnostic imaging, spinal shock management and definitive management.

Discussion of all these aspects is out of scope of this article. In this article we will discuss the current classification systems and management guidelines.

Thoracolumbar injuries -

Best classification system: An ideal classification system should have good reproducibility, reliable estimation of prognosis and suggestion of treatment guideline. There are many classification systems available for spinal injuries but most of them have not gained universal acceptance. One of the most significant advancement in the recent years is the advent of new classification system which is clinically more relevant. For the thoracolumbar fractures described classification systems are Dennis, McAfee, AO/Magrel and McCormak. None of these have gained wide acceptance due to lack of reproducibility and treatment guidelines. Recently a new system is introduced by Vaccaro et al termed as TLICS (thoracolumbar injury classification system).[3,4] This system is currently the most widely accepted classification which provides insight into prognosis, treatment modality and approach. The system has three components; (1) Fracture morphology, (2) Posterior ligamentous complex (PLC) integrity, (3) Neurological status (Table 1) [Figure 1].

Fracture morphology can be decided on plain AP and lateral radiographs. Posterior ligamentous complex (PLC) is composed of ligamentum flavum, interspinous ligament, and supraspinous ligament and facet capsule. Integrity of PLC is evaluated clinically by palpating the gap at interspinous region and radiologically by interspinous widening, facet subluxations /fractures observed on x-ray or CT scan, break in the black line of

ligaments on T1W images, hyperintensity in interspinous region on STIR sequence of MRI [Figure 2].

Decision making operative vs nonoperative: Each component in this classification system has been given a score and treatment plan is then decided on total score.

If the score is less than 3, nonoperative management is recommended and a score more than 5 suggests better outcome with surgical intervention. A score of 4 can be managed either way depending on other clinical parameters. Agreement among surgeons on treatment recommendation by TLICS is more than 96%.[5]

Table-1: TLICS (Thoraco Lumbar Injury Classification & Severity) score

Fracture Morphology	Points
Compression fracture	1
Burst fracture	+1
Translation/rotation	3
Distraction	4
Neurological Involvement	
Intact	0
Nerve root	2
Cord, conus medullaris, incomplete	3
Cord, conus medullaris, complete	2
Cauda equina	3
Posterior Ligamentous Complex Integrity	
Intact	0
Injury suspected/indeterminate	2
Injured	3

Table-2: SLIC (Subaxial Injury Classification).

Fracture Morphology	Points
Compression fracture	1
Burst fracture	+1
Distraction (e.g. facet perch, hyperextension)	3
Translation/rotation (e.g. facet dislocation, unstable tear drop, advanced flexion compression injury)	4
Neurological Involvement	
Intact	0
Nerve root	1
Cord, complete	2
Cord, incomplete	3
Continuous cord compression (in setting of a neurodeficit)	+1
Posterior Ligamentous Complex Integrity	
Intact	0
Indeterminate (e.g. isolated interspinous widening, MRI signal change only)	1
Disrupted (e.g. widening of anterior disc space, facet perch or dislocation, kyphosis)	2

Patients with stable thoracolumbar fracture without neurological deficit can be managed conservatively with a short period of bed rest and gradual mobilization with brace support. A prospective randomized study with follow-up at 16 to 22 years showed that patients with stable thoracolumbar burst fractures with intact neurology who were treated non-operatively reported less pain & better function as compared to the operated group. Neurological deficit is an indication of spine instability and severity of spine injury. Therefore incomplete spine cord injury is usually an indication for surgical decompression thus a greater score has been assigned in the classification.

Optimal approach for operative treatment: A group of leading spinal surgeons from level-I trauma centers, the spine trauma study group (STSG) has given recent consensus guidelines for management of these injuries.[6] Neurologically intact patient with intact PLC can be managed conservatively and if they require surgical stabilization for early mobilization can be managed with a posterior approach. Whenever the PLC is disrupted the panel recommends a posterior approach.

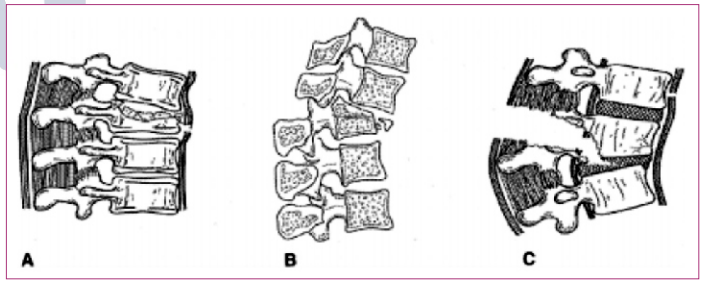


Fig. 1: Fracture morphology - (A) Compression (B) translation / rotation (C) Distraction

A subset of these patients who have severe anterior column comminution and incomplete SCI may require an additional anterior approach for direct decompression and anterior column reconstruction. The rationale behind anterior approach is that thoracolumbar fractures mainly have anterior column damage causing anterior neural compression. Anterior approach directly decompress the

neural elements and reconstruct the anterior column. Additional advantage of anterior approach is preservation of posterior musculature. When there is complete SCI, decompression is usually not required and aim of the treatment becomes restoration of spinal stability and alignment.

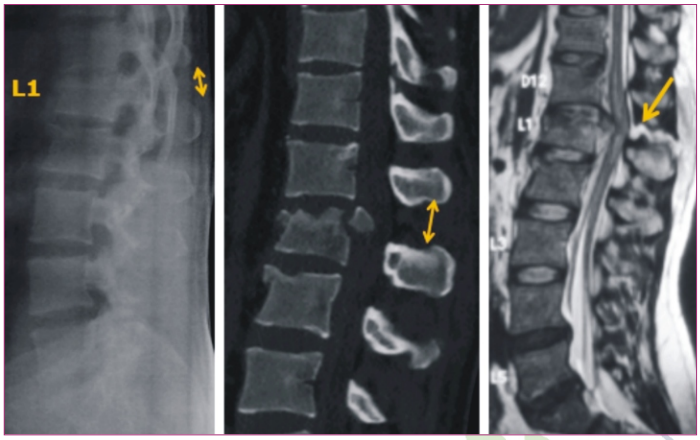


Fig. 2 : Radiograph and CT scan showing the interspinous widening. MRI T2W images showing break in the black line of PLC (ligamentum flavum, interspinous and supraspinous ligaments). [TLICS= distraction injury 4 + PLC disrupted 3 + incomplete conus injury 3].

In general when PLC is disrupted posterior approach becomes mandatory for restoration of the posterior column. However, when PLC is intact, the decision of anterior or posterior approach largely depends on surgeon's preference. Recently with the advent of advanced approaches for decompression & reconstruction of anterior column via posterior approach (Transpedicular, transfacetal, lateral extracavitory), almost all patients can be managed with posterior alone approach. Posterior alone approach is more familiar to spine surgeons and it also prevent handling the abdominal viscera and retro-peritoneal neurovascular structures thus decreasing the morbidity and complications. Additionally, at high thoracic and low lumbar levels major vessels don't allow anterior stabilization.

Recent advancement is advent of minimally invasive approaches for decompression and stabilization such as endoscopy for anterior decompression, MIS para-vertebral microscopic approach for corpectomy & decompression, percutaneous fixation for posterior stabilization. These approaches have reduced intra operative blood loss, perioperative morbidity and has facilitated rapid postoperative recovery. However, long term outcome is similar to open approaches and there is steep learning curve for these approaches. One systematic review which compared all the surgical techniques has shown that there is no difference in long term outcome.

Direct decompression v/s indirect decompression: Thoracolumbar fractures have anterior neural compression, thus ideally direct decompression is possible with anterior approach. However, anterior approaches are unfamiliar to most of the orthopedic surgeons and pose significant morbidity in poly-trauma patients. Therefore, in recent years, new posterior approaches were developed for direct decompression such as transpedicular, transfacetal decompression, and lateral extracavitory approach.

Another technique for posterior decompression is indirect decompression via ligamentotaxis. Ligamentotaxis reduces the retropulsed fragment effectively when canal compromise is less than 50%. Attachment of PLL reduces the retropulsed fragments into the canal and decompress the cord by posterior distraction and ligamentotaxis. However, when canal compromise is more than 67%, there is severe anterior communication, PLL attachments to the fragments may not be intact. In such cases ligamentotaxis or indirect decompression may fail to achieve canal clearance and anterior decompression is required.[6]

Cervical spine injuries : Around 36% of all SCI have cervical spine fractures.[2] Subaxial cervical spine is involved in two third of the all cervical spine fractures.

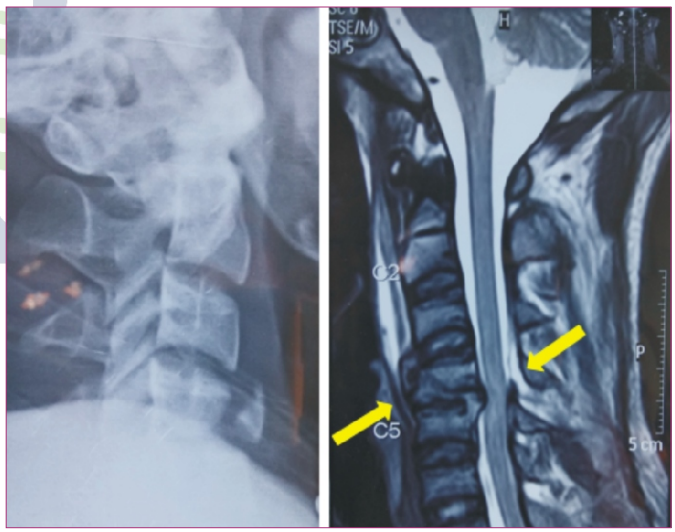


Fig. 3: Case example- 22 year old male sustained a RTA, presented with intact neurology. X-ray shows tear drop fracture of vertebral body which seems to be stable. On MRI, evident DLC disruption shown by arrows indicating instability. [SLIC-distraction 3+ intact neurology 0+ DLC disruption 2=5]

As compared to thoracolumbar injuries, cervical injuries have high potential for neurologic injury due to greater

degree of mobility in cervical spine. Like thoracolumbar fractures, there is no universally accepted classification system for cervical injuries. Most popular classification systems of the cervical spine injuries were White & Punjabi and Allen-Furguson. The White and Punjabi classification is based on the stability of the spine but it does not provide guidelines for treatment. Whereas the Allen- Furguson system is based on the mechanism of the injury. This system also does not provide any treatment guidelines and subcategories are cumbersome. Similar to the TLICS, a recent classification has been proposed by Moore et al and subsequently modified by Vaccaro et al, called as Subaxial Injury Classification (SLIC) Scoring System.[7, 8]

This system is reproducible and suggests treatment guidelines and provides prognostic information. The system has three components similar to TLICS; (1) Fracture Morphology, (2) Discoligamentous Complex (DLC) Integrity, (3) Neurological Status [Table 2]. The scoring system in SLIC is little different from the TLICS, translation/rotational injuries have been considered more severe in cervical spine and therefore given greater score in SLIC as compared to TLICS. Another difference is consideration of DLC rather than PLC, which also includes anterior longitudinal ligament (ALL), disc, and PLL (posterior longitudinal ligament) in addition to ligament flavum, interspinous ligament, and supraspinous ligament and facet capsule. In cervical spine interspinous ligament is the weakest component of the DLC, therefore interspinous widening alone is not considered instability in cervical spine. Anterior opening of the disc space (hyperextension) or facet subluxation is considered disruption of the DLC [Figure 3].

If the cumulative score is 3 or less, the patient can be managed conservatively whereas a score of 5 or more suggests surgical intervention. A score of 4 can be managed either way depending on surgeon and patient factors.[8]

Optimal surgical approach: It remains debatable whether to perform anterior surgery or posterior surgery in cervical spine injuries. Anterior approach directly targets the neural compression and achieves better spinal cord decompression. Additional benefits are restoration of sagittal alignment, better fusion rates and lesser infection rates. However anterior fixation with plates is not biomechanically as much stronger as posterior fixation. In addition, posterior approach is more familiar to spine surgeons, directly reduces the facets and a greater number of levels can be decompressed. In general neural compression is primarily anterior thus better decompression is achieved with anterior approach.[9] DLC injuries are best approached depending on the location of the injury.

One of the controversial situation in cervical spine is hyper-extension injuries in elderly population with pre-existing cervical spondylosis. These patients often have incomplete neurological deficit (central cord syndrome), no morphologic bony injury and intact DLC and therefore a score of 4. Here we have two schools of thoughts. Some would prefer to manage these patients conservatively if neurological examination is improving. However most of the spine surgeons will agree upon early surgical intervention. The approach should be decided by the sagittal alignment and the number of the levels involved. If cervical spine is lordotic then posterior approach with laminectomy and stabilization or a laminoplasty would be appropriate. If the cervical spine is kyphotic posterior approach will further worsen the kyphosis and not able to achieve effective decompression thus contraindicated in this situation. In this instance an anterior approach will effectively decompression the cord and correct the deformity.

Cervical burst fracture with neurological deficit should be approached anteriorly with either discectomy or corpectomy clearing the spinal cord directly. If posterior ligaments are intact anterior plating and grafting achieves adequate stability.[10]

Distraction injuries could be either anterior as posterior depending as the mechanism such as hypertension or hyper flexion. Anterior distraction injuries cause damage to ALL and disc which can be best managed with anterior discectomy and fusion. Posterior distraction injuries usually have either unilateral or bilateral facet dislocation along with disc material herniation into the canal which can be removed via anterior approach followed by reduction & fusion.

Translation or rotation injuries are the most severe form of the injuries with marked bony and DLC disruption. These injuries have a score of 6 even without considering neurological status and should be managed operatively. They usually manifest with unilateral or bilateral facet dislocation. If there is disc herniation in the canal, anterior discectomy and fusion should be done. If there is no herniation, can be managed anteriorly or posteriorly depending on surgeon's preference.

Another controversial scenario in cervical trauma is cervical traction and closed redaction in patient with facet dislocation with either incomplete deficit or intact

neurology. The controversy here is whether to perform an MRI first or closed reduction first due to the fact that disc herniation may be further pushed into the canal and cause neurodeficit while performing a closed reduction. To date, there is no published article in the literature which has reported neurodeficit with closed reduction in an awake, oriented and neurologically intact patient.

The most controversial subject in spinal cord injury is use of high dose methylprednisolone. This was widely used in practice after the results of the NASCIS (National Spinal Cord Injury Studies) trials. However in recent studies there is no proven benefit of steroid use on neurological status and this practice has been discontinued or become personal choice.[10]

Table 3: Tips and Tricks for routine practice.

- Look for subtle signs of PLC injury on X-ray.
- Further imaging is necessary to rule out PLC disruption CT/ MRI STIR sequence.
- Always screen the whole spine (noncontiguous injuries).
- Always **d**o PR exam to identify complete vs incomplete injury.
- TLICS scoring helps determining the treatment protocol
- MAP > 90 mm Hg & SPO_2 = 100% should be maintained for first seven days to prevent secondary injury
- Use of steroids remains controversial
- Surgical stabilization helps easy rehabilitation & early mobilization
- Always be prepared to tackle dural tear.
- Mobilize at the earliest, chest physio, bladder training, and prevention of bedsores.

Conclusion: The best available classification systems for thoracolumbar and cervical injuries are TLICS and SLIC, respectively. These systems are reproducible and guide the management protocol. Almost all thoracolumbar injuries can be managed with posterior alone approach which is familiar to most of the spine and orthopedic surgeons. Cervical injuries are mostly managed with anterior approach. There is no proven benefit of high dose steroid use in spinal cord injury patients.

References:

1. National spinal cord injury statistical center, facts and figures at a glance. Birmingham, AL, university of Al abama at Birmingham, 2017.
2. Chabra HS, Arora M. Demographic profile of traumatic spinal cord injuries admitted at Indian spinal injuries center with special emphasis on mode of injury; a retrospective study. Spinal cord (2012) 50, 745-754.
3. Vaccaro AR, Lehman RA, Hurlbert RJ, et al. A new classification of thoracolumbar injuries. Spine 2005; 30:23252333.
4. Vaccaro AR, Zeiller SC, Hurlbert RJ, et al. The thoracolumbar injury severity score. J spinal Disord Tech 2005; 18:209215.
5. Vaccaro AR, Baron EM, Sanfilippo J, et al. Reliability of a novel classification system for thoracolumbar injuries: the thoracolumbar injury severity score. Spine 2006; 31:S62S69.
6. Vaccaro AR, Lim MR, Hurlbert RJ, et al. Surgical decision making for unstable thoracolumbar spine injuries. J Spinal Disord Tech 2006;19: 110.
7. Moore, Vaccaro AR, Anderson PA. Classification of lower cervical spine injuries. Spine 2006;31:S37S43.
8. Vaccaro AR, Hulbert RJ, Patel AA, et al. The subaxial cervical spine injury classification system. Spine 2007;32:23652374.
9. Dvorak MF, Fisher CG, Fehlings MG, et al. The surgical approach to subaxial cervical spine injuries. Spine 2007;32:26202629.
10. Kwon BK, Vaccaro AR, Grauer JN. Subaxial cervical spine trauma. J Am Acad Orthop Surg 2006;14:7889.

Dr Mukesh Haritwal, Dr Pravin Gupta, Dr I P Agarwal
Department of Spine Surgery, Shalby Multispecialty Hospital, Jaipur.

Osteoporotic Vertebral Fracture

Osteoporosis is characterized by decreased bone mass. The resulting decrease in mechanical strength of bone typically manifests as osteoporotic fractures, with about one half of osteoporotic fractures occurring in the spine. There is female preponderance of osteoporotic fracture over male.

Osteoporosis is classified as primary and secondary osteoporosis. It is essential to identify causes of secondary osteoporosis.

Primary osteoporosis is related to age related physiological changes, with two types.

1. Post menopausal osteoporosis
2. Senile osteoporosis

Predisposing factors for osteoporosis are excessive alcohol abuse, cigarette smoking, less calcium intake, sedentary life style.

Etiology of **Secondary osteoporosis[1] :**

1. Osteomalacia
2. Gastrointestinal disease e.g. Crohn's disease, ulcerative colitis, celiac sprue
3. Endocrinal defects e.g. hypothyroidisom, hyperthyroidisom
4. Corticosteroid abuse

Pathology : Osteoporosis is a disease of decreased bone mass (osteoid material) with normal mineralization process. Declining bone mass is a universal phenomenon of aging.[2] Peak bone mass is attained in the mid thirties for both sexes. Gender, nutrition, race, exercise habits, and overall health all influence bone mass. Peak bone mass is higher in men than in women. After the fourth decade, both men and women lose bone mass from the skeleton. Two phases of this loss have been identified: slow and accelerated. The slow phase (Type II) is related to an imbalance between resorption and formation. It is equal in both men and women. It results in an annual basal slow phase rate of bone loss of 0.3% to 0.5%.[3] The accelerated phase(Type I) that occurs with estrogen deficiency, a phenomenon found exclusively in women. It is responsible for cortical bone mass loss of 2% to 3% per year. This loss is in addition to the slow phase losses, which continue during the accelerated phase.

The spine is composed of primarily trabecular bone. Compared with cortical bone, it has a high surface-to-volume ratio. Metabolic activity (remodeling) occurs on bone surface therefore trabecular bones in general, and the vertebral bodies in particular, are resorbed preferentially in times of skeletal loss.[4] Osteoporosis is thus characterized by decrease in size and number of trabeculae.

Accelerated phase is Type I osteoporosis and slow phase is Type 2 osteoporosis as described in Table 1.[3]

	Type I	Type II
Gender ratio	6:1	2:1
Age	40 years	65 years
Estrogen deficiency	Yes	No
Bone loss	Cancellous bone will affect more (distal end radius, vertebrae)	Equal involvement of Corticle and cancellous bones (hip, pelvis)

Table - 1 : Difference in Type I (accelerated) and II (slow) osteoporosis

Clinical Features: Most of the osteoporotic vertebral fractures have unnoticed trauma, approximately 30% of vertebral fractures are recognized at the time of injury.[5]

Osteoporotic fractures occur following trivial falls during daily activities with no significant trauma. In the acute stage, there is pain in the affected region that is aggravated by activities but the pain usually improves in 23 weeks. As the collapsed anterior part of the vertebral body heals, the spine gradually bends forward into kyphosis. Depending on the extent of osteoporosis, further collapse of the vertebral body can occur. Finally, fishshaped vertebra can result with or without chronic instability. Progressive kyphosis due to multiple fractures and sagittal imbalance can result in muscle fatigue and pain. In a prospective study, it was observed that the overall function declined among patients with vertebral fractures similar to those with hip fractures.[6] Apart from chronic pain, sleep disturbance, depression due to decreased mobility and self-esteem, and poor quality of life are all reported sequel of these fractures. Furthermore, recent studies have observed a relationship between osteoporotic kyphotic deformity in elderly and gastroesophageal reflux disease.[7] Vertebral fractures are

also associated with increased mortality, presumably due to restrictive pulmonary function, decreased mobility, and cardiovascular disease.[8]

Investigations for Osteoporotic Fractures : Plain anteroposterior and lateral radiographs are the initial imaging study, which show compression of the vertebral body.[5]

Magnetic resonance imaging (MRI) 1.5 or 3 Tesla is a sensitive tool to diagnose osteoporotic fractures because it identifies vertebral body edema and presence of pathology which may be unrecognized in conventional radiographs. MRI is also useful in patients with chronic persistent pain and will show typical fluid signal within the vertebral body diagnostic of pseudoarthrosis.

Computed tomographic scan is helpful in identifying the specific morphology of vertebral fractures that are not well visualized on plain films, in demonstrating injury to the posterior vertebral wall, and in the evaluation of the integrity of the posterior bony elements. BMD assessment through dual energy x-ray absorptiometry (DEXA) of the hip and spine is used to establish or confirm a diagnosis of osteoporosis (Table - 2), predict future fracture risk, and monitor patients in the long run.

Group	T score
Normal	> Or = -1 SD
Osteopoenia	Between -1 to - 2.5 SD
Osteoporosis	<-2.5 SD
Severe osteoporosis	<-2.5 SD with fragility fracture

Table - 2 : Osteoporosis based on total hip bone mass density

In all patients with osteoporotic vertebral fractures, the clinician should consider secondary causes of osteoporosis, such as osteomalacia, multiple myeloma, hyperthyroidism, hyperparathyroidism, and renal failure.[9]

Classification of Osteoporotic Fracture : Ever since the early 1960s, numerous authors attempted to classify osteoporotic fractures however, only the following classifications gained international acceptance to some extent.[10,11]

In 1995, Sugita et al[12] classified osteoporotic fractures into 5 types based on the initial lateral radiographs: (1) the swelled front type (2) the bow type (3) the projecting type (4) the concave type and (5) the dented type.

Kanchiku et al[13] were the first to compare the diagnostic success rates for osteoporotic fractures using MRI and plain radiographs. According to the area of regional intensity changes seen on T1-weighted midsagittal images, the authors classified the fractures into 6 types: total, anterior,posterior, superior, inferior, and central. No intraspinal protrusion in the inferior and superior types was seen, but there was a high frequency of intraspinal protrusion in the total and posterior types, which the authors believe to be more unstable.

In 2017 German orthopedic society has proposed a classification system (Fig.1) which also includes rotational injuries.[10]

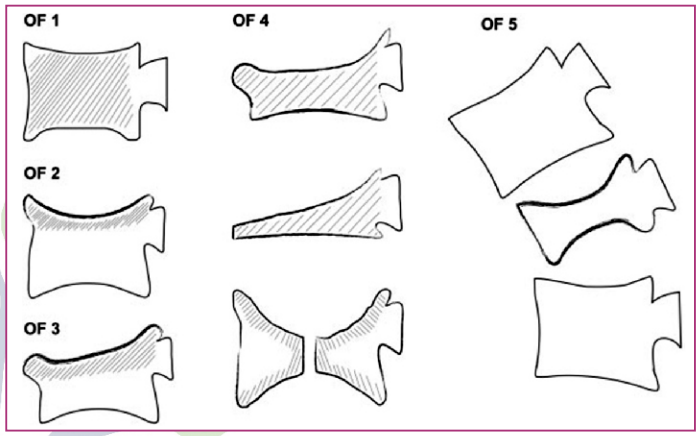


Fig.1 : Osteoporotic fracture classification

OF 1 : No vertebral deformation (vertebral body edema in MRI-STIR only). This type is rare. The stable injury is clearly visible on MRI-STIR sequence only. X-rays and CT scan do not show vertebral deformation.

OF 2 : Deformation with no or only minor involvement of the posterior wall (<1/5). This type of fracture affects one endplate only (impression fracture). The posterior wall can be involved, but only minor. OF 2 are stable injuries.

OF 3 : Deformation with distinct involvement of the posterior wall (>1/5). This type of fracture affects one end plate only, but shows distinct involvement of the anterior and posterior wall (incomplete burst fracture). The fracture can be unstable and may collapse further over time.

OF 4 : Loss of integrity of the vertebral frame structure, or vertebral body collapse, or pincer-type fracture. This subgroup consists of 3 fracture types. In case of a loss of integrity of the vertebral frame structure both endplates and the posterior wall are involved (complete burst fracture). A vertebral body collapse is typically seen as a final consequence of a failed conservative treatment and can impose as a plain vertebral body. Pincer-type fractures involve both endplates and may lead to severe deformity of the

vertebral body. OF 4 are unstable fractures and intravertebral vacuum clefts are often visible.

OF 5 : Injuries with distraction or rotation. This group is rare but shows substantial instability. The injury includes not only the anterior column but also the posterior bony and ligamentous complex.

Management : Conservative Treatment of Osteoporotic Fractures[5]

The care of patients with vertebral fractures includes pain management, early mobilization and rehabilitation, and prevention of further fractures. Acute pain due to osteoporotic fractures usually resolves by 10 to 12 weeks. Especially, in the early phase, effective analgesia is necessary to allow early mobilization of the usually elderly patients. Bed rest should be as short as possible to avoid complications of recumbence.

Oral analgesics including acetaminophen, tramadol, codeine, and nonsteroidal anti-inflammatory drugs (diclofenac, aceclofenac, ibuprofen, ketoralac) are standardly prescribed.

Medication used for the treatment of osteoporosis may also provide pain relief in patients with an acute osteoporotic fracture. Calcitonin, administered either by subcutaneous or intranasal routes, can be beneficial in reducing pain from acute vertebral fractures.[14] Bisphosphonates, popularly used in the management of osteoporosis, have also been used in the management of pain.[15] Furthermore, 2 meta-analyses have shown that teriparatide can be used for pain management in patients with acute fractures. Patients randomized to teriparatide had less back pain compared with a placebo or alendronate during a 30-month follow-up period.[16,17]

Once a patient has suffered an osteoporotic fracture, then it is recommended to initiate pharmacologic treatment, irrespective of the BMD scores. Current Food and Drug Administration approved pharmacologic options for osteoporosis are bisphosphonates (alendronate, ibandronate, risedronate, and zoledronic acid), calcitonin, estrogen agonist/ antagonist (raloxifene), estrogens and/or hormone therapy, parathyroid hormone 134 (teriparatide), and receptor activator of nuclear factor kappa-B (RANK) ligand inhibitor (denosumab). Combinations of these drugs are not used. Repeat BMD assessment is performed 2 to 3 years after the initiation of osteoporosis treatment based on which further decision to continue treatment is made. Postmenopausal women and men aged 50 years and older (candidates at risk for osteoporosis) are advised to include adequate amounts of total calcium intake (1000–1200 mg/day), vitamin D intake (800–1000 IU /day), regular weight-bearing and muscle strengthening exercise, and methods to reduce the risk of falls and advise on avoid consumption of tobacco, and excessive alcohol.

In table 3 different drugs their mechanism of action and adverse effects is summarized.[18]

S. No.	Drug	Dosage	Mechanism of action	Adverse effect
1	Raloxifene	60 mg/day	Osteoblast activation	Deep venous thrombosis, stroke
2	Bisphosphonate	variable	Osteoclast inhibition	Osteonecrosis of jaw, atypical femur fracture
3	Calcitonin	200 IU/day	Osteoclast inhibition	Prostate cancer
4	Denosumab	Twice a year subcutaneously	Osteoclast inhibition	Osteonecrosis of jaw, atypical femur fracture, cellulitis
5	Parathyroid hormone analogue	20 mcg sc daily for not more than 2 years.	Osteoblast activation	Leg cramp, dizziness
6	Anabolic steroids		Osteoblast activation	Masculinizing side effect

Table - 3 : Drugs for management of osteoporosis

Surgical Management : If pain does not decrease by conservative treatment or patient develops neurological deficit then surgical management is considered. Determination of surgical technique depends on kyphosis, instability and neurological involvement. Vertebroplasty, Kyphoplasty, pedicle screw stabilization and decompression are available options for management of ostoporotic vertebral compression fracture.

Vertebroplasty and Kyphoplasty: Vertebroplasty, involving the percutaneous fluoroscopically guided injection of polymethylmethacrylate (PMMA) directly into a fractured vertebral body, has been used to stabilize osteoporotic vertebral compression fractures. Substantial pain relief in a majority of patients treated with vertebroplasty has been reported.[19] Kyphoplasty is a minimally invasive procedure that involves the percutaneous insertion of an inflatable bone tamp into a fractured vertebral body under fluoroscopic guidance. Inflation of the bone tamp will elevate the endplates,

restoring the vertebral body back toward its original height while creating a cavity to be filled with bone void filler, most commonly PMMA. Results of kyphoplasty suggest significant pain relief, as well as the ability to improve height of the collapsed vertebral body and reduction of spinal kyphosis.[20] (Fig. 2)

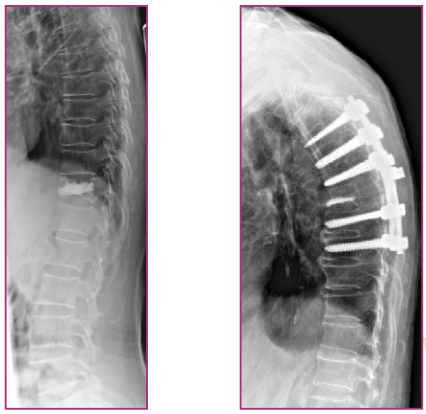


Fig. 2 : Kyphoplasty Vertebroplasty

Indications and Contraindications : Indications for vertebroplasty and kyphoplasty include (1) stabilization of painful or progressive osteoporotic and osteolytic vertebral compression fractures, (2) painful vertebra due to metastases or multiple myeloma, (3) Kummell disease, and (4) painful vertebral hemangioma. Contraindication is fractures that result in neurologic compromise. Patients with localized spine infections, sepsis, bleeding diatheses, or cardiopulmonary compromise that precludes safely performing the procedure also should not be treated by vertebroplasty or kyphoplasty.

Instrumentation of the Osteoporotic Spine : The selection of spinal instrumentation must take into account the fragility of osteoporotic bone, the stability of the spine, and the likely failure mechanisms of any applied instrumentation. The preoperative workup should include evaluation for the severity of osteoporosis, which might impact the surgeon's choice of reconstruction techniques.

Geriatric patients who have chronic vertebral pseudoarthrosis with instability or neurological deficit, intractable pain with collapsed vertebra, and kyphotic deformity require spinal instrumentation[21]. Shikata et al[22] have demonstrated good results with posterolateral decompression, reconstruction, and stabilization in osteoporotic fractures with neurological deficit. Ataka et al[23] postulated that the instability at the fracture site is the main factor causing neurological deficits in patients with osteoporotic thoracolumbar fractures, contrary to the popular belief of neural compression by bone fragments. They studied 14 consecutive patients who had incomplete neurological deficits following osteoporotic fractures and performed long segment posterior instrumented fusion without any canal decompression. They observed that there was no implant failure at a mean follow-up period of 25 months, and in all patients, neurological improvement was obtained by at least 1 modified Frankel grade. The presence of degenerative changes such as facet arthropathy, hypertrophied joints, presence of osteophytes, DISH-like changes, etc, poses difficulties during surgical exposure, identification of standard anatomical landmarks, and pedicle screw insertion. Despite being the most rigid form of posterior instrumentation, pedicle screws can have poor fixation in patients with osteoporosis.

For additional supplementation,sublaminar wires and pedicle augmentation using materials such as PMMA, calcium phosphate, or calciumhydroxyapatite can be used.[24,25]

From a surgical point of view,augmentation of pedicle screws with PMMA is the most effective and practical technique to improve the hold of the screws in the bone. However, the surgeon should be wary that the application of PMMA carries risks of cement leakage with possible embolic insults.

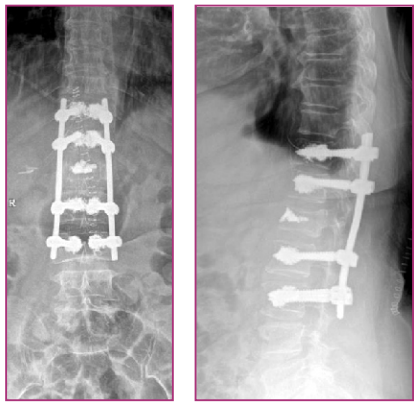


Fig. 3 : Cemented pedicle screws with vertebroplasty

The combination of Kyphoplasty/Vertebroplasty and instrumentation, so called hybrid stabilization (Figure 3), can effectively shorten the entire construct and therefore help to minimize the surgical trauma. Additionally, percutaneous instrumentation further decreases the invasiveness of the procedure.

References :

1. Harper KD, Weber TJ: Secondary osteoporosis. Diagnostic considerations. Endocrinol Metab Clin North Am. 27:325-348 1998
2. Cummings SR, Kelsey JL, Nevitt MC, et al.: Epidemiology of osteoporosis and osteoporotic fractures. Epidemiol Rev.
3. Riggs BL, Melton LJ 3rd: Involutional osteoporosis. N Engl J Med. 314:1676-1686 1986

4. Riggs BL, Hodgson SF, O'Fallon WM, et al.: Effect of fluoride treatment on the fracture rate in postmenopausal women with osteoporosis. N Engl J Med. 322:802-809 1990.
5. Shanmuganathan Rajasekaran, Rishi M. Kanna,Osteoporotic Thoracolumbar FracturesHow Are They Different?Classification and Treatment Algorithm.
6. Bliuc D, Nguyen ND, Milch VE, et al. Mortality risk associated with low-trauma osteoporotic fracture and subsequent fracture in men and women. JAMA. 2009;301:513521.
7. Imagama S, Hasegawa Y,Wakao N, et al. Influence of lumbar kyphosis and back muscle strength on the symptoms of gastroesophageal reflux disease in middle-aged and elderly people. Eur Spine J. 2012;21:21492157.
8. Center JR, Nguyen TV, Schneider D, et al. Mortality after all major types of osteoporotic fracture in men and women: an observational study. Lancet. 1999;353:878882.
9. National Osteoporosis Foundation. Physician's Guide to Prevention and Treatment of Osteoporosis. Washington, DC: National Osteoporosis Foundation; 2005.
10. Classification of Osteoporotic Thoracolumbar Spine Fractures: Recommendations of the Spine Section of the German Society for Orthopaedics and Trauma (DGOU)
11. Genant HK, Wu CY, van Kuijk C, Nevitt MC. Vertebral fracture assessment using a semi-quantitative technique. J Bone Miner Res.1993;8: 1137-1148.
12. Sugita M, Watanabe N, Mikami Y, Hase H, Kubo T. Classification of vertebral compression fractures in the osteoporotic spine.J Spinal Disord Tech. 2005;18:376-381
13. Kanchiku T, Taguchi T, Kawai S. Magnetic resonance imaging diagnosis and new classification of the osteoporotic vertebral fracture. J Orthop Sci. 2003;8:463-4.66
14. Knopp JA, Diner BM, Blitz M, et al. Calcitonin for treating acute pain of osteoporotic vertebral compression fractures: a systematic review of randomized,controlled trials. Osteoporos Int. 2005;16:12811290.
15. Armingeat T, Brondino R, Pham T, et al. Intravenous pamidronate for pain relief in recent osteoporotic vertebral compression fracture: a randomized double-blind controlled study. Osteoporos Int. 2006;17:16591665.
16. Nevitt MC, Chen P, Dore RK, et al. Reduced risk of back pain following teriparatide treatment: a meta-analysis. Osteoporos Int. 2006;17:273280.
17. Nevitt MC, Chen P, Kiel DP, et al. Reduction in the risk of developing back pain persists at least 30 months after discontinuation of teriparatide treatment: a meta-analysis. Osteoporos Int. 2006;17:16301637.
18. Harrison text book of internal medicine.
19. Rapado A: General management of vertebral fractures. Bone. 18 (3 Suppl):191S-196S 1996
20. Watts NB, Harris ST, Genant HK: Treatment of painful osteoporotic vertebral fractures with percutaneous vertebroplasty or kyphoplasty. Osteoporos Int. 12:429-437 2001
21. Hu SS. Internal fixation in the osteoporotic spine. Spine (Phila Pa 1976). 1997;22:43S48S.
22. Shikata J, Yamamuro T, Iida H, et al. Surgical treatment for paraplegia resulting from vertebral fractures in senile osteoporosis. Spine (Phila Pa 1976). 1990;15:485489.
23. Ataka H, Tanno T, Yamazaki M. Posterior instrumented fusion without neural decompression for incomplete neurological deficits following vertebral collapse in the osteoporotic thoracolumbar spine. Eur Spine J. 2009;18:6976.
24. Frankel BM, D'Agostino S, Wang C. A biomechanical cadaveric analysis of polymethyl-methacrylate-augmented pedicle screw fixation.J Neurosurg Spine. 2007;7:4753.
25. Shea TM, Laun J, Gonzalez-Blohm SA, et al. Designs and techniques that improve the pullout strength of pedicle screws in osteoporotic vertebrae: current status. Biomed Res Int. 2014;2014:748393.

Dr Darshan Gautam, Dr Rajat Mahajan, Dr Nirdesh H. Jagadeesh

Membership of IOA

Membership forms should be sent through the state chapter only, no forms should be sent directly to the IOA office.

1) Application for Life Member will be through the State Chapters as it is mandatory for all to become members of both IOA & State Chapters simultaneously.
2) Membership forms to be collected by State Chapters with two pay order / DD, one towards the state membership fee of Rs. 2500/- and the other for Rs. 5,000/- (Five thousand only) in favour of "Indian Orthopaedic Association" payable at New Delhi.
3) The State Chapter will forward the application form and DD/pay order after due verification, to IOA.

Membership form can be downloaded from:
https://www.ioaindia.org/uploadpdf/new%20format%20of%20IOA%20membership%20form-2019.pdf
Send filled form along with DD to ROSA Secretariat.

Management of Adolescent Idiopathic Scoliosis

Scoliosis is a spinal deformity consisting of lateral curvature and rotation of the spinal column. Typically, for scoliosis to be considered, there should be more than 10° curve on standing posterior-anterior radiograph of whole spine. The causes are classified broadly as Congenital, Neuromuscular, Syndromic, Degenerative, Secondary and Idiopathic. The majority of scoliosis cases encountered by the general orthopaedic practitioner are Idiopathic type. Non idiopathic causes must be ruled out as their management is different. ***In order to understand management of scoliosis, first step is to know how to manage Adolescent idiopathic scoliosis (AIS).*** AIS is by far the most common type of scoliosis, affecting children between ages 10 to 18 years. It is found in as many as 4 in 100 adolescents. In general, AIS curves progress during the rapid growth period of the child. Larger curves which require intervention is 8 to 10 times more common in girls than boys. While most curves stop progressing after skeletal maturity but curves greater than 60° continue to progress during adult-hood.

History, physical examination and radiographs are critical in the initial evaluation of scoliosis and in determining which patients need additional evaluation and consideration.

History should include age at onset, evidence of progression, amount of growth left, presence of back pain or breathing difficulty, sibling history and most importantly feelings of child or family about overall appearance.

Physical Examination: Adams forward bend test is a useful OPD screening tool. Scoliometer or iPhone measure app can measure degree of vertebral rotation accurately (Fig. 1). School screening for scoliosis is controversial and is falling out of favour. Careful general and neurological examination is essential to rule out non idiopathic causes. Growth status of the child can be assessed like height charting, pubic hair and breast development, tanner staging, etc.

Scoliometer App based Scoliometer

Fig. 1: Scoliometer measurements are useful in surgical planning and follow up of non-surgical patients to reduce radiation exposure.

Radiology : Erect whole spine PA x-ray should be done at the first visit. Other views like lateral and bending films should be done only if intervention is planned. (Fig. 2) One should remember to keep radiation exposure limited and use gonad / thyroid shield. CT scan should be strictly avoided in idiopathic cases (to limit radiation exposure). MRI is recommended for all non idiopathic cases. In idiopathic types, MRI is done for left sided curves, rapidly progressive curves, curves with positive neurological findings like absent abdominal reflexes or hyperreflexia, younger and larger curve patients.

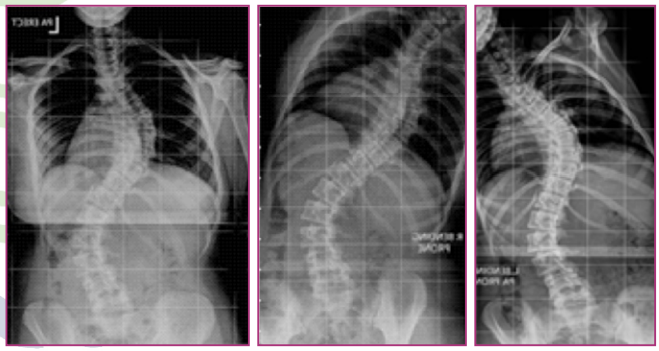


Fig. 2: Standing PA and Supine bend films of the entire spine to include both shoulders and pelvis.

Treatment of AIS is fairly well defined in present times. The treatment for idiopathic scoliosis is based on age, curve magnitude and risk of progression. Treatment options are observation, orthotic management and surgical correction. First step is to classify the curve. Lenke classification (Fig. 3) is most widely used system followed all over the world. It was able to address many pitfalls of Kings classification (Fig. 4).

Even Lenke classification has rule breakers but it still continues to be the most widely used classification. And in order to understand the rule breakers, Kings classification is important.

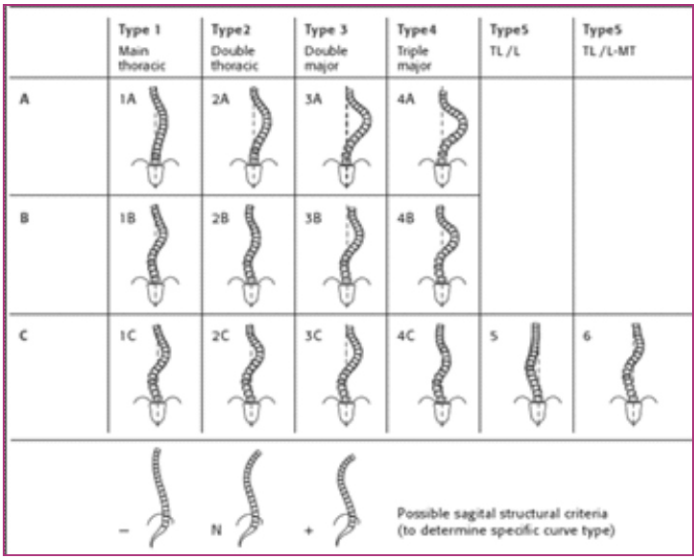


Fig. 3: Lenke Classification

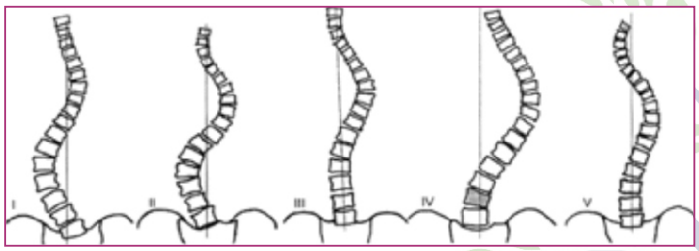


Fig. 4: Kings Classification

Treatment Options: Observe, Brace or Operate.

Curves less than 25 degrees are usually observed. Child is followed on 6 monthly basis till skeletal maturity. Scoliometer reading and if required Xray is done on every visit.

Curves from 25 to 40 degrees are braced. Numerous braces are available like TLSO, Milwaukee brace, Boston brace, etc. Most popular brace is Total contact TLSO with pads to correct the curve. (Fig. 5) Braces may achieve correction but the main purpose is to prevent rapid progression of curve during growth spurt. In flexible curves, braces may achieve excellent correction.

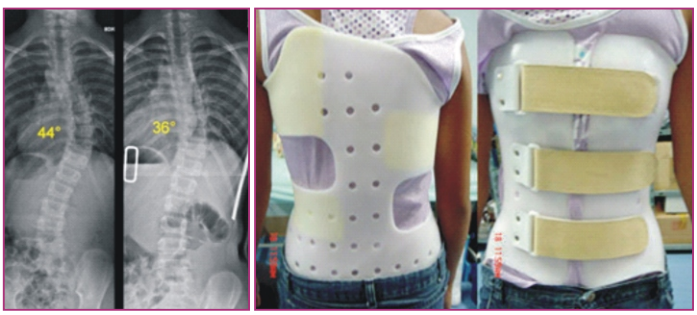


Fig. 5: TLSO in a 12 year old girl with AIS.

Brace is ideally to be worn for 18 to 22 hours a day. Child can remove the brace only while bathing and sports activity. Counselling is very important to achieve satisfactory result. Night bracing for 10 to 12 hours is an alternative option but studies don't favour it above full time bracing. Regular 6 month evaluation is mandatory. Braces are to be worn till skeletal maturity and gradually weaned off.

Well trained Orthotist and motivated child are the key to success of bracing.

Curves more than 40 degrees require surgical intervention. Aim of surgery is to achieve curve correction and fusion to achieve cosmetic and balanced spine. Surgical options include fusion and non-fusion surgery. ***Fusion is gold standard since many decades***. Instrumentation methods progressed from Harrington system to Segmental pedicle screw fixation. Planning of scoliosis surgery involves clinical and radiological evaluation. Clinical measurements include scoliometer measurements of thoracic and lumbar prominence. Radiological measurements include Cobb angle of proximal thoracic, main thoracic and thoracolumbar/ lumbar curves. Major or structural curve is the largest and stiff curve. Minor or Non Structural curves are smaller and flexible ones. The standard rule is to fuse the major curve and leave the minor curves. One must not forget Moe's teaching that mobile lumbar spine is far better than straight and fused one. Multiple studies have proven that if fusion stops at or above L2, patient satisfaction is very high. Hence, the concept of selective thoracic fusion (STF) for double curves is very important to understand. In order to plan UIV (Upper instrumented vertebra) and LIV (Lower instrumented vertebra) one must read the original papers of Moe and Lenke.

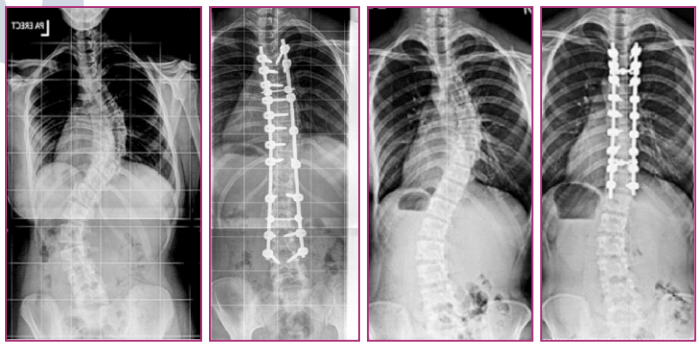


Fig. 6 : Surgical Correction of Scoliosis

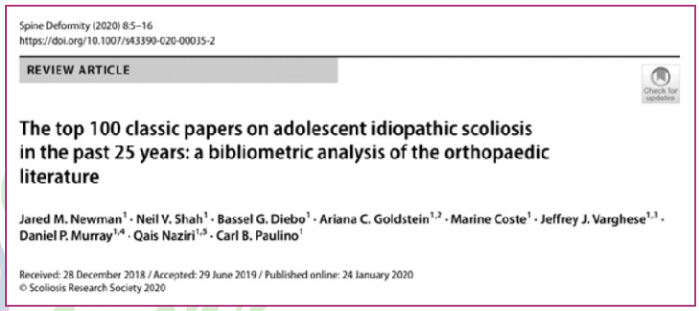
Posterior surgery is the most commonly done AIS surgery. It involves pedicle screw instrumentation, adequate releases and osteotomy, rod placement and correction manoeuvres (Fig. 6). Fusion is the target of AIS surgery hence adequate time should be given to decortication and bone grafting. Intra-operative

neuromonitoring is the standard of care at present to prevent neurological complications. Iso-C arm or O-arm based navigation system make pedicle screw fixation accurate in deformed spine. Pre op CT and 2D C-arm based navigation is not very accurate in deformed spine especially in the apical region.

Anterior surgery is less common nowadays but can be used as a release procedure in stiff and rigid curves. Thoracoscopic approach make anterior surgery cosmetic. In Thoracolumbar or Lumbar curves, anterior surgery can save one level distally which means better mobility.

CONCLUSION: In order to understand the concept of paediatric spinal deformity, management of adolescent idiopathic scoliosis is the first step. Clinical and radiological parameters are given equal importance. Lenke classification is most widely used system at present. Newer 3D EOS based classification systems will be the future. School screening surveys are not so popular at present. Parent and child counselling is most important part of scoliosis management. For bracing to be successful the child and treating physician has to believe in the concept. Aim of all treatments is to achieve cosmetic, balanced and flexible spine. Posterior fixation, release, correction and fusion is gold standard surgery. Selective thoracic fusion has better outcome than Non-selective surgery. One must try to stop at L2 or L3. Non fusion surgery like tethering is still in its early days.

BIBLIOGRAPHY: This article has link to all the relevant publication linked to AIS.



Spine Deformity (2020) 8:5–16
https://doi.org/10.1007/s43390-020-00035-2

REVIEW ARTICLE

The top 100 classic papers on adolescent idiopathic scoliosis in the past 25 years: a bibliometric analysis of the orthopaedic literature

Jared M. Newman[1] · Neil V. Shah[1] · Bassel G. Diebo[1] · Ariana C. Goldstein[1,2] · Marine Coste[1] · Jeffrey J. Varghese[1,3] · Daniel P. Murray[1,4] · Qais Naziri[1,5] · Carl B. Paulino[1]

Received: 28 December 2018 / Accepted: 29 June 2019 / Published online: 24 January 2020
© Scoliosis Research Society 2020

Dr Chiraya Pamecha
Shriram Hospital, Udaipur

Practice Safely
Essential Principles of a Valid Consent as per Indian Law

- Take the consent of the patient before commencing a treatment/procedure
- Consent must be taken from the patient himself
- Consent should be free and voluntary
- Consent should be informed [Not blank signature]
- Consent should be procedure specific
- Consent obtained during the course of surgery is not acceptable
- Consent for blood transfusion
- Fresh consent should be taken for a repeat procedure
- Surgical consent is not sufficient to cover anesthesia care
- Patient has the right to refuse treatment
- Unilaterally executed consents are void
- Witnessed consents are legally more dependable
- Consent should be properly documented
- Consent for illegal procedures is invalid
- Signature on consent form when the patient's right/left hand is impaired
- Consent for HIV screening test
- No need for Consent in Emergency

Preliminary Results and Technical Note on Paraspinal Percutaneous Stenoscopic Lumbar Decompression in Foraminal Stenosis with or without Disc Prolapse.

Dr. Tarun Dusad
Apollo Spectra and Mahaveer Jaipuriya
Rajasthan Hospital, Jaipur

Dr. Vikas Yadu
Dhanvantri Hospital & Medical Research Centre, Jaipur

ABSTRACT :

Introduction: Traditional transforaminal endoscopic surgery to manage far lateral disc herniations is performed through Kambin's triangle which is often very narrow in foraminal and extraforaminal stenosis. To overcome this hurdle, we introduce a modified full endoscopic procedure with use of stenoscope (10 degrees endoscope) and paraspinal surgical approach to treat foraminal and extraforaminal stenosis with or without disc herniation. The purpose of this study was to describe Paraspinal PSLD (Percutaneous stenoscopic lumbar decompression) technique and to demonstrate the preliminary clinical outcomes.

Material and Methods: Prospective data from 15 consecutive patients with foraminal and/or extraforaminal stenosis with or without far lateral disc herniation, were collected who underwent paraspinal PSLD. The clinical outcome was noted using the visual analog scale, Oswestry Disability Index, and Odom's Criteria. The site of pathology was approached from 5-6 cms from midline with docking of working channel over isthmus and facet. Foraminal decompression was done after exposing the exiting nerve root using high speed burr and punches.

Results: The preliminary results of 15 patients (M:F=5:10) with mean age 57.21 ± 14.31 years (ranging from 40-75) were noted at 1 month of follow up. The VAS for leg pain improved from preoperative Score 8.13 ± 1.68 to postoperative Score 2.81 ± 1.32 at 1 month of follow up. The ODI improved from 63.2 ± 10.67 to 24.2 ± 5.42 postoperatively at 1 month follow up. Excellent or good results were obtained in 87.67% of patients on the basis of Odom's criteria and symptomatic improvements were obtained in 94% of patients. Only 2 patients had postoperative dysesthesia which resolved mostly in 3 months of time and one patient needed revision surgery due to incomplete decompression.

Conclusion: Paraspinal PSLD could be an efficacious alternative to overcome the hurdles of traditional transforaminal approach to manage foraminal and extraforaminal stenosis with or without far lateral disc herniation which offers full scale decompression after exposure of exiting nerve root, thus reducing the risk of its injury.

Introduction: Far lateral disc herniations in lumbar spine are reported to be more common in older patients, thus it is usually complicated by degenerative changes causing foraminal and extraforaminal stenosis. Lumbar foraminal or extraforaminal stenosis is not an uncommon cause of lumbar radiculopathy, with a reported incidence of 8-11%, coinciding with rate of far lateral disc herniation which account for 2.6-12 % of all disc herniations reported in various series.[1,2]

Despite the development of microscopic and endoscopic techniques, optimal treatment for the above mentioned pathology is still a matter of contention. The surgical procedures dealing with foraminal and extraforaminal neural compression are often challenging due to inherent difficult anatomical access with fear of neural damage, facet damage which can cause instability and necessitating fusion in future.

The paraspinal muscle splitting approach to treat foraminal and extraforminal neural compression has been reported to provide success rate in range of 71-88%.[3] However, muscle retraction, handling of exiting nerve dorsal root ganglion may be the source of irritating dysesthesia and chronic back pain in some patients. Traditional transforaminal endoscopic surgery to manage far lateral disc herniations is performed through Kambin's triangle. But it is frequently associated with degenerative changes and foraminal stenosis as mentioned earlier. Supporting this, Ozer et al also reported narrowed or no space (safe zone) in 82.4% of patients with far lateral disc herniation and 79.2% of the cadavers.[4] Thus, it poses a greater challenge and surgeons hesitate to perform surgery and rely on conservative treatment. To overcome this hurdle, we introduce a modified full endoscopic procedure with use of

stenoscope (10 degrees endoscope) and paraspinal surgical approach to treat foraminal and extraforaminal stenosis with or without disc herniation. The purpose of this study was to describe Paraspinal PSLD (Percutaneous stenoscopic lumbar decompression) technique and to demonstrate the preliminary clinical outcomes.

Material and Methods -

Study Design: Data was collected and evaluated prospectively between "2019-20" after institutional research board approval. All subjects were from a single institute and operated by a single trained endoscopic spine surgeon. Independent observer evaluated the preoperative data, operative room notes, radiological and post-operative follow up data of all patients operated for Paraspinal PSLD.

Inclusion Criteria:

1. Single level degenerative lumbar foraminal or extra-foraminal stenosis with or without far lateral disc herniation.
2. Grade I stable spondylolisthesis with only single sided foraminal or extra-foraminal stenosis
3. Minimum 1 month follow up

Exclusion Criteria:

1. Multilevel pathology
2. Combined lateral recess and foraminal stenosis
3. Infection
4. Revision Spine Surgery
5. Mobile on dynamic radiographs or > Grade I Spondylolisthesis
6. < 1 month follow up

Patient evaluation: Demographic data was collected which included age, sex, symptoms (mechanical and neurological). Clinical data was assessed which included Visual Analogue Scale (VAS score of 1-10) for pain, Oswestry Disability Index (ODI 1-100) for disability indices. Data regarding the same was collected pre and post operatively at 2 weeks and1 month. Final outcome was graded both subjectively and objectively, using the scoring system given by Odom's Criteria.

Radiological evaluation included level of stenosis, side, site (foraminal or extra foraminal), assessment of disc herniation, orientation of facet (pre-operative MRI).

Surgical technique: In the present study we have modified the traditional procedure of transforaminal endoscopic decompression to Paraspinal Percutaneous Stenoscopic Lumbar Decompression (Para PSLD) which has two most important components. First is the relatively medial approach approximating 5-7 cms from midline to get a more familiar field of vision and to preserve the facet joint as much as possible. Second is the use of Stenoscope (Fig 1) i.e an endoscope which is appropriate to be used in stenosis.

Fig. 1. Maxmore Stenoscope with 10 degree visual angle.

Endoscopic procedures are known for their disadvantage of being two dimensional in vision. Cases of stenosis need greater orientation and depth perception by surgeon to achieve a good decompression. An ideal endoscope which can be used in stenosis should have appropriate diameter which allow instruments to be inserted down to the floor of spinal canal adjacent to neural structures and to be handled through it with ease, but not so large that makes it difficult in tilting, rotating and dealing with the other side. It should allow more of head-on visualisation along with a balance of some optic angle to increase the field of vision. As the endoscope optic angle moves closer to 0 degrees, it will give less out of field view and minimises the surgeon's disorientation. In this study, we have used endoscope with 10 degrees optic angle (stenoscope), 8.4 mm outer diameter and 5.7 mm inner diameter. With this diameter and angle, we can use most of the instruments needed for decompression (even 5mm Kerrison Rongeur) for decompressing neural structures with minimal handling and greater orientation.

We hypothesised that, ideal angle to approach for foraminal decompression should neither be too steep that may enhance chances of exiting nerve root injury, nor be too shallow to damage the facet joint.

To summarise, the unique characteristic of the surgical technique used in present study are-

- Skin entry point is relatively medial.
- Approach angle is relatively steep than traditional transforaminal technique.

- Visualisation of exiting nerve before starting decompression.
- Use of 10 degree endoscope.
- Avoiding use of needle to reach the target area.
- Extraforaminal landing of scope

The surgical process can be explained into 5 steps

1. **Pre-operative planning**: Axial MRI or CT scan is used to plan the skin entry point from the midline and the trajectory targeting the stenosed area (Fig. 2).

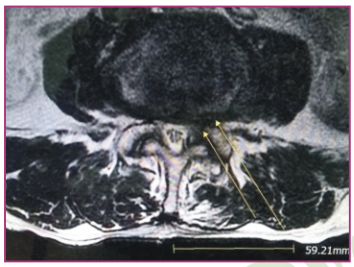


Fig. 2. Preoperative planning for entry point. Parallel line to facet is taken along the lateral margin of facet and projected on skin.

Bony removal can be minimised by going along the facet alignment. A line almost parallel to facet alignment is projected from stenosed area to skin and distance is calculated from midline. This can vary from 5-7 cm depending on the target pathology. At this distance angle of scope is near 45 degrees which in our view is neither too steep to increase chances of exiting nerve injury, nor too shallow to increase facet joint damage to a significant level. With the diameter of stenoscope i.e. 8.4 mm it is possible to look inside the foramen, even the traversing nerve root clearly with slight tilting of scope using skin elasticity.

2. **Patient Preparation:** The patient is given general anaesthesia. The patient is placed in a prone position on a radiolucent operating table with the affected side facing the surgeon and draped aseptically.

3. **Extraforaminal docking:** A midline connecting the spinous processes is drawn on patient's skin under true anteroposterior fluoroscopic guidance (Fig 3A). A second line parallel to first is drawn laterally at distance planned as per pre-operative planning (Fig 3B). An obturator is placed on the second line parallel to disc and targeting the distal part of foramen at desired level under true lateral fluoroscopic guidance (Fig 3C). Skin incision of 6-8 mm length is made at that site (Fig 3D). A dissector is then passed from the incision to targeted area along the trajectory measured previously which can usually vary between 30-60 degrees depending on the location of pathology and facet alignment. An artery

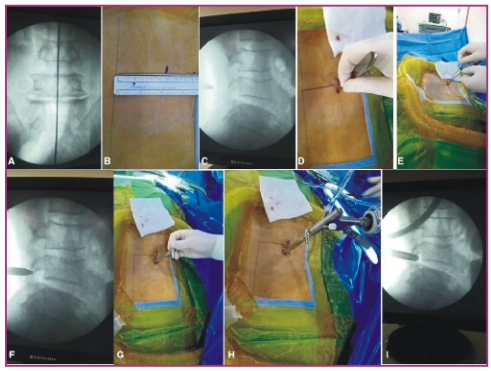


Fig. 3. Intraoperative images of entry making to foraminal/extraforaminal region.

forceps is then used to make space for endoscopic instruments to pass (Fig 3E). We do not use needle to target the disc space or Kambin's triangle in the described technique; instead obturator is passed directly and placed on the lateral surface of isthmus, thus minimising exiting nerve root injury while making entry (Fig 3F). Now bevel ended working cannula is introduced over the obturator (Fig 3G). After confirmation of correct landing with fluoroscopy, obturator is withdrawn and 10 degree stenoscope is introduced (Fig 3H). Thus the working cannula and stenoscope are placed outside the foramen and just in contact the isthmus (Fig 3I).

4. **Exploration of Exiting Nerve Root:** Soft tissue from the isthmus and superior articular process is cleared. In most of the cases Kambin's triangle was narrowed or there was no space at all. The hypertrophied part of superior articular process is removed using endoscopic burr or Kerrison's rongeur to make some space or in other words to create safe zone (Fig 4A & B).

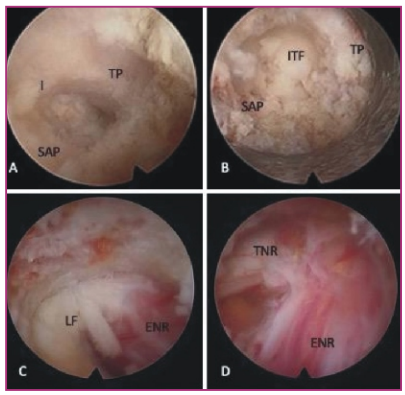


Fig. 4. Endoscopic views of surgery starting from landing, safe zone formation, nerve root decompression and end point of decompression.

Inter transverse fascia is carefully dissected and removed from distal to proximal area until the perineural fat around the nerve root begins to appear. With 5-7 cm distance from the midline and about 45 degrees angle, it is possible to explore the lateral part of exiting nerve root first, frequently which is least compressed and then follow it to the foramen. This technique is particularly useful in exploring the nerve root safely with minimised bone work in patients with severely stenosed foramen and at L5-S1 level where relatively medial entry point has to be made at times due to high iliac crest. Exploring the nerve root first makes it relatively mobile and helps in reducing the post-effect of its handling which can occur in foraminal decompression and unroofing of nerve root.

5. **Foraminal decompression:** Now the compressive elements of the exiting nerve root can be identified easily. The hypertrophied ligament flavum, foraminal ligament, part of transverse process and superior articular process compressing the exiting nerve root are removed using high speed drill burrs and Kerrison's rongeurs (Fig 4C). If there is accompanying disc herniation then it can be removed easily from the inferior aspect of foramen and extraformanial part. Soon with advancement in foraminal decompression, perineural fat near traversing nerve root is visible. The endpoint of the procedure is free mobilisation of exiting nerve root and visualisation of traversing nerve root in lateral recess (Fig 4D). The medial extent of foraminal decompression can be assessed by palpating the superior pedicle with nerve hook and confirmed with anteroposterior fluoroscopy. After adequate homeostasis, the endoscope is withdrawn and a drain is introduced to prevent post-operative haematoma which can be removed usually in 24 hours. Single ethilon suture is applied over skin. Patients can be mobilised out of bed on day one and can be discharged thereafter.

Results: 17 consecutive patients satisfying the inclusion criteria were managed by Paraspinal PSLD between 2019-20. 2 patients who had follow up of less than 1 month were excluded from the study. Thus, a total of 15 patients with foraminal or extra-extra-foraminal stenosis with or without far lateral disc herniation formed our study cohort. The mean age at the time of surgery was 57.21 $\pm$ 14.31 years, M:F = 5:10 and mean follow up was 2.5 months.

Statistically significant improvement was seen in the mean pre-operative clinical parameter at the first follow up and this maintained at the final follow up. VAS = 8.13 $\pm$ 1.6 (leg pain) & 6.27 $\pm$ 1.85 (back pain), improved to 2.81 $\pm$ 1.32 (leg) and 2.54 $\pm$ 1.48 (back), ODI = 63.2 $\pm$ 10.67 improved to 24.2 $\pm$ 5.42 respectively.

Intra-Operative blood loss was non-recordable but mean amount of blood loss in post-operative drain was 35 $\pm$ 15 ml. Operative time averaged 95.3 $\pm$ 10.67 min. In this series, post-operative dysesthesia was noted in 2 cases. Now recovered till final follow up, but one case had mild dysesthesia without any functional deficit. There was one case of partial nerve root injury but patient didn't develop any neurological deficit. The patient had degenerative scoliosis and nerve root was quite superficial unlike expected.

In the current study 87.67% had excellent to good results as per Odom's criteria with complete resolution of symptoms and 13.3% fair and no poor result was noted. One patient required revision surgery due to incomplete decompression and fusion surgery was done.

Discussion: Foraminal or extraforaminal stenosis with or without disc herniation is not an uncommon reason for failed back surgery syndrome resulting in persistent leg pain after surgery. Far lateral disc herniation is most commonly seen in elderly population which is often associated with spondylotic changes in lumbar spine like hypertrophy of ligament flavum, superior articular process, foraminal ligament, inter transverse ligament. This results into radiculopathy with severe pain as dorsal nerve root ganglion situated there is very sensitive to external compression.

A revolution in endoscopic spine surgery occurred when Kambin introduced the concept of “safe zone” called the Kambin's triangle, after that several researchers have developed percutaneous transforaminal endoscopic techniques for foraminal decompression[5]. Traditional technique includes introduction of a needle in kambin's triangle to identify the desired level, then the obturator and working channel follows it. But, several anatomical studies have demonstrated that Kambin's triangle is not existing in many cases of Foraminal and extraforaminal stenosis because of spondylotic changes[4]. Thus, introduction of needle and the obturator targeting the so called safe zone can be dangerous and may result into exiting nerve root injury. Transforaminal endoscopic surgeries are usually started from 9-11 cm from midline and involves use of 20 degrees or more angled endoscope.

Spine surgeons are more familiar with posterior approaches instead of lateral approach, and the use of angled endoscope may add on the disorientation in initial cases.

To overcome all these hurdles we have introduced a modified technique to approach the foraminal and extra-foraminal region. In paraspinal PSLD technique, the site of skin entry is located from 5-7 cm from midline and the initial docking point of obturator and working channel is isthmus without any use of needle to locate the level. The operating surgeon gets a more familiar posterior view.The exiting nerve root is exposed first before starting the foraminal decompression which seems to be theoretically safer than the traditional technique. In severe foraminal stenosis, it is feasible to first expose the extraforaminal part of exiting nerve root with slight lateral tilting of stenoscope and then follow it through the foramen, removing only that part of superior articular process which is required to be removed for decompression.

In the current technique, there was considerable improvement in VAS (5.32 for leg pain & 3.73 for back pain), ODI (39) with lower rate of post-operative dysesthesia. The reported success rate following microsurgical foraminotomy of FEF lesions is ranging from 58 to 80%, but many patients have postoperative leg pain, which is the main cause of poor outcomes.[6,7] Jang et al reported 85.7% success rate of PELD (Percutaneous Endoscopic Lumbar Decompression) in 35 patients with extra-foraminal disc herniation with 6 patients reporting post-operative dysesthesia and 3 required open surgery in follow up.[8] Choi et al in a similar study noted 92% success rate with 3 post-operative dysesthesias and 2 open surgery in follow up.[9] Ahn et al reported results of percutaneous endoscopic foraminotomy in 33 consecutive patients and got 93.9% symptomatic improvement with 2 patients showing dysesthesia and 1 required open surgery for a hidden disc herniation.[10] Our preliminary results were comparable to the results obtained with open microscopic surgery and PELD with greater symptomatic improvements and lesser post-operative complications.

The current study is not without limitations. This is a study with small study cohort showing only the preliminary results. Long term results with more number of subjects will be needed to get its rightful comparison with literature and to know the revision surgery rates. There may be a learning curve for this novel technique. The use of a drill and punches under endoscopic control is unfamiliar to most spine surgeons.

Conclusion: Paraspinal PSLD could be an efficacious alternative to overcome the hurdles of traditional transforaminal approach to manage foraminal and extraforaminal stenosis with or without far lateral disc herniation which offers full scale decompression after exposure of exiting nerve root, thus reducing the risk of its injury.

References:

1. Rust M.R.Olivero W.C.Far-lateral disc herniations; the result of conservative management.J Spinal Disord. 1999; **12**: 138-140.
2. Epstein NE . Evaluation of varied surgical approaches used in the management of 170 far-lateral lumbar disc herniations: indications and results *J Neurosurg* 1995 **83**: 648656.
3. Theodossios B& Dimitrios K& Georgios M& Efthymia T& Kleo P. Microsurgical muscle-splitting approach for extracanalicular lumbar disc herniation: An analysis of 28 consecutive cases. Acta orthopaedica Belgica 2009. 75. 70-4.
4. Ozer AF, Suzer T, Falsafi M, Aydin M, Sasani M, Oktennoglu T. Anatomic assessment of variations in Kambin'striangle: a surgical and cadaveric study. World Neurosurg 2017;100:498-503.
5. Kambin P, Gellmann H. Percutaneous lateral discectomy of the lumber spine: a preliminary report. Clin Orthop Relat Res 1983;174:127-32.
6. Foley KT, Smith MM, Rampersand YR (1999) Microendoscopic approach to far-lateral lumbar disc herniation. Neurosurg Focus 7 (5).
7. Epstein NE (2002) Foraminal and far lateral lumbar disc herniations: surgical alternatives and outcomes measures. Spinal Cord Oct 40 (10): 491500.
8. Jang, Jee-Soo MD; An, Sun-Hwa RN; Lee, Sang-Ho MD Transforaminal Percutaneous Endoscopic Discectomy in the Treatment of Foraminal and Extraforaminal Lumbar Disc Herniations, Journal of Spinal Disorders & Techniques: July 2006 - Volume 19 - Issue 5 - p 338-343. doi: 10.1097/01. bsd. 0000 204500. 14719.2e
9. Choi, Gun, MD, PhD; Lee, Sang-Ho, MD, PhD; Bhanot, Arun, MD; Raiturker, Pradyumna Pai, MD; Chae, Yu Sik, MD Percutaneous Endoscopic Discectomy for Extraforaminal Lumbar Disc Herniations: Extraforaminal Targeted Fragment-ectomy Technique Using Working Channel Endoscope, Spine: January 15, 2007 - Volume 32 - Issue 2 - p E93-E99 doi: 10.1097/01.brs. 0000 252093.31632.54.
10. Yong Ahn, MD, PhD, Hyun-Kyong Oh, RN, Ho Kim, BS, Sang-Ho Lee, MD, PhD, Haeng-Nam Lee, RN, Percutaneous Endoscopic Lumbar Foraminotomy: An Advanced Surgical Technique and Clinical Outcomes, *Neurosurgery*, Volume 75, Issue 2, August 2014, Pages 124133.

Post Traumatic L4 - L5 Spondyloptosis with Cauda Equine Syndrome: A Case Report

Dr Nilesh Barwar
AIIMS, Jodhpur

Abstract: Spondyloptosis at lumbar level usually encountered in isthmic or dysplastic type of spondylolisthesis. Post traumatic lumbar spondyloptosis is a comparatively rare entity. As the injury is basically a complete failure of all osteo-ligamentous structures, it is highly unstable and has high probability of complete neurological deficit. On the contrary, the injury also has a great deal of chances of meaningful neurological recovery if realignment & stabilization is done on an urgent basis. Here we report a case of L4-L5 post traumatic spondyloptosis with complete motor weakness below the injury level with sensory and bowel & bladder dysfunction. The injury recovered significantly within 4 months after operative reduction, decompression and stabilization.

Key words: Traumatic lumbar spondyloptosis.

Introduction: Traumatic spondyloptosis is a devastating injury, disrupting all the columns of spine. As the soft tissue constraints like ALL, PLL and posterior ligamentous structures are completely torn, this translational injury is highly unstable.[1] There is a serious biomechanical failure of the spine that could only happen with involvement of great amount of energy viz. a fall from significant height, a fall of heavy weight on to the body and motor vehicle crashes, etc.[2] Traumatic spondyloptosis is frequently reported at lumbosacral junction, but there are limited number of cases in literature with regard to complete translation at L4-L5.[3,4] Here we report a case of L4 - L5 post traumatic spondyloptosis with an intraoperative finding of intact thecal sac and significant recovery of the neurological function in the follow up period.

Case presentation : In our emergency department we received a case of lumbar spine injury with paraplegia in a 24-year-old female. History suggested a freak accident involving her attempt to remove a key from a stationery tractor in a field that started its engine while in a gear. As it run amok she suffered a run over injury.

On clinical evaluation, she was fully conscious with GCS 15/15. Her vitals were in normal range except she couldn't pass urine. She had lower back ache with tenderness in lumbar spine. On careful logrolling, there was a step off in the lower lumbar region. Neurological examination revealed that there was a complete paraplegia with sensory deficit below his both mid thighs. Perianal sensation was absent and so was the voluntary anal control. Deep tendon reflexes in lower limb were absent. Babinski reflex was mute. In the upper limbs, neurological examination was normal. She did not have any signs of head injury, chest injury, pelvic injury, etc.

Considering his lower back pain and paraplegia, radiographic study was done.[Figure 1] There was a complete translation of L4 vertebral body over the L5 with L5 superior end plate coming in to direct contact of inferior aspect of L4 pedicles. Pars fracture of L4 in both the sides were present.

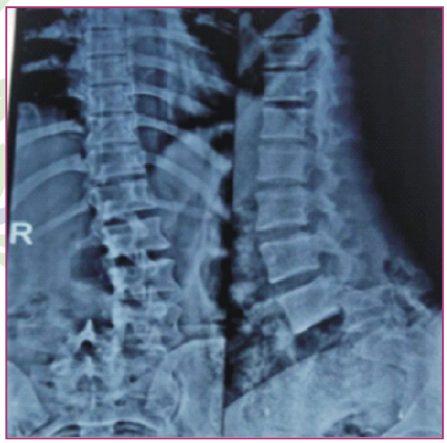


Fig. 1: AP & Lat views involving thoraco-lumbo-sacral spine. Meyerding grade V translational injury (spondyloptosis)at L4-L5

A CT scan was done to better elucidate the injury. In axial plane, there were two vertebral bodies in one section with left side translation of L4 as well. [Figure 2 (A,B,C)]

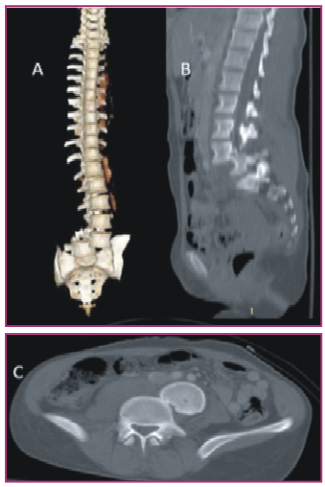


Fig. 2 (A, B,C): 3D CT scan, mid sagittal and axial sections showing Meyerding grade V dislocation at L4-L5.

On MRI study, vertebral canal compromise seen with obvious discontinuity of thecal sac in T2 weighted sagittal sections. [Figure 3(A, B, C)] Considering severe injury of very unstable nature, we took the case for operative procedure on the same day.

Operative procedure:

Fig. 3 (A, B, C, D): T2 weighted MRI with sagittal, coronal and axial sections showing apparent thecal sac discontinuity.

Patient was positioned prone. As soon as we positioned the patient, to our surprise, there was a complete automatic reduction of the injury in fluoroscopic study. L3 to L5 posterior exposure was done under aseptic precautions. The broken L4 posterior elements were removed. Contrary to our assumption, the dural sac was intact and no CSF leak was found. In the right side of the canal at the level of L4, a free facetal fragment was found and removed. The L4-L5 plane was completely unstable and we could mobilize the spine segment in both sagittal and coronal planes even with the thumb pressure to the spine processes.

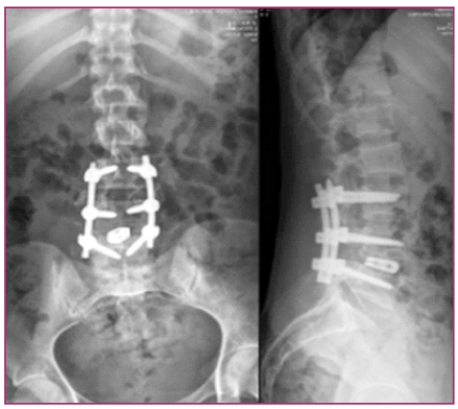


Fig. 4 : Post-operative radiograph AP & Lat. views of lumbar spine showing reduction and posterior instrumented fusion.

Considering unstable injury, we fixed the spine with pedicle screws in L3, L4 and in L5 with two rods. The L4-L5 interbody area was prepared, discectomy done and an interbody cage of size 11 with bone graft was placed. The construct was tightened. Vertebral canal and L4 roots decompression was ensured. [Figure 4]

Facetal decortication and fusion were done. Fluoroscopy was used for spine alignment, reduction and implant position. Till the last follow up at 6 months, the construct was stable and no sign of instability was visualized.

Post-operative course: Vital management was ensured. Neurological recovery started on day 2 when some flickering began to appear in quadriceps on both sides. By the end of 3rd month, neurology improved with 4/5 motor power around both the hips and knees. Around ankles, though it improved with plantar flexion 3/5 and dorsiflexion 2/5, yet less than that around the hips and knees. Skin sensation was completely improved. Bladder and bowel function improved and she was able to pass urine herself. Physiotherapy is ongoing. Sitting and wheel chair mobilization were started. Considering his recovery track record, in times to come, the neurological function should further improve.

Discussion: One hundred percent translation of the spine segment is a disastrous injury. It can happen at any level, yet it has more tendency to happen at the junctional areas of spine where mobile and rigid segments meet. In the thoracolumbar junction, the spondyloptosis is less forgiving as it damages the spine cord.[5] However, if it happens in lumbar or lumbosacral junctional area, chances of neurological recovery are great.[6] The nerve roots and rootlets behave as peripheral nerves. Hence early restoration of the bony canal of the spine is of paramount importance along with stability.

Operative reduction and three column fixation of the spine give optimum environment to the neural structures to recover. The disrupted interbody level should better be fused as the intervening disc is already disrupted along with posterior element injury. Since single motion segment fixation and fusion may not give appropriate stability, it may be prudent, as in our case, to involve one more motion segment for a rigid stabilization.[7]

Despite a wild translational injury, the thecal sac might be intact, every such an injury should be given the highest priority as far as operative management is concerned.[8] This injury could have a great potential for recovery as well. Instrumented fusion is appropriate and serves dual benefit of realignment, decompression and rigid stabilization.

Conclusion: Traumatic spondyloptosis in lumbar spine is a grave injury with subsequent serious neurological deficit. In such an injury segment of spine is completely unstable as the soft and bony constraints are totally jeopardized. Nevertheless, the injury has a promising recovery pattern, provided that early reduction and stabilization are executed. Prone positioning itself helps in reduction of the significant translation. Even after a great deal of vertebral body translation, the dural continuity may still be intact, particularly at lower lumbar region owing to wide inherent vertebral canal. [Abbreviations: ALL- anterior longitudinal ligament, PLL- posterior longitudinal ligament]

References:

1. Meyerding HW: Spondylolisthesis as an etiologic factor in backache. J Am Med Assoc. 1938, 111 (22): 1971-1976. 10.1001/jama.1938.02790480001001.
2. El-Khoury G, Whitten C: Trauma to the upper thoracic spine: anatomy, biomechanics, and unique imaging features. AJR Am J Roentgenol. 1993, 160 (1): 95-102. 10.2214/ajr.160.1.8416656.
3. Chatani K, Yoshioka M, Hase H, Hirasawa Y: Complete anterior fracture-dislocation of the fourth lumbar vertebra. Spine. 1994, 19 (6): 726-729.
4. Ahmed A, Mahesh BH, Shamshery PK, Jayaswal A: Traumatic retrolisthesis of the L4 vertebra. J Trauma Acute Care Surg. 2005, 58 (2): 393-394. 10.1097/01.TA.0000073998.94089.D1.
5. Arash Fattahi, Abdoulhadi Daneshi. Traumatic thoracic spine spondyloptosis treated with spondylectomy and fusion. Surg Neurol Int. 2018; 9: 158.
6. Michael P Bellew, Bradley J. Bartholomew. Dramatic neurological recovery with delayed correction of traumatic lumbar spondyloptosis. Case report and review of the literature. J Neurosurg Spine 2007 Jun;6(6):606-10.
7. Zhou T-H, Tang X, Xu Y-Q, Zhu Y-L: Traumatic spondyloptosis of L4. Spine. 2010, 35 (17): E855-E859. 10.1097/BRS. 0b013 e3181d798f2.
8. Lu X, Hou C, Yuan W, Zhang Z, Chen A: Complete traumatic anterior dislocation of the lumbosacral joint: a case report. Spine. 2009, 34 (14): E488-E492. 10.1097/BRS.0b013e3181a8cdad.

ROSA & ICS Web Symposium on "OSTEOARTHRITIS"

On the occasion of World Arthritis Day, 12th October 2020 ROSA and ICS (Indian Cartilage Society) conducted webinar on Osteoarthritis with prevention as the main theme.

With able guidance of Dr. Rajesh Goyal, President ROSA; Dr. Rahul Katta, Secretary ROSA; Dr. Santosh Sahanand, President ICS, the webinar was moderated by Dr. Saurabh Mathur, Secretary, ICS Nationwide galaxy of speakers like Dr Arun Vaishya from Jodhpur, Dr Sandeep Patel from Chandigarh, Dr Anil Jain from Jaipur and Dr Vaibhav Bagariya from Mumbai presented on different aspects on prevention of osteoarthritis knee to keep joints painfree with good stability and function.

Variety of topics were covered from Pharmacological management, Visco-supplementation, Orthobiologics, role of Orthotics to cartilage repair techniques etc. Webinar was followed by extensive discussion by esteemed panelists Dr Vinod Kumar from Delhi, Dr Kailash Patil from Pune, Dr Himeshwar Harshwardhan, Dr D. P. Choudhary, Dr Vinay Goyal and Dr C. K. Ameta from Rajasthan.

Seminar was well attended and appreciated by more than 500 delegates of ROSA and ICS.

ROSA Executive Committee Meeting, (Minutes)
Online Video Meeting
Saturday 24th October 2020, 09:00 p.m.

The meeting was attended by -

1. Dr Rajesh Goyal (President)
2. Dr Arun Vaishy (President Elect)
3. Dr Rahul Katta (Secretary)
4. Dr Saurabh Mathur (Treasurer)
5. Dr Jayant Sen (Past Secretary)
6. Dr Ashok Khandaka
7. Dr S. B. Solanki
8. Dr C. K. Ameta
9. Dr Rahul Garg
10. Dr Anurag Talesra
11. Dr Hitesh Mangal
12. Dr Vinay Goyal [Invitee]

Leave of absence was granted to Dr Vinay Joshi (Past President) Dr Mohan Mantri, Dr Jagveer Singh, Dr K C Gagal, Dr Kuldeep Nathawat, Dr Vijay Beniwal for their personal commitments.

1. The meeting was chaired by Dr Rajesh Goyal (President). He asked the Secretary Dr Rahul Katta to start with the agenda.

2. OBITUARY: Dr Rahul Katta Secretary informed about sad demise of Dr Pawan Kumar Goyal ROSA LM 093. All members paid homage to senior member of society Dr Pawan Kumar Goyal.

3. ROSACON 2021: Progress Report by Organizing Secretary Dr. Ashok Khandaka. Dr Khandaka informed the executive committee members that venue and faculty was finalized, tentative scientific program is ready but due to uncertain situations of corona pandemic it would not be possible to organize physical conference in near future. It was already decided to postpone ROSACON 2021 for few months during EC meeting held in July 2020. After discussions among members it was decided that annual conference must be physical and it is difficult to organise ROSACON 2021 physically in next few months, so it should be rescheduled to 2022 at Jaipur and ROSACON 2022 Bharatpur should be rescheduled to 2023. The same must be put in AGM for approval.

4. MID TERM ROSACON 2021: Secretary Dr Rahul Katta informed to the members that Midterm ROSACON 2021 is scheduled at Bhilwara and Dr. Pramod Sharma is organising Secretary. Dr Anurag Talesera pointed out that if it is not possible to have MIDTERM ROSACON 2021 due to corona pandemic situation, it must be rescheduled to year 2022. Dr Rajesh Goyal proposed that if Bhilwara team shows their reluctance in organising in 2021, team KOTA is ready to organise it in 2021. After discussions house decided that Secretary Dr Rahul Katta will ask organising Secretary Dr Pramod Sharma about confirmation of organising MIDTERM ROSACON 2021 at Bhilwara, proposal of KOTA shall be considered thereafter. Decision would be finalised in AGM.

5. ROSA AGM: Secretary Dr Rahul Katta informed that in last EC meeting it was decided that according to ROSA constitution it is mandatory to have AGM once a year. President Dr Rajesh Goyal informed that change of guard i.e. handing over the charge to President Elect would be done in AGM. He proposed to have AGM on Sunday 10.01.2021, the proposed day of ROSACON 2021, a combined physical and virtual meeting at Jaipur. Executive committee unanimously agreed to have ROSA AGM on 10.01.2021. ROSA orations, fellowships and awards for year 2020 would be deferred for 2021. Best paper award, Best case report award, Best publication in ROSA Voice (Ganpat Rai ji Gold Medal) P.G. quiz (Dr Girija Nath- Leela Sen Gold Medal)would be presented in AGM.

6. REGARDING ISSUE OF DR. SANDEEP ADKE; Secretary Dr Rahul Katta informed the house that Dr. Sandeep Adke has sent an email on 12.10.2020 raising few issues about election of IOA state representative of Rajasthan in year 2017. He wrote that ROSA must take appropriate actions on the issues raised by him. Dr Rahul Katta informed the house that in IOA state representative elections, there is no role of state organisation in nomination and election procedure, only IOA members from Rajasthan are eligible to vote irrespective of ROSA membership.

Secretary Dr Rahul Katta also informed the house that he received a phone call from Dr Sandeep Adke on 15.10.2020, Dr Adke raised same issues and argued that

ROSA has involvement in this issue so ROSA officials must take necessary action. A suitable reply was given by Secretary to him i.e. that ROSA is not involved and responsible for the decisions of the IOA so he must submit his grievances to appropriate authorities of IOA, but Dr Adke threatened that he will expose the ROSA office bearers and take necessary action. Dr Rahul Katta also informed that Dr Sandeep Adke recorded the telephonic conversations without his knowledge and permission. Dr Adke also made this recording public by posting it on various what's app groups and personal chat along with disparaging and intimidatory comments about ROSA & its Secretary.

House agreed that ROSA has no role in IOA state representative elections. All the members of the house strongly condemned the acts of Dr Sandeep Adke. Few members demanded disciplinary action against him as he tried to defame our august association and Secretary. It was unanimously decided by all the members of the house that such kind of acts would not be tolerated in future, in case Dr Adke further alleges ROSA or any of its office bearers, a strong disciplinary and legal action would be initiated against him and his membership of ROSA. All the members of the house suggested and permitted the secretary Dr Rahul Katta that he may initiate suitable action should he feel it necessary including legal notice against Dr Adke for violation of his rights of privacy and confidentiality.

7. CONSTITUTIONAL AMENDMENTS: Dr Saurabh Mathur and Dr Solanki submitted a proposal for amendments in ROSA constitution regarding rights of membership of ROSA for members residing outside the state, introduction of post of Joint Secretary and revision of contribution amount for sponsoring ROSA awards & fellowships. After discussions among the members it was decided to form a three member constitution amendment committee comprising of Dr Arun Vaishy, Dr Jayant Sen & Dr C.K. Ameta. All three members gave their consent for the same. This committee will suggest necessary constitutional amendments, submit them to Executive committee in next meeting. After EC approval these amendments would be circulated among members for suggestions and objections. Finally these would be put in AGM for approval.

7. ROSA ELECTION RESULT: This year Elections were held for the post of President Elect [President 2022]. Dr Arun Vaishy President Elect Election officer informed the house that he has received only one nomination from Dr Vinay Goyal so he has been elected unopposed for the post of President Elect 2021. Official declaration of result would be done in AGM.

8. ROSA ICS & ORTHO ONE FELLOWSHIPS: Dr Saurabh Mathur who is Secretary of ICS informed that after a long perusal ROSA ICS FELLOWSHIPS for two fellows from Rajasthan has been finalised. Each fellow will join the ICS centres of excellence at Coimbatore or Ahmedabad. Travel and stay expenses would be reimbursed by ICS after completion as per rules. Another fellowship

ROSA ORTHO ONE FELLOWSHIP where at present waiting of 6-8 years is there, has been finalised for ROSA members. It would be 1 month fellowship for two fellows from ROSA at ORTHO ONE centre at Coimbatore. Selections of fellows would be done as per the criteria laid by ROSA & ICS during ROSACON. All the members of the house appreciate the hard work of Dr Saurabh Mathur for these fellowships.

With no other matter to discuss, President Dr Rajesh Goyal thanked President Elect and all members for active participation, positive suggestions and contribution for the success of the meeting.

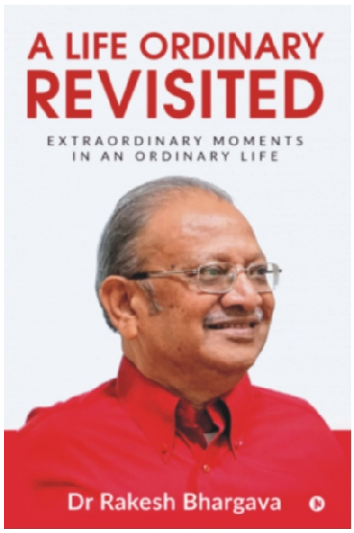
Rahul Katta

Dr Rahul Katta
Secretary ROSA

Medicolegal Tip

We must remember that sharing clinical data - clinical information, external photographs, radiological images and other patient data through which the identity of the patient may be revealed could be considered as a breach of patient-doctor confidentiality if consent is not obtained.

A Life Ordinary Revisited
Dr Rakesh Bhargava



Dr. Rakesh Bhargava is not unknown to any of our ROSA members and is a towering figure in Orthopaedic Surgery in India. He has recently published a book "A *Life Ordinary Revisited"*, which is an autobiography with anecdotes from his life. The book blurb reads 'The story of a non-entity can be interesting and intriguing too. Does anyone ever deign to read the story of a mediocre life?'

Born on 15th September 1950, he did his schooling from St Columba's School, New Delhi. It was his grooming there in the English language and Literature, which included the perusing of English language classics in prose and poetry that honed his writing skills. After passing MBBS from SMS Medical College, Jaipur he completed his MS (Ortho) under the renowned Magsaysay and Padamshri awardees Prof Dr P K Sethi in 1977. During his training he has been an avid debater of Rajasthan University, and contributed articles to the Campus magazines regularly. He was awarded the Johnson and Johnson fellowship of IOA in 1982 and was the First World Orthopaedic Concern Visiting Professor to Hasanuddin University, Ujung Pandang, Indonesia.

If one asked him to describe his book in five words, he feels they would be,

Honest, Frank, Facetious, Retrospective Ruminations.

Though conceived since a long time, the actual impetus and motivation to write came after his episode of coronary attack, during which he had a cardiac arrest. His revival forced him into a pensive state of assessing what he had achieved, and what more he wished and hoped for. There are no funny or poignant case stories of patients, for he did not wish to embroil any patients without their consent and knowledge.

Dr Bhargava says that nothing really inspired him to write an autobiography but the thought that every life lived has a story to tell, be it exceedingly great and inspiring, or casual and nonchalant. What it is to be was never the choice of the life lived, but decided and willed by the Creator and His moving finger. Nevertheless, each life's story has something novel, something exhilarating, something inspirational about it, and hence needs to be told. Whether people read it or not is again inconsequential.

The book has nineteen chapters. Each chapter has some extraordinary moments from that phase of his life.

"To name a few, the chapter on 'My Resurrection' tells about my brush with death. From the tweet of one of my twitter acquaintances I came to know that I was not alone in my experience, but nonetheless it was a unique experience. An extraordinary outcome of a patient I operated upon was largely instrumental in my 'Life in the Present'. In 'My Childhood' and 'My Schooling', I have tried to recount the extraordinary moments which shaped my formative years, and moulded my personality. The chapters which deal with my medical and orthopedic training, namely 'My Training', 'My Days in the Plaster Room', 'My Days in the Operation Theatre', and 'My Mentor' would be, I imagine, of interest and use to the budding orthopods for they dwell on how to learn, what to learn and why", says Dr Bhargava.

"As with most of us, the pandemic has largely been a period of isolation and confinement with the family, with no regrets. Like so many of my friends who have taken to their hobbies as their foci of indulgence, I have been engaged in my passion for reading and writing. I am currently in the throes of reading books like Sadhguru's Death- An inside Story and Inner Engineering, Lin Yu Tang's Importance of Living, The Rubaiyat of Omar Khayyam, and Bertrand Russell's In Praise of Idleness. I see a lot of merit in living life with the tramp as an ideal as professed by Lin YuTang, like Tennyson's Lotus Eaters.

The book 'A Life Ordinary Revisited' is available on Amazon online

Papers published in indexed journals (2020) by ROSA Members

S. No.	AUTHOR	ARTICLE	JOURNAL
1.	Dr. Ravindra Lamoria	Influence of 3 different fixation methods on femoral tunnel widening in ACL reconstructed patients evaluated using CT scan	European Journal of Orthopedic Surgery and Traumatology
2.	Dr. Umesh Meena	Can patients with complex acetabular fractures be operated by combined anterior and posterior approaches in a single anaesthetic sitting ?	Journal of Orthopedic Science
3.	Dr. Kamaldeep Singh	Outcome analysis following arthroscopic augmentation with autologous hamstring graft in partial tear of the anterior cruciate ligament with preservation of an intact bindle: A case series	Current Orthopedic Practice
4.	Dr. Nihit Mantri	Hip displacement in cerebral palsy: the role of surveillance	IJO
5.	Dr. Kuldeep Nahar	Surgical management of pelvic ring injuries	International Journal of Research in Orthopedics
6	Dr. Rajesh Sharma	Comparison between simultaneous versus staged bilateral TKA	International Journal of Research in Orthopedics
7	Dr. Abhishek Saxena	Clinical and radiological distal tibia fracture treated MIPPO	International Journal of Orthopedic Science
8	Dr. Nitish Gehlot	Regional and experiential differences in surgeon preference for the treatment of cervical facet injuries	European Spne Journal
9.	Dr. Nitish Gehlot	Traumatic anterior atlantoaxial rotatory subluxation (Type III) associated with Type III odontoid fracture.	JBJS
10.	Dr. Kuldeep Nahar	Management of unusual metallosis and failed elbow replacement in rheumatoid female	International Journal of Research in Orthopedics
11.	Dr. Kuldeep Nahar	Long term outcome of ipsilateral dislocation of open displaced elbow with close shoulder dislocation	International Journal of Research in Orthopedics
12.	Dr. Kuldeep Nahar	Surgical management of critical femoral bone loss by bone transport over intramedullary nail by monorail system.	International Journal of Research in Orthopedics
13.	Dr. Kuldeep Nahar	Non vascularised large free fibular bone graft in post traumatic and infectious ulnar bone defect	International Journal of Research in Orthopedics

ROSA SECRETARIAT:
Dr. Rahul Katta
Hon. Secretary
E-4, Shastri Nagar, Jaipur - 302016 (Raj.)
Mobile : +91-9829010490 | E-mail : rahulkatta@hotmail.com

Printed by : **Sarawgi Printers**, 9829011974, 0141-4011974