Acta Neurochirurgica (2019) 161:1895–1900
https://doi.org/10.1007/s00701-019-03995-1

HOW I DO IT - SPINE DEGENERATIVE

How I do it? Transforaminal endoscopic decompression of intraspinal facet cyst

Hyeun-Sung Kim[1] · Sagar Bhupendra Sharma[1] · Harshavardhan Dilip Raorane[1]

Received: 8 May 2019 / Accepted: 25 June 2019 / Published online: 2 July 2019

Abstract

Background Transforaminal endoscopic surgery provides equivalent results to open surgery with added advantages of feasibility under local anesthesia, no injury to posterior elements, preservation of the ligamentum flavum, ease of revision surgery, and cost-effectiveness. The technique of transforaminal endoscopic excision of cysts of facet or zygapophyseal joints is scarcely described in literature.

Methods The transforaminal endoscopy is applicable to cyst lying in the extraforaminal, foraminal, and intraspinal regions. The "mobile" outside-in technique combined with osteotomy of the tip of the superior articular process facilitates intraspinal access for complete decompression.

Conclusion Transforaminal endoscopic removal of the facet cyst is a viable alternative to traditional open surgery with added advantages of a minimal access procedure.

Keywords Transforaminal endoscopic spine surgery · Synovial cyst · Facet cyst · Ganglion cyst · Instability · Minimally invasive spine · Spondylolisthesis · Spinal stenosis · Degenerative spine

Relevant anatomy

The knowledge of Kambin's triangle forms the foundation for all transforaminal procedures [6]. Kambin's triangle is a window of entry into the lumbar spinal canal. It is dorsolateral to the spinal canal and bounded medially by the traversing nerve root and the superior articular process; the base is formed by the superior endplate of caudal vertebrae and the hypotenuse is formed by the exiting nerve root (Fig. 1).

Description of the technique

Analysis of the transforaminal corridor Analysis of the transforaminal route on preoperative MRI and CT scan is the essence of the procedure. Important considerations are given to the size of the foramen, the location of the exiting nerve root, presence of root anomalies (like conjoined root, low-lying root, and furcal nerves), the height of iliac crest (in cases of L5S1 levels) and the location of the retroperitoneal contents, and the safety triangle formed by the back muscles [1].

Positioning The patient is positioned prone on a Wilson frame on a radiolucent table. The procedure is done under local anesthesia.

Skin marking Under C-arm guidance, mark the midline, the iliac crest, and the rib cage. Next, mark the transverse disc line in AP view. Then, in lateral view, draw a line parallel to the disc space. The intersection of the first and the

Hyeun-Sung Kim and Sagar Bhupendra Sharma contributed equally to this work.

This article is part of the Topical Collection on *Spine degenerative*

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s00701-019-03995-1) contains supplementary material, which is available to authorized users.

✉ Hyeun-Sung Kim
neurospinekim@gmail.com

Sagar Bhupendra Sharma
dr.sagarsharma2110@gmail.com

Harshavardhan Dilip Raorane
dr.harsh35@gmail.com

[1] Department of Neurosurgery, Nanoori Gangnam Hospital, 731, Eonju-ro, Gangnam-gu, Seoul 06048, Republic of Korea

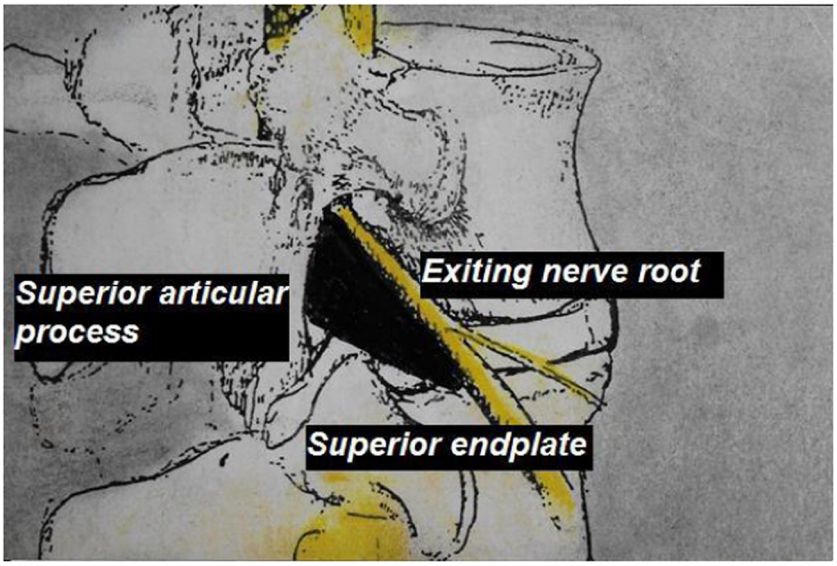

Fig. 1 Schematic representation of the Kambin's triangle

second line is the entry point. Before making the skin incision, it is essential to palpate the lateral border the back muscles and avoid entry lateral to it as it may cause abdominal organ injury.

Discography Under C-arm guidance, an 18G long spinal needle is introduced into the disc space. The tip of the spinal needle should lie in the lower half of the foramen and near the posterior vertebral border in lateral view

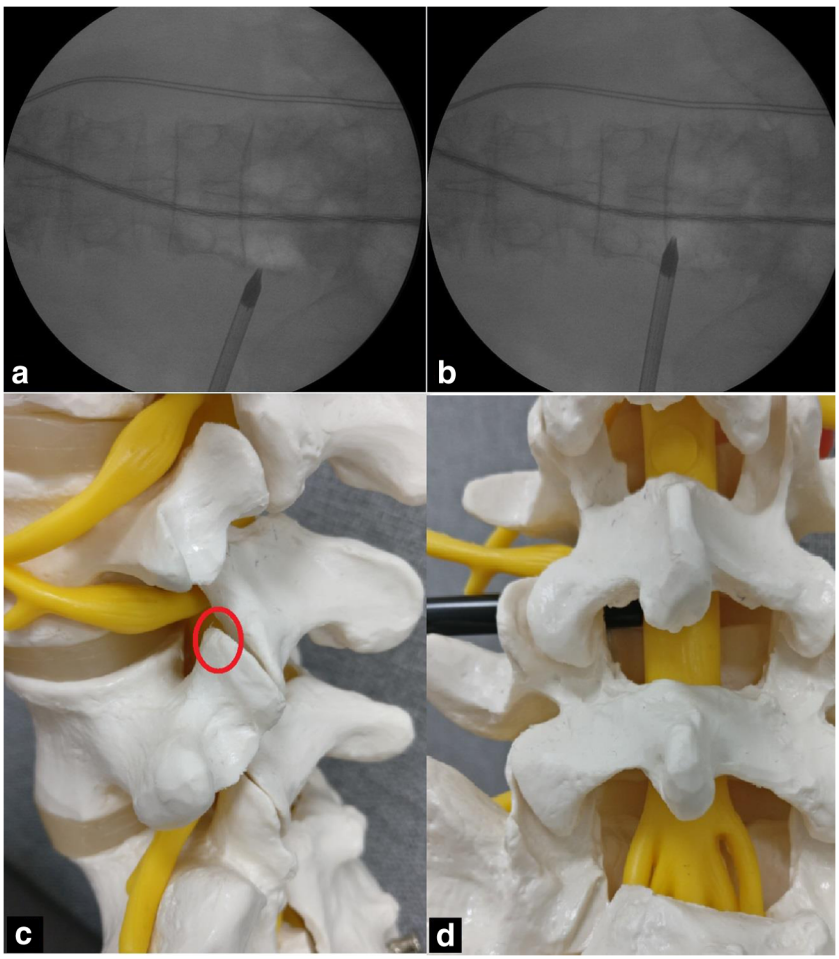

Fig. 2 **a** Initial positioning of the working channel before facetectomy. **b** Repositioned cannula into the foramen after osteotomy. **c** Area of facetectomy to access the intraspinal portion. **d** Demonstration of entry into the spinal canal after osteotomy

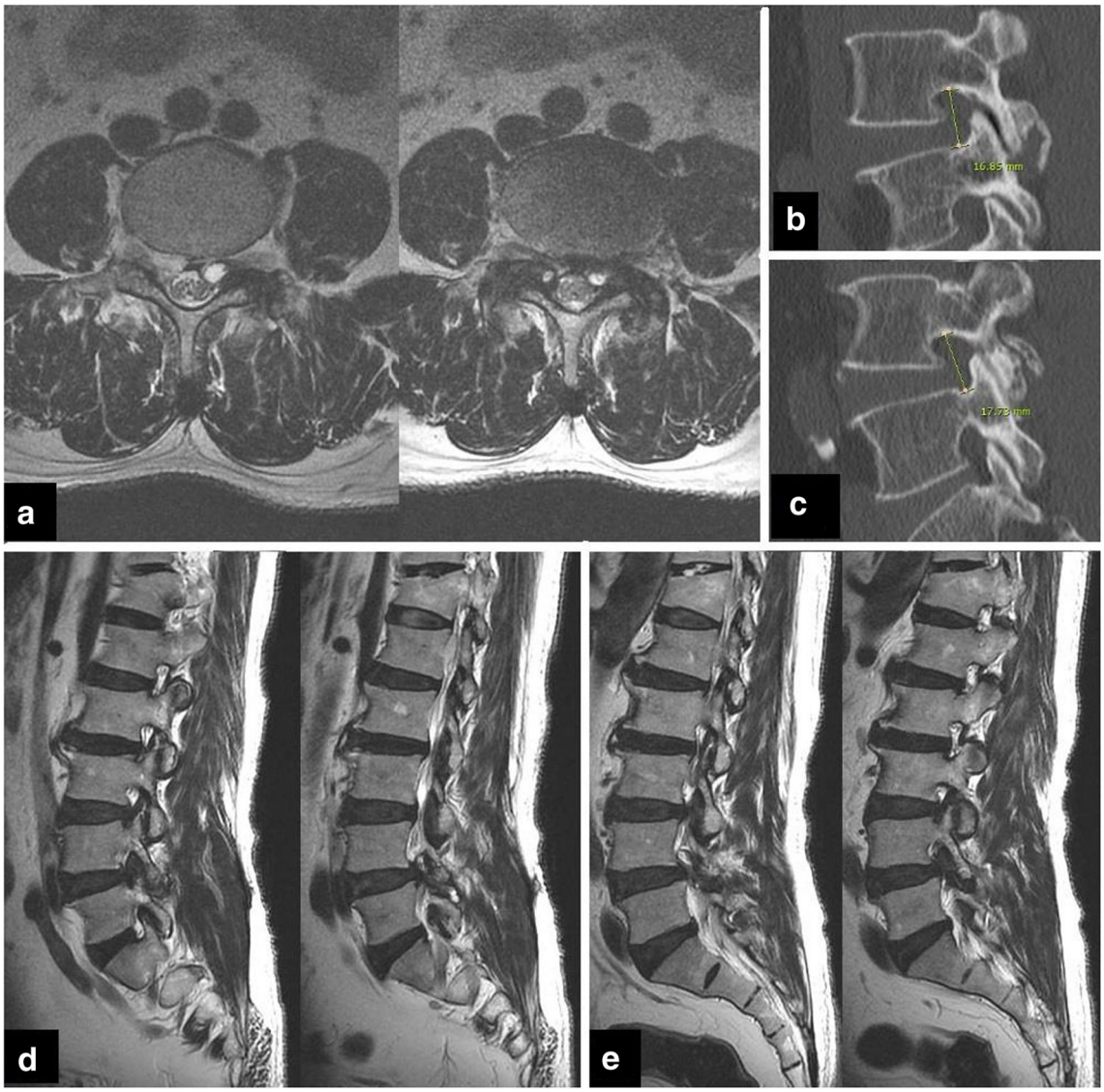

Fig. 3 **a** Preoperative axial MRI showing bilateral facet cyst at the L4L5 region. **b**, **c** CT scan showing the dimensions of neural foramen on the left and right sides, respectively, are big enough for endoscopic access with no bony hindrance. **d** Foraminal stenosis and cyst on the left side. **e** Foraminal stenosis and cyst on right side

when the needle reaches the medial pedicular line in AP view. Discography is done with indigo carmine dye to delineate the disc intraoperatively.

Working channel placement The spinal needle is replaced with a guide wire. Next an obturator is inserted and then the working channel is inserted. The working channel is docked at the outer margin of the intervertebral foramen. We use the mobile "outside-in" technique as it allows free movement of the working channel and access to epidural space [7].

Osteotomy of the superior articular process The success of the procedure relies on the successful creation of the transfacetal access. We use a 3.5-mm diamond drill for the bone work. Drilling begins in the lower part of the foramen by removing the ventral portion of the superior articular process (SAP). This allows the endoscope to be reintroduced at a more horizontal angle for easy access to the epidural space. Moving cranially, the soft tissue and foraminal ligaments are removed from the foramen to reach the tip of the SAP. The tip of the SAP is removed using the drill. Removal of the tip exposes the exiting nerve root. The exiting root is protected with the bevel end of the working cannula and the ventral-lateral portion of the inferior articular process is drilled out. The removal of SAP allows access into the epidural space through a more horizontal pathway (Fig. 2).

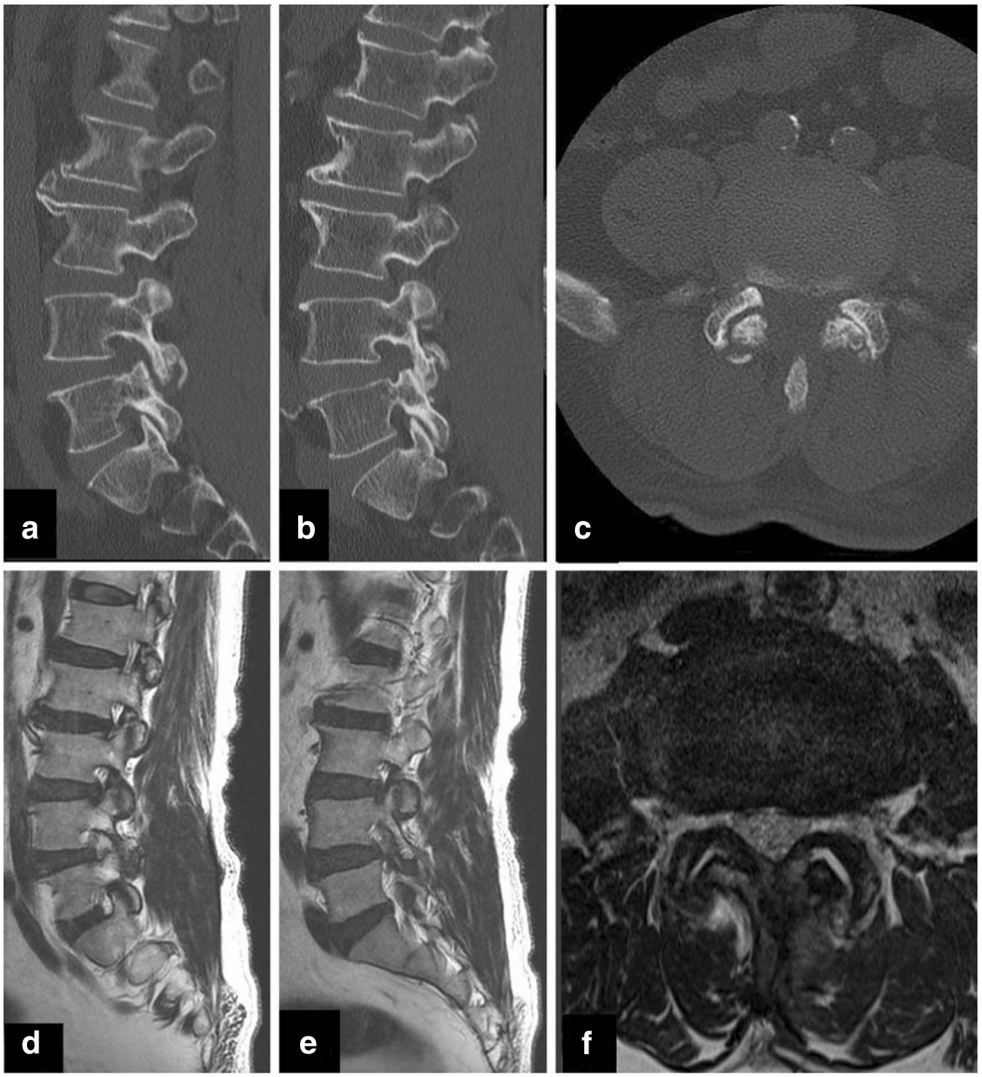

Fig. 4 **a**, **b** Post-operative CT scan showing osteotomized tip of SAP on left and right side, respectively. **c** Complete preservation of facet integrity on post-operative CT scan. **d**, **e** Post-operative MRI showing complete foraminal decompression on left and right sides, respectively. **f** Axial view showing complete removal of cysts on both sides

Cyst removal Immediately adjacent to the facet lies the ligamentum flavum which is removed using forceps and punches. This exposes the wall of the cyst. It removed piecemeal using disc forceps and Kerrison punches. The procedure is demonstrated in Video I. A case example of bilateral facet cyst operated by bilateral transforaminal endoscopy is demonstrated in Figs. 3, 4, and 5.

Indications

Symptomatic facet cysts located in the extraforaminal, foraminal, and intracanalicular areas.

Limitations

Experience with transforaminal endoscopic discectomy is necessary to carry out this procedure. In some cases, such as low-lying nerve root or a vascular anomaly or severe foraminal stenosis, an interlaminar procedure will be a better choice. Caution is warranted in cases of facet cysts associated with gross instability as these cases have a high chance of recurrence [9].

How to avoid complications

1. Thorough analysis of the foraminal anatomy on preoperative MRI and CT scan
2. Fluoroscopic visualization during spinal needle and working channel placement
3. Meticulous dissection in the foraminal area using radiofrequency probe and adequate protection of the exiting nerve root
4. A dural tear can be disastrous and care should be taken to avoid it

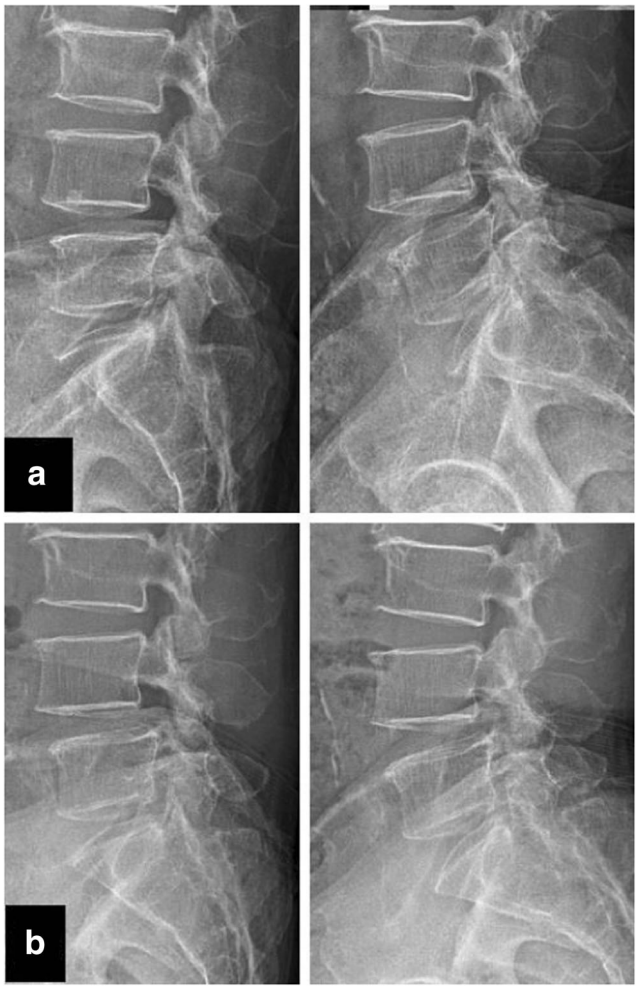

Fig. 5 **a** Preoperative flexion and extension X-rays. **b** Post-operative flexion and extension X-rays. Note that there is no change in disc height and degree of listhesis and no increase in angular motion post-operatively. Thus, stability is preserved

Specific perioperative considerations (pre- and postop workup, instructions for the postop care)

The patient is mobilized on the next day as per the pain tolerance. Physiotherapy in the form of static quadriceps exercises, ankle pumps are started first followed by mobilization out of bed with a brace.

Specific information to give to the patient about surgery and potential risks

The need for a revision decompression in cases of recurrence and the possibility of future fusion surgery in cases of gross instability should be explained to the patient. Dural tear and exiting root dysesthesia/injury are potential complications that should also be explained.

Key points

i. Transforaminal removal of the cysts is an excellent alternative to traditional open surgery with minimal complications [3].
ii. Careful evaluation of the neuroforaminal anatomy is essential for case selection.
iii. C-arm visualization during needle insertion and working channel placement is essential to avoid iatrogenic injury to neural and retroperitoneal contents.
iv. The mobile outside-in technique provides the competence to access the spinal canal at a more horizontal angle and free movement of the endoscope to access various locations [7].
v. The exiting nerve root should be safeguarded during the procedure.
vi. Osteotomy of the SAP is the key to successful access to the pathology inside the spinal canal.
vii. The radiofrequency probe is an essential tool for palpation, dissection, and bleeding control,
viii. Dural tear and exiting root injury are ghastly complications. Avoid at all costs.
ix. The recurrence rates with facet cysts have been reported to be in the range of 2–3% [8].
x. Transforaminal endoscopy causes minimal tissue trauma, does not injure the posterior elements of the spine, preserves the back muscles, is feasible under local anesthesia, does not require resection of the ligamentum flavum, does not causes epidural scarring, and is cost-effective [4, 5]. This makes revision surgery easy [2].

Conclusion

In properly selected cases, transforaminal endoscopy can be an effective solution for removal of the facet cysts not only in the extraforaminal and foraminal regions but also for intraspinal cysts.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (name of institute/committee)

and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

References

1. Ahn Y (2012) Transforaminal percutaneous endoscopic lumbar discectomy: technical tips to prevent complications. Expert Rev Med Devices 9(4):361–366. https://doi.org/10.1586/erd.12.23
2. Ahn Y, Lee S-H, Park W-M, Lee H-Y, Shin S-W, Kang H-Y (2004) Percutaneous endoscopic lumbar discectomy for recurrent disc herniation: surgical technique, outcome, and prognostic factors of 43 consecutive cases. Spine. 29(16):E326–E332
3. Ahn SS, Kim SH, Kim DW, Lee BH (2016) Comparison of outcomes of percutaneous endoscopic lumbar discectomy and open lumbar microdiscectomy for young adults: a retrospective matched cohort study. World Neurosurg 86(2016):250–258. https://doi.org/10.1016/j.wneu.2015.09.047
4. Choi K-C, Shim H-K, Kim J-S, Cha KH, Lee DC, Kim ER, Kim MJ, Park C-K (2019) Cost-effectiveness of microdiscectomy versus endoscopic discectomy for lumbar disc herniation. Spine J. https://doi.org/10.1016/j.spinee.2019.02.003
5. James A, Laufer I, Parikh K, Nagineni VV, Saleh TO, Härtl R (2012) Lumbar juxtafacet cyst resection: the facet sparing contralateral minimally invasive surgical approach. J Spinal Disord Tech 25(2):13–17. https://doi.org/10.1097/BSD.0b013e31822ac4e5
6. Kambin P, Brager MD (1987) Percutaneous posterolateral discectomy. Anatomy and mechanism. Clin Orthop Relat Res 223:145–154
7. Kim HS, Adsul N, Kapoor A, Choi SH, Kim JH, Kim KJ, Bang JS, Yang KH, Han S, Lim JH, Jang J-S, Jang I-T, Oh S-H (2018) A mobile outside-in technique of transforaminal lumbar endoscopy for lumbar disc herniations. J Vis Exp 138. https://doi.org/10.3791/57999
8. Komp M, Hahn P, Ozdemir S, Merk H, Kasch R, Godolias G, Ruetten S (2014) Operation of lumbar zygoapophyseal joint cysts using a full-endoscopic interlaminar and transforaminal approach. Surg Innov 21(6):605–614. https://doi.org/10.1177/1553350614525668
9. Sabo RA, Tracy PT, Weinger JM (2009) A series of 60 juxtafacet cysts: clinical presentation, the role of spinal instability, and treatment. J Neurosurg 85(4):560–565. https://doi.org/10.3171/jns.1996.85.4.0560