CASE REPORT

Three-level thoracolumbar vertebroplasty with screw-rod-wire construct in Kummels disease patient with neurological deficit after low impact injury

Farid Yudoyono1,2
Ivanmorl Ruspanah2
Hasan Baraqbah1,2

1Neurospine and Pain Center, Santosa Hospital Bandung Kopo, Bandung, Jawa Barat, Indonesia
2Department of Neurosurgery, Hasan Sadikin Hospital, Bandung, Jawa Barat, Indonesia

Abstract

Kummel disease (KD) or avascular necrosis is characterized by osteonecrosis of the vertebrae which often occurs in the thoracic area with compression fractures, intravertebral vacuum clefts, change in posture to kyphotic within months to years after minor trauma. KD is a rare disease but its incidence continues to increase with age and osteoporosis increases. Fixation of unstable thoracic fractures using the transpedicular pedicle screw (TPS) has been accepted as a procedure performed by experts. However, TPS itself has several complications combination with vertebroplasty and wire can reduce the incidence of the misplaced screw.

Keywords: Kummel disease, Osteoporosis, Transpedicular screw, Vertebroplasty

Introduction

In 1895, a German surgeon named Kummel reported for the first time 6 patients with minimal post-traumatic spinal compression fractures which later is named after him as Kummel disease (KD). KD is characterized by osteonecrosis of the vertebrae which often occurs in the thoracic area with compression fractures, intravertebral vacuum clefts, The incidence of Kummel disease increases every year with increasing age and the presence of osteoporosis.1,2

Osteoporosis is the leading cause of non-traumatic vertebral compression fractures and accounts for 750,000 vertebral fractures per year in the USA.3 Compression fractures caused by osteoporosis are often preceded by minimal trauma to previous history, 30% of compression fractures caused by osteoporosis cannot be treated with conservative therapy and the presence of KD can accelerate the deterioration of the vacuum cleft.4 Recent studies on patients reveal that the osteolysis incidence among patients with KD is faster than the process of bone callus formation.5

Vertebroplasty is a minimally invasive procedure to reduce and heal fractured bones and reduce pain. The procedure uses a guide of fluoroscopy by inserting bone cement into the
vertebral body via transpedicular access. As age increases in the population, bone cement vertebroplasty has also increased in terms of its use as an alternative procedure.\textsuperscript{3,6-10}

The procedure was carried out with sterility techniques. After a linear skin incision and unilateral hemilaminotomy decompression on severe symptoms-side was performed. Unipediculate vertebroplasty technique was performed according to operator discretion considering the high risk cement leakage during augmentation. Jamshidi needle advance until the anterior third of the vertebrae and was followed by injection of a 3 cc bone cement mixture with adequate mixing to prevent leaks outside the vertebrae, then was continued with the installation of a pedicle screw with rod of Th 12 screw was tightened first then L2 screws compressed with the help of the compressor force applied using both L2 screw as pivot points and using wire put into spinous process Th12, L1 and L2.\textsuperscript{9,10,11}

**Case report**

A 67-years-old woman experienced persistent and severe thoracolumbar back pain and bilateral leg weakness after slipped at home. She was unable to perform her daily activities with moderate pain for 6-months then developed severe pain in the same region. The pain was gradually progressive, localized, associated with lower leg weakness or numbness. She visited a local clinic where she was advised conservative management with Taylor’s Brace, and analgesics. The pain worsened and she developed difficulty in walking. She came to our center 8-months after the injury with severe pain and difficulty in walking. There is no history of any long term steroid intake. On examination, there was significant tenderness in the thoracolumbar junction with local kyphotic deformity.

Preoperative physical examination thoracolumbar back pain visual analog scale (VAS) 8/10 and evaluation of her physical condition excluded any surgical contraindications. The neurological examination revealed motoric strength 3/5 for the right leg and 4/5 on left leg and increase physiological reflex and pathological reflexes with the Oswestry disability index (ODI) was 29/50. Radiological evaluation of thoracolumbar plain X-ray show burst fracture two-level vertebrae of L1-2. Magnetic resonance imaging (MRI) evaluation showed intravertebral cleft on L1 and L2. The patient and her family provided written informed consent after being advised of the possible benefits and risks of surgery. On MRI, Kummell’s disease demonstrates low T1-weighted and high T2-weighted signal (fluid signal) associated with the vertebral cleft, producing the characteristic “double-line sign” (Figure 1). The bone densitometry showed T-score -2.5 respectively.

Hematological examination and biochemical evaluation did not reveal any significant findings suggestive of infection or malignancy. As the patient did not respond to conservative management and the pain was so severe that it was affecting her daily activities; we performed surgery (Figure 2).

![Figure 1. MRI T2WI presence of a band-like radiolucency in a collapsed vertebral body, referred to as an intraosseous vacuum cleft. On T2-weighted images, the cleft may be hyper intensive that occupied by the fluid](image)

![Figure 2. A. Lateral image view after surgery of vertebroplasty (VP) with the screw-rod-wire construct. B. Anteroposterior view](image)

She had significant pain relief postoperatively and was mobilized with Taylor’s brace. The patient was discharged on the fifth postoperative day with pain improvement. She received forsoban 3 mg every 3 monthly as anti-osteoporotic treatment. Follow-up at 6-12 months showed improved motor functions of both lower limbs and the
visual analog scale score for the thoracolumbar region improved from eight preoperatively to two postoperatively. During the outpatient department visit, the VAS score, ODI score, and kyphotic angle were improved until 12-months after surgery, (Figure 3). Infection, Implant failure and subsequent new fracture on adjacent side are post operative risk for this patient.

![Figure 3. The local kyphotic angle on lateral image x-ray after surgery](image)

**Discussion**

The high prevalence of osteoporosis with increasing age in the population causes many health problems. Multiple vertebral compression fractures occur in about 6% of cases. It is often accompanied by previous scoliosis or scoliosis that occurs after a vertebral fracture. These characteristics occur in old age, women with severe degrees of osteoporosis or with various comorbidities such as prolonged use of steroids, diabetes mellitus, and inability to take osteoporosis drugs.

KD should have 3 characteristics: 1) asymptomatic period after back pain related to low impact trauma; 2) appearance of kyphotic posture without any other trauma; and 3) recurrence of back pain weeks to months after the initial trauma additionally a classic finding on neuroimaging is the presence of an intravertebral vacuum cleft on anteroposterior view, on CT or MRI.

Vertebroplasty (VP) provides an alternative if conservative therapy does not give improvement. This procedure is minimally invasive and can improve the quality of life of the patient and improve kyphotic posture. In accordance with previous studies, patients who underwent vertebroplasty experienced an improvement in the kyphotic angle. In this case, we performed VP by unipediculate technique after the bone cement filled the vertebra we inserted a pedicle screw with rod fixation. This was similar to previous studies in terms of the effectiveness of the unipediculate technique similar to bipediculate. However, the pedicle screw itself has several complications, especially in the thoracic bone which has a small pedicle, combination with vertebroplasty can reduce the incidence of misplaced screw and kyphosis after surgery.

In this case, we adopted interspinous wiring as an adjunct to screw-rod to strengthen the construct based on the previous review by Chandran et al. and Ghori et al., interspinous wirings could restore the posterior tension band and this technique also offers a stable fixation. Based on previous studies the authors did not found any long-term complications of wire-like fatigue and fractures in the thoracolumbar region during follow-up.

Upper and lower vertebrae are selected segment in the instrumentation because this is a potential way to balance the amount of cement and the stability of the surgical segment. Regarding leakage of bone cement into the disc is not common during vertebroplasty but it can happen; and often, it does not have significant complaints after the procedure. The incidence of leakage is 6% - 52% without symptoms. The most severe symptoms that arise due to this leak are pulmonary and brain embolism, perforation of the heart, and death. Blood vessels disorders in the vertebrae, low cement viscosity, high energy pressure at injection, although it is not common it can cause asymptomatic pulmonary embolism to occur in 4.6% of all patients.

Our case is unique because multiple burst fractures and neurological deficits occurred after low impact injury. The posterior structure was preserved with hemilaminotomy and unipediculate VP with a screw-rod-wire construct performed to avoid misplaced screw and improved local kyphotic after surgery. No complication related to procedure and implant during follow up. Knowledge of the characteristics of KD can provide extra care and reduce potentially unnecessary procedures. The diagnosis of Kummel disease can reliably be made based on classic imaging findings.

**Conclusion**

Multilevel VP in thoracolumbar is effective and safe in treating burst fractures in KD patients. VP which is accompanied by a screw-rod-wire construct has a significant effect in reducing pain, improving disability and kyphotic posture.

**Acknowledgement**

There is no potential conflict of interest relevant to this article reported. No specific grant was provided for this article. All authors...
took part in the design of the study, literature review, and writing of the manuscript.

References

1. Nickell LT, Schucany WG, Opatowsky MJ. Kummell disease. Proc (Bayl Univ Med Cent). 2013;26(3):300–1. DOI: 10.1080/08898280.2013.1192899

2. Xiong XM, Sun YL, Song SM, et al. Efficacy of unilateral transverse process-pedicile and bilateral puncture techniques in percutaneous kyphoplasty for Kummell disease. Experimental and Therapeutic Medicine. 2019;18:3615-21. DOI: 10.3892/etm.2019.7980

3. Tan E, Wang T, Pelletier MH, et al. Effects of cement augmentation on the mechanical stability of multilevel spine after vertebral compression fracture. J Spine Surg. 2016;2(2):111-21. DOI: 10.21037/jss.2016.06.05

4. Nakamae T, Fujimoto Y, Yamada K, et al. Percutaneous vertebroplasty for osteoporotic vertebral compression fracture with intravertebral cleft associated with delayed neurologic deficit. Eur Spine J. 2013;22(7):1624–32. DOI: 10.1007/s00586-013-2686-8

5. Park SJ, Kim HS, Lee SK, et al. Bone cement-augmented percutaneous short segment fixation: an effective treatment for Kummell’s disease?. J Korean Neurosurg Soc. 2015;58(1):54-9. DOI: 10.3340/jkns.2015.58.1.54

6. Sabo A, Hatgis J, Granville M, et al. Multilevel contiguous osteoporotic lumbar compression fractures: the relationship of scoliosis to the development of cascading fractures. Cureus. 2017;9(12):2-15. DOI: 10.3340/jkns.2015.58.1.54

7. Wang H, Sribastav SS, Ye F, et al. Comparison of percutaneous vertebroplasty and balloon kyphoplasty for the treatment of single level vertebral compression fractures: a meta-analysis of the literature. Pain Physician. 2015;18(3):209-22. Available from: https://www.painphysicianjournal.com/linkout?issn=&vol=18&page=209

8. Ye LQ, Liang D, Jiang XB, et al. Risk factors for the occurrence of insufficient cement distribution in the fractured area after percutaneous vertebroplasty in osteoporotic vertebral compression fractures. Pain Physician. 2018;21(1):E33-E42. Available from: https://www.painphysicianjournal.com/linkout?issn=&vol=21&page=E33

9. Zidan I, Fayed AA, Elwany A. Multilevel percutaneous vertebroplasty (more than three levels) in the management of osteoprototic fractures. J Korean Neurosurg Soc. 2018;61(6):700-6. DOI: 10.3340/jkns.2017.0253

10. Shi G, Feng F, Hao C, et al. A case of multilevel percutaneous vertebroplasty for vertebral metastases resulting in temporary paraparesis. J Int Med Res. 2019;1-5. DOI: 10.1177/0300060519835084

11. Knavel EM, Rad AE, Thielen KR, et al. Clinical outcomes with hemivertebre filling during percutaneous vertebroplasty. Am J Neuroradiol. 2009;30(3):496-9. DOI: 10.3174/ajnr.A1416

12. Pesenti S, Blondel B, Peltier E, et al. Percutaneous cement-augmented screws fixation in the fractures of the aging spine: is it the solution?. BioMed Research International. 2014;2014:1-5. DOI: 10.1155/2014/610675

13. Saracen A, Kotwica Z. Complications of percutaneous vertebroplasty an analysis of 1100 procedures performed in 616 patients. Medicine. 2016;95(24):1-5. DOI: 10.1097/MD.0000000000003850

14. Chandran RS, Sharmad M S, Vipin V, et al. Comparative study of interspinous wiring and lateral mass fixation in conjunction with anterior fusion in the treatment of sub axial cervical spine trauma. Journal of Medical Science and Clinical research. 2017;5(3):18724-30. DOI: 10.18535/jmscr/v5i3.73

15. Ghorri A, Le H V, Makanji H, et al. Posterior fixation techniques in the subaxial cervical spine. Cureus. 2015;7(10):e338. DOI 10.7759/cureus.338

16. Guo HZ, Guo DQ, Tang YC, et al. Selective cement augmentation of cranial and caudal pedicle screws provides comparable stability to augmentation on all segments in the osteoporotic spine: a finite element analysis. Ann Transl Med. 2020;8(21):1-15. DOI: 10.21037/atm-20-2246

17. Matouk CC, Krings T, Ter Brugge KG, et al. Cement embolization of a segmental artery after percutaneous vertebroplasty: a potentially catastrophic vascular complication. Interventional Neuroradiology. 2012;18(3):358-62. DOI: 10.1177/15910991201800318