The Journal of Turkish Spinal Surgery

Volume: 26 • Number: 1 • January 2015
pp. 13-17

ORIGINAL ARTICLE / *ORJİNAL MAKALE*

EFFECTIVENESS OF VERTEBROPLASTY AND KYPHOPLASTY IN OSTEOPOROTIC VERTEBRAL BODY COMPRESSION FRACTURES: A COMPERATIVE STUDY

OSTEOPOROTİK OMURGA CİSİM KIRIKLARINDA VERTEBROPLASTİ VE KİFOPLASTİNİN ETKİNLİĞİ: KARŞILAŞTIRMALI BİR ÇALIŞMA

Evren YÜVRÜK[1], Tarkan ÇALIŞANELLER[1], Mehmet Reşid ÖNEN[1], Sait NADERİ[2]

SUMMARY

Purpose: It is the comparison of effectiveness of vertebroplasty and kyphoplasty for pain management and reduction of vertebral height loss in osteoporotic vertebral body fractures.
Material and Methods: In our clinic since 2008, 75 vertebral fortification surgeries were performed for OVBF. 38 patients whose pre-operative and post-operative data and patients themselves were accessible included in the study.
Results : Preoperative VAS scores of vertebroplasty (VP) patients were 7.61 ± 0.49 and postoperatively it was 3.33 ± 0.57 ($p<0.005$). Kyphoplasty (KP) patients preoperative score was 7.23±0.56 and 24 h postoperative was 3.41 ± 1.06 ($p < 0.005$). VP patients preoperative vertebral body (a) anterior, (b) midline and (c) posterior heights were 17.54 ± 5.35 mm, 13.07±3.99 mm, 20.35 ± 4.12 mm respectively and postoperative 18.69 ± 5.35 mm, 14.39 ± 3.90 mm, 21.35 ± 4.40 mm respectively ($p<0.05$). KP patients preoperative vertebral body (a) anterior, (b) midline and (c) posterior heights were 16.46 ± 6.97 mm, 11.78 ± 5.15 mm, 18.91 ± 3.99 mm respectively and postoperative 17.99 ± 6.29 mm, 13.38 ± 5.09 mm, 20.32 ± 3.71 respectively ($p<0.05$).
Conclusion: For treatment of pain and maintenance of vertebral height in osteoporotic vertebral fractures efficiency of VP and KP were found to be similar.

Keywords: Kyphoplasty, osteoporotic vertebral body fracture, vertebroplasty

Level of evidence: Retrospective clinical study, Level III

ÖZET

Amaç: Osteoporotik omurga cisim kırığına bağlı ağrı ve omurga yüksekliği kaybının giderilmesinde vertebroplasti ve kifoplastinin etkinliğinin karşılaştırılmasıdır.
Materyal ve Metot: Kliniğimizde 2008'den bu yana 75 olguda VKOF nedeniyle omurga güçlendirme uygulaması yapılmıştır. Preop ve postoperatif tüm verilerine ve hastanın kendisine ulaşılabilen 38 hasta çalışmaya dahil edilmiştir.
Sonuçlar: VP uygulanan hastaların preoperatif VAS skoru 7.61 ± 0.49 ve postoperatif - 24 saat VAS skoru 3.33 ± 0.57 ($p<0.005$) olarak, KP uygulanan hastaların preoperatif VAS skoru 7.23±0.56 ve postoperatif - 24 saat VAS skoru 3.41 ± 1.06 ($p < 0.005$) olarak bulundu.
VP uygulanan hastaların omurga cisminin preoperatif orta hat ön (a), orta (b) ve arka (c) yükseklikleri sırası ile 17.54 ± 5.35 mm, 13.07±3.99 mm, 20.35 ± 4.12 mm; postoperatif orta hat ön (a), orta (b) ve arka (c) yükseklikleri sırası ile 18.69 ± 5.35 mm, 14.39 ± 3.90 mm, 21.35 ± 4.40 mm olarak ölçüldü ($p<0.05$). KP uygulanan hastaların omurga cisminin preoperatif orta hat ön (a), orta (b) ve arka (c) yükseklikleri sırası ile 16.46 ± 6.97 mm, 11.78 ± 5.15 mm, 18.91 ± 3.99 mm; postoperatif orta hat ön (a), orta (b) ve arka (c) yükseklikleri sırası ile 17.99 ± 6.29 mm, 13.38 ± 5.09 mm, 20.32 ± 3.71 olarak ölçüldü ($p<0.05$).
Sonuç: Osteoporotik omurga cisim kırığına bağlı ağrının giderilmesi ve omurga yüksekliğinin sağlanmasında VP ve KP benzer etkinlikte bulunmuştur.

Anahtar Sözcükler: Kifoplasti, osteoporotik omurga cismi kırığı, Vertebroplasti,

Kanıt Düzeyi: Retrospektif klinik çalışma, Düzey III

INTRODUCTION:

Osteoporotic vertebral body fractures (OVBF) may lead to pain in the fracture area, loss in vertebral height, kyphosis deformity and instability. Since Ross *et al*. (15) published the risk of another fracture in a patient with osteoporotic fracture is increased 5 times, physicians specialized on spinal surgery has developed many treatments and methods for OVBF.

In last quarter of the century, with the minimally invasive surgery paradigm, in this group of disease where the pain is the major finding, vertebroplasty (VP) and kyphoplasty (KP) became more popular. Vertebral fortification for osteolytic vertebral body tumors is another indication of VP and KP (3,12). There are many studies comparing VP and KP on pain. In those studies many parameters like pain management, restoration of the vertebral body height, cement leakage and new fracture at the adjacent level were studied (5,7,9,11,16). Unlike VP, in KP application, it was reported that additional to the treatment of the fractured bone, kyphosis angle is straightened parallel to the increase in the body height (1), and less amount of cement was used (5).

[1] Surgeon of the Neurosurgery, Department of Neurosurgery, Umraniye Teaching and Research Hospital, İstanbul.
[2] Prof. Dr., Surgeon of the Neurosurgery, Department of Neurosurgery, Umraniye Teaching and Research Hospital, İstanbul.

Aim of this study is to compare effectiveness of VP and KP for pain and vertebral body height loss removal in osteoporotic vertebral fractures.

MATERIALS AND METHODS:

In our clinic since 2008, 75 vertebral fortification surgeries were performed for OVBF. 38 patients whose pre-operative and post-operative data and patients themselves were accessible included in the study. Patients gone through vertebral fortification surgery for osteolytic vertebral body tumors were not included in this study.

For VP, for every level total of 4 cc polymethylmetacrylate (PMMA) injection bi-pedicular and for KP following balloon expansion to 1.5 cc, total of 5 cc PMMA injection bi-pedicular performed.

For all patients preoperative and postoperative 24 h VAS scores and improvement in the pain were studied. Pain improvement was grouped into three as full recovery (>90), partial recovery (70-90%) and minimal recovery (<70%).

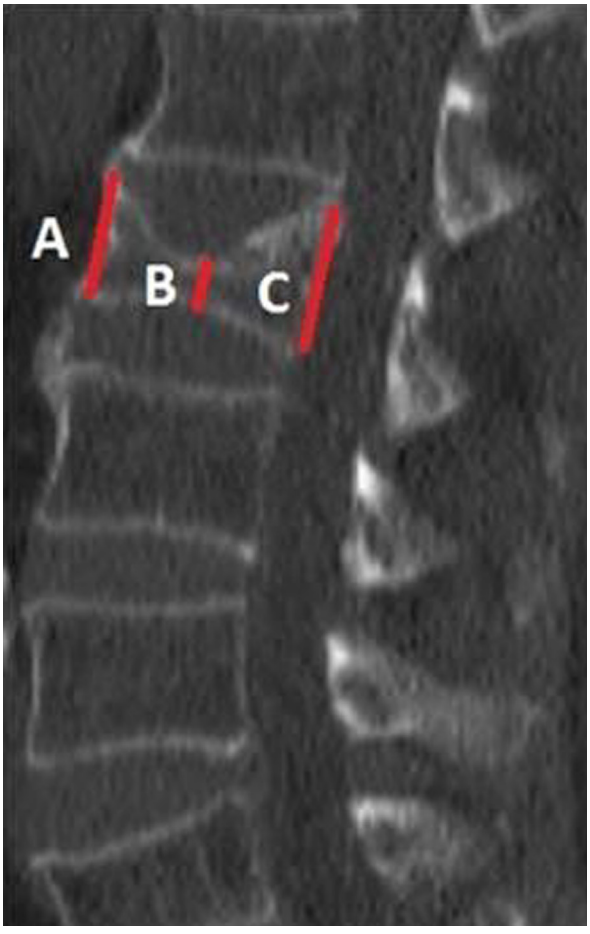


Figure-1. Exemplary case images (Preoperative (a) anterior, (b) midline and (c) posterior heights, sagittal CT)

Also operated vertebral body (a) anterior, (b) midline and (c) posterior heights of the patients preoperatively and postoperatively were compared from sagittal CT scans (Figure-1).

Cement leakage, neurological complications and late fracture at the adjacent level were also studied.

RESULTS:

38 patients treated in our clinic for OVKB (25 female, 13 male) were included in this study. In 21 patients, total of 25 levels were treated with VP and in 17 patients, total of 23 levels were treated with KP. Average age of the VP patients were 66.9 ± 8.4 (45-84 years) and KP patients were 63.5 ± 13.02 (32-81 years) ($p > 0.05$).

Preoperative VAS scores of vertebroplasty (VP) patients were 7.61 ± 0.49 and postoperatively it was 3.33 ± 0.57 ($p<0.005$). Kyphoplasty (KP) patients preoperative score was 7.23±0.56 and 24 h postoperative was 3.41 ± 1.06 ($p < 0.005$) (Table-1). When VP and KP patients' preoperative and postoperative VAS scores were compared no significant difference was found ($p > 0.05$).

Table-1. Preoperative and postoperative VAS scores before and after VP and KP

Procedure	Preoperative	Postoperative P
VP	7.61±0.49	3.33±0.57 0.000
KP	7.23±0.56	3.41±1.06 0,000

61.9% of the VP patients and 52.9% of the KP patients pain was totally resolved (>90%). Similarly, 38.1% of the VP patients and 47.1% of the KP patients pain was totally resolved (>90%). For both procedures none of the patients had unchanging pain (Table-2).

VP patients preoperative vertebral body (a) anterior, (b) midline and (c) posterior heights were 17.54 ± 5.35 mm, 13.07±3.99 mm, 20.35 ± 4.12 mm respectively and postoperative 18.69 ± 5.35 mm, 14.39 ± 3.90 mm, 21.35 ± 4.40 mm respectively (Table-2).

Tablo-2. Rates of pain relief succeeding kyphoplasty and vertebroplasty application.

Pain relief rate	Vertebroplasty	Kyphoplasty
Complete (>90%)	13 (61,9%)	9 (52,9%) (9)
Incomplete (70-90%)	8 (38,1%)	8 (47,1%)
No pain relief (<70%)	0 (0)	0 (0)

When preoperative and postoperative measurements were compared, in all measurements statistically significant differences were found (Figure-2) ($p<0.05$).



Figure-2. Sagittal lumbar CT images before (a) and after (b) VP procedure.

KP patients preoperative vertebral body (a) anterior, (b) midline and (c) posterior heights were 16.46 ± 6.97 mm, 11.78 ± 5.15 mm, 18.91 ± 3.99 mm respectively and postoperative 17.99 ± 6.29 mm, 13.38 ± 5.09 mm, 20.32 ± 3.71 respectively (Table-3 and 4).

Table-3. CT and VAS values before and after vertebroplasty.

Vertebroplasty	Anterior (mm)	Midline(mm)	Posterior (mm)
Preoperative measurement	17.54±5.35	13.07±3.99	20.35±4.12
Postoperative measurement	18.69±5.35	14.39±3.90	21.35±4.40
p	0,028	0,007	0,019

Table-4. CT scan and VAS values before and after kyphoplasty procedure.

Kyphoplasty	Anterior (mm)	Midline (mm)	Posterior (mm)
Preoperative measurement	16.46±6.97	11.78±5.15	18.91±3.99
Postoperative measurement	17.99±6.29	13.38±5.09	20.32±3.71
p	0,000	0,000	0,000

When preoperative and postoperative measurements of KP patients were compared, in all measurements statistically significant differences were found ($p < 0.05$).

In KP patients no cement related complication was observed, and only one of the VP patients cement leakage to the adjacent disc was observed.

When adjacent segment fractures are taken into consideration, only in one VP patient at the postoperative 3rd month level above the procedure a fracture was located. Fracture in the neighboring segment was also treated with vertebroplasty. In Figure-2 preoperative and postoperative sagittal CT images of a vertebroplasty patient, in Figure-3 preoperative sagittal CT and T1 weighed MRI image and postoperative sagittal and axial CT images of a KP patient are given.

DISCUSSION:

Galiert reported the first application of Vertebroplasty in 1987 (6), and Reiley reported the first application of Kyphoplasty in 1993 (9). In the last 30 years minimally invasive surgery concept is trending. These two methods of minimally invasive surgery, has some difference in application and utilization. Different aspects of these two percutaneous interventions are given in Table-5.

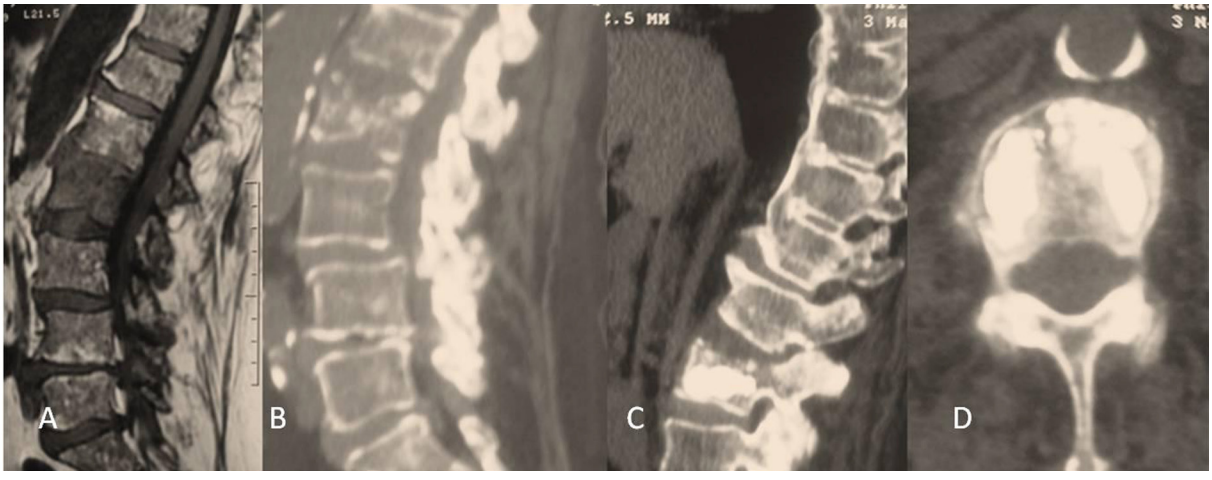


Figure-3. T1 weighed 227 MRI images of a case before KP procedure (a) and sagittal CT image (B) and same case's postoperative sagittal (c) and axial (d) CT images.

Table-5. Specifications of KP and VP applications.

	Kyphoplasty	Vertebroplasty
Procedure	Cavity formation with a balloon And filling with PMMA	Filling present cavities with PMMA
PMMA amount	3- 8 ml	1-3 ml
Process time	relatively longer	Shorter
Cost	Expensive	Cheap
Complication (5)	Less risk for cement leakage (0,3%)	Relatively higher risk for cement leakage (1,6%)
	Less risk for new Compression fracture (14,1%)	Relatively higher risk for new compression fracture (17,9%)
	Relatively higher risk For infection (0,3%)	Relatively lower risk for infection (0,1%)

American National Osteoporosis Society reports more than 50% of the >50 years of age Americans have either osteopenia or osteoporosis. This shows that osteoporosis is not just a disease that causes pain but a public health issue (13). In the same study in this group of diseases 80% is observed in female population. Our study supports this data. Primary complaints of the OVBF patients are lumbar and back pain resulting from a low energy trauma or a provocative move (14). Magnetic resonance imaging (MRI) scans following this clinical picture supports the diagnosis when heterogeneous bone marrow signal and hyper-intense (defining edema) images at STIR sequences were observed.

IN X-ray images and CT scans observation of the loss of vertebral height is diagnostic. In OVBF minimally invasive VP and KP procedures aim to minimize pain in early stage and sustain vertebral height.

In Gill *et al*. study it was shown that VP and KP decrease pain distinctly (7). Taylor significant decrease in pain scores of osteoporotic cases after percutaneous intervention (17). In our study it was shown that both VP and KP procedures are similarly sufficient for pain removal. When literature is taken into consideration, more than 90% of the osteoporotic fracture patients had reduced pain but reduction in the pathological fractures this rate decreases (2,4).

Second most important problem in OVBF after pain is kyphosis deformities that develop later on due to loss of body height. These deformities are not only important for morphological deformities but also for increased risk of fracture in the adjacent levels (8). Adjacent level fractures are important problems and require a new vertebral reinforcement surgery. Major cause of this problem is that extensively reinforced vertebral body compresses and stresses the adjacent osteoporotic vertebrae. In order to avoid this outcome, excessive cement application must be avoided. Due to this reason in this study maximum of 4 cc cement was applied.

In our series in only one case adjacent vertebra fracture was observed. It was reported that VP has less effect on body restoration than KP (10,18). In our study, it was shown that both KP and VP has rectification according to the preoperative values similarly. When complications are taken into consideration, none of the methods were superior to one another. Theoretically KP is superior to VP for restoration of vertebral height and avoiding cement leakage but in our study both methods resulted in similar clinical outcomes. Main reason of this is viscous application of the cement in VP and targeting to midline and anterior portions of the vertebral body.

In conclusion, VP and KP have similar efficiency for pain removal and height restoration resulting from osteoporotic vertebral fractures. But randomized control experiments comparing two procedures are required for further evaluation.

REFERENCES:

1- Bademci G, Aydın Z, Batay F, Attar A, Çağlar Ş. Yaşlılarda ağrılı osteoporotik omurga çökme kırıklarının tedavisinde kifoplasti- vertebroplasti etkinliğinin değerlendirilmesi. *Turk J Geriatr* 2005; 8: 5-9.

2- Barr JD, Barr MS, Lemley TJ, McCann RM. Percutaneous vertebroplasty for pain relief and spinal stabilization. *Spine* 2000; 25: 923–928.

3- Dalbayrak S, Onen MR, Yılmaz M, Naderi S. Clinical and radiographic results of balloon kyphoplasty for treatment of vertebral body metastases and multiple myelomas. *J Clin Neurosci* 2010 ;17: 219-224.

4- Deramond H, Depriester C, Galibert P, Le Gars D. Percutaneous vertebroplasty with polymethylmethacrylate. Technique, indications, and results. *Radiol Clin North Am* 1998; 36: 533–546.

5- Eck JC, Nachtigall D, Humphreys SC, Hodges SD. Comparison of vertebroplasty and balloon kyphoplasty for treatment of vertebral compression fractures: a meta-analysis of the literature. *Spine J* 2008; 3: 488-497.

6- Galibert P, Deramond H, Rosat P, et al. Preliminary note on the treatment of vertebral angioma by percutaneous acrylic vertebroplasty. *Neurochirurgie* 1987; 33: 166–168.

7- Gill J. B., Mark K., Paul C. Chin. Yan Zhang, and Robert Schutt, Jr. Comparing pain reduction following kyphoplasty and vertebroplasty for osteoporotic vertebral compression fractures. *Pain Physician* 2007; 10: 583-590.

8- Kayanja MM, Evans K, Milks R, Lieberman IH. Adjacent level load transfer following vertebral augmentation in the cadaveric spine. *Spine* 2006; 31: 790-797.

9- Lieberman IH, Dudeney S, Reinhardt MK, Bell G. Initial outcome and efficacy of "kyphoplasty" in the treatment of painful osteoporotic omurgal compression fractures. *Spine* 2001; 26: 1631-1638.

10- McKiernan F, Faciszewski T, Jensen R. Does omurgal height restoration achieved at vertebroplasty matter. *J Vasc Interv Radiol* 2005;16: 973-979.

11- Mut M, Naderi S. Risk of refracture and adjacent omurga fracture after vertebroplasty and kyphoplasty. *World Spine Journal* 2006; 2: 1-4.

12- Mut M, Naderi S. Metastatik omurga tutulumlarında vertebroplasti ve kifoplasti uygulaması. *J Turk Spinal Surg* 2008; 19: 153-162.

13- National Osteoporosis Foundation. America's Bone Health: The State of Osteoporosis and Low Bone Mass in Our Nation. Washington, DC: National Osteoporosis Foundation, 2002.

14- Patel U, Skingle S, Campbell GA, Crisp AJ, Boyle IT. Clinical profile of acute vertebral compression fractures in osteoporosis. *Br J Rheumatol* 1991; 30: 418–421.

15- Ross PD, Dawis JW, Epstein RS, Wasnich RD. Pre-existing fractures and bone mass predict vertebral fractures incidence in women. *Ann Intern Med* 1991;114: 919-923.

16- Santiago FR, Abela AP, Alvarez LG, Osuna RM, García Mdel M. Pain and functional outcome after vertebroplasty and kyphoplasty. A comparative study. *Eur J Radiol* 2010; 75: 108-113.

17- Taylor RS, Taylor RJ, Fritzell P. Balloon kyphoplasty and vertebroplasty for vertebral compression fractures: a comparative systematic review of efficacy and safety. *Spine* 2006; 31: 2747-2755.

18- Voggenreiter G. Balloon kyphoplasty is effective in deformity correction of osteoporotic vertebral compression fractures. *Spine* 2005 ; 30: 2806-2812.

Address: Evren YÜVRÜK, Surgeon of the Neurosurgery, Department of Neurosurgery, Umraniye Teaching and Research Hospital, İstanbul.
Tel.: 0216 6321818 **GSM:** 05057153247
E-mail: evreny82@gmail.com
Arrival date: 12th November, 2014
Acceptance date: 17th December, 2014