



Results of using Thoracolumbar Injury Classification and Severity Score (TLICS) in Treatment of Thoracolumbar Fractures

Torakolomber Kırıkların Tedavisinde Torakolomber Yaralanma Sınıflaması ve Şiddet Skoru (TLICS) Kullanımının Sonuçları

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ABSTRACT

Aim: To compare short and long term pain intensity changes and long term loss of correction rates in patients who were treated either by kyphoplasty or posterior segmentation due to their TLICS and LSC scores, therefore evaluate the specificity of these classifications.

Material and Methods: Medical records of 106 patients operated due to thoracolumbar compression or burst fracture in our clinics between years 2012 to 2015 have been evaluated retrospectively. The patients were evaluated with postoperative radiography (loss of reduction) and visual analogue scale (VAS) in their follow-ups.

Results: The average stay on hospital was 6.53 ± 4.51 days in kyphoplasty group. The mean preoperative Cobb angle was 10.76 ± 11.67 degrees, which improved to 10.19 ± 10.66 degrees at postoperative 1th month. Beside this, the mean preoperative VAS score was 7.93 ± 0.68 then improved to 4.25 ± 0.77 and 2.75 ± 1.43 at postoperative 6th, 12th month follow-ups respectively. There were 42 patients in instrumentation group. The mean hospitalization was 13.47 ± 10.43 days. The mean preoperative Cobb angle was 15.84 ± 10.52 and it improved to 11.86 ± 8.15 degrees at the postoperative 1th-month follow-up. The preoperative VAS scores of the patients improved from 7.71 ± 0.71 to 4.09 ± 0.79 and 4.26 ± 1.23 at 6th and 12th month follow-ups.

Conclusion: In long term follow up the kyphoplasty group showed more loss of correction however lesser VAS scores comparing to the instrumentation group. Although evaluating TLICS scores to kyphoplasty patients is still based on case reports in our series it was performed to 64 patients.

Keywords: Burst fracture, kyphoplasty, posterior instrumentation, Thoracolumbar Injury Classification Severity Score (TLICS)

ÖZ

Amaç: Bu çalışma ile TLICS ve LSC skorları itibarıyla kifoplasti veya posterior segmentasyon ile tedavi edilen hastalarda kısa ve uzun dönem ağrı şiddeti değişikliklerini ve uzun süreli korreksiyon oranlarını karşılaştırmak için bu sınıflandırmaların özgüllüğünü değerlendirmeyi amaçlandı.

Materyal ve Metod: Torakolomber kompresyon ya da burst fraktürü nedeniyle 2012 ile 2015 yılları arasında opere edilen 106 hastanın tıbbi kayıtları retrospektif olarak incelendi. Hastalar, takiplerinde postoperative radyografi ve vizüel ağrı skalası (VAS) ile değerlendirildi.

Sonuçlar: Kifoplasti grubunda ortalama hastanede yatış süresi $6,53 \pm 4,51$ idi. Ortalama preoperative Cobb açısı $10,76 \pm 11,67$ derece iken; post-op 1. ayda $10,19 \pm 10,66$ derece olarak ölçüldü. Bununla birlikte ortalama preoperatif VAS skorları $7,93 \pm 0,68$ iken; sırası ile 6. ayda ve 12. ayda $4,25 \pm 0,77$ ve $2,75 \pm 1,43$ oldu. Enstrümantasyon grubunda 42 hasta vardı. Ortalama hastanede yatış süresi $13,47 \pm 10,43$ gündü. Ortalama preoperative Cobb açısı $15,84 \pm 10,52$ derece iken; post-operatif 1. ay takiplerinde $11,86 \pm 8,15$ derece olarak ölçüldü. Preoperatif VAS skorları $7,71 \pm 0,71$ iken; sırasıyla 6. ay ve 12. ayda $4,09 \pm 0,79$ ve $4,26 \pm 1,23$ oldu.

Sonuç: Kifoplasti grubunda enstrümantasyon grubuna kıyasla uzun dönem takibinde daha fazla korreksiyon kaybı izlenirken VAS skorları daha düşük idi. Kifoplasti hastalarında TLICS skorlarının değerlendirilmesi hala 64 hastalık vaka serimize dayanmaktadır.

Anahtar kelimeler: burst fraktürü, kifoplasti, posterior enstrümantasyon, Thoracolumbar Injury Classification Severity Score (TLICS)

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INTRODUCTION

Burst fractures comprise 20 % of thoracolumbar fractures that occur due to anterior and middle vertebral column support deficiencies formed by axial loading forces. Surgery is indicated in presence of serious deformity and/or neurological deficit. However, there is still controversy about efficacy of anterior or posterior surgical approaches.

Several classification systems are used for making a decision at thoracolumbar fractures' surgical treatments. The most frequently used one is the Denis classification which is based on 3 column concept that doesn't give any information about the neurological condition, therefore it is inadequate for surgical evaluation. Even though Magerl classification is a detailed classification on fractures also known as AO spine system^(1,13) fractures' morphology and pathophysiology it does not possess data about neurological progress. Load-Sharing classification (LSC)⁽¹⁴⁾ is a quantitative system based on prediction of posterior instrumentation implant insufficiency which determines surgical indication. Thoracolumbar Injury Classification System (TLICS)⁽²¹⁾ is the first quantitative scoring system that provides information about the neurological condition. Application of both LSC and TLICS together may help in decision of surgical indication and approach.

Compression fractures may cause severe pain, kyphotic deformity, respiratory function deficiency, and impairment in quality of life, however they are evaluated by their own classification systems. Balloon kyphoplasty, a minimally invasive technique which was first described by Garfin et al.⁽⁶⁾ is effective at pain relief and deformity correction. With this procedure, the vertebral corpus is penetrated percutaneously via pedicles to correct vertebral height and kyphotic deformity. After reaching

the corpus the balloon is inflated and then polymethylmethacrylate (PMMA) is injected to fill the space that was created.

One other surgical method for treating unstable thoracolumbar burst fractures is short-segment instrumentation which is one level up and one level below fusion. Even though short-segment instrumentation indirectly fixes kyphotic correction and spinal canal encroachment, it may cause implant failure and early loss of correction due to lack of anterior support.

The main purpose of thoracolumbar vertebrae fracture management is to protect the neural structures from possible injuries, decrease pain, ensure early mobilization and turning to usual daily life activity. This may be achieved by neural canal decompression with/without spinal canal anatomic alignment reconstruction.

In our study we aimed to compare short and long term pain intensity changes and long term loss of correction rates in patients who were treated either by kyphoplasty or posterior segmentation due to their TLICS and LSC scores, therefore evaluate the specificity of these classifications.

MATERIAL AND METHODS

Medical records of 106 patients operated due to thoracolumbar compression or burst fracture in our clinics between years 2012 to 2015 have been evaluated retrospectively. Two groups such as kyphoplasty group, and posterior instrumentation (fixation) group comprising long-segment instrumentation and short-segment instrumentation were generated according to the morphology of the fractures. All patients underwent plain radiography, computerized tomography (CT) scanning and magnetic resonance imaging (MRI), evaluated for fracture morphology, neurological condition and posterior longitudinal ligament (PLL) integrity,

and their TLICS scores from 1 to 10 were recorded in their files. Thoracolumbar Injury Classification and Severity Score (TLICS) is a new classification system to measure the severity of the spinal cord injury. The system consists of 3 parts and is used at surgical intervention decision making (Table 1).

For surgical indication fracture morphology, PLL integrity and neurological condition were assessed. Kyphoplasty was performed to neurologically intact patients with severe back pain and compression or burst fractures. Their TLICS score was below 4 points. On the other hand, vertebral height loss more than 20%, kyphotic progression more than 20 degrees, presence or absence of spinal canal invasion were also considered as surgical indications. Short segment instrumentation as one above one below and if the pedicles are not damaged one to the fractured vertebrae was preferred in fractures above thoracic 11 level and below lumbar 2 level, long-segment instrumentation as 2 levels above and 2 levels below the fracture was preferred otherwise.

LSC assessments were done at the 1st month of the follow-up, scores were recorded to the files. The score consists of 3 parts. The grading is done according to the spinal CT scans. On sagittal reconstructions if the vertebra corpus height disintegration is more than 30% it gets 1 point, if disintegration is between 30-60 % it gets 2 points, and if it is more than 60% it gets 3 points. On cross sectional CT scans if the fractured fragments displace 0-1 mm into the spinal canal it gets 1 points, displacement up to 2mm and less than 50% of vertebrae corpus it gets 2 points, and displacement more than 2mm or more than 50% of vertebrae corpus gets 3 points. Finally considering kyphotic deformity correction, 3 degrees and less correction gets 1 point, 4 to 9 degrees of correction gets 2 points, more than 10 degrees of correction gets 3 points.

If the calculation of all these parameters is more than 7 anterior column support is recommended.

This study also compares TLICS and LSC mean ratios. The patients were evaluated with the morphology of the fracture and neurologic condition in terms of TLICS and LSC systems. TLICS under 4 point we performed kyphoplasty procedure, TLICS between 4-6 points and LSC score below 7 point, we performed posterior instrumentation to the patients.

Outcome Measures

Patients pain intensities were done by 10 cm visual analogue scale (VAS). In that system patients are asked to mark their pain score from 0 to 10 (0 meaning no pain, 10 meaning worst pain). Each patients' preoperative and postoperative 6th and 12th month follow up VAS scorings were recorded.

The International Standards for Neurological Classification of Spinal Cord Injury, published by the American Spinal Injury Association (ASIA)⁽⁹⁾ was used to assess the neurological status of our patients. The patients were enrolled as follows: ASIA E; without neurological deficit, ASIA B,C and D; with neurological deficit, ASIA A; complete spinal cord injury. ASIA scores were recorded preoperatively and postoperatively.

Surgical Procedures

Kyphoplasty procedure was performed in the operating room (OR) under sedation and local anesthetics. Cephazoline sodium 1gr iv was used for surgical prophylaxis. Patients were positioned in prone position. By using C-armed fluoroscopy antero-posterior (AP) and lateral scans the fractured vertebrae was positioned in the middle. Then two 11-gauge Jamshidi needles were bilaterally tapped percutaneously to the upper-outer edge of the pedicle and were inserted transpedicular into the collapsed vertebral body

while checking with the AP fluoroscopy scans. Two kirschner guide wires and cannulas were placed at the posterior half part of the vertebrae, biopsies were taken for pathological examination and after that the balloons were inflated bilaterally and simultaneously. Once inflated, the balloon elevates the end plates and thereby restores the height of the vertebral body. The balloons were deflated and removed, and the space was filled with 3-4 cc of PMMA. Antero-posterior and lateral fluoroscopy scans were observed for cement leakage.

Short segment and long segment instrumentations were performed under general anesthesia in prone position on straightened table while bracing the abdomen. Under guidance of C-armed fluoroscopy scans the fractured vertebrae was located. After routine surgical preparations like skin disinfection and sterile draping, standard posterior midline skin incision was made. Fascia was cut from the midline; paravertebral muscles were scraped and all facet joints were revealed.

In short segment instrumentation transpedicular screws were inserted one level above and one level below the fractured vertebrae, and one augmented screw to the fractured vertebrae if the fractured vertebrae's pedicle remained unharmed. In long segment instrumentation transpedicular screws were placed two levels above and two levels below the fractured vertebrae. Usually titanium polyaxial transpedicular screws of 6.5 mm diameters at lumbar and of 5.5 mm diameters at thoracic region were used and connected with slightly bended rods. Local kyphotic angle was corrected by distracting with spreader forceps and anterior vertebral height was restored. All screws' positioning, kyphotic and anterior vertebral height restorations were checked under fluoroscopy. Decompressive laminectomy was performed to relieve the spinal cord and nerve

roots either at the fractured level or to the spinal stenosis level.

Ethical Approval

All procedures performed were in accordance with the 1964 Helsinki declaration. Written informed consent for scientific purposes and clinical data collection was obtained according to institutional protocol.

Statistical Analysis

Statistical analysis were done using SPSS for Windows© version 21 (Armonk, NY). Relevance to normal range of variations were studied by visual (histogram and possibility graphs) and analytic (Kolmogorov-Smirnov/Shapiro-Wilk tests) methods. Descriptive statistics were done by mean±standart deviation for variables showing normal distribution, and median±interquartile range for variables with abnormal distribution. Normal distribution was observed in preoperative and postoperative 1st month values at posterior segmental instrumentation group, therefore comparison was done by T test. Other groups variables showed abnormal distribution therefore these parameters were compared by using Wilcoxon test. P value less than 0.05 was considered as significant.

RESULTS

Patients average age was 48.64 ± 19.99 years, and there were 66 males and 40 females. Of these 104 patients 64 (60.4 %) were treated with kyphoplasty, 10 (9.4 %) patients were treated by short segment instrumentation and 32 patients (30.2 %) were treated by long segment instrumentation. The demographic characteristics of the patients are shown on table 2.

In kyphoplasty group (n=64) the average age was 54.23 ± 19.15 . In this group, 95 fractured vertebrae were treated. The mean PMMA quantity was 7.36 ± 4.04 . There was no

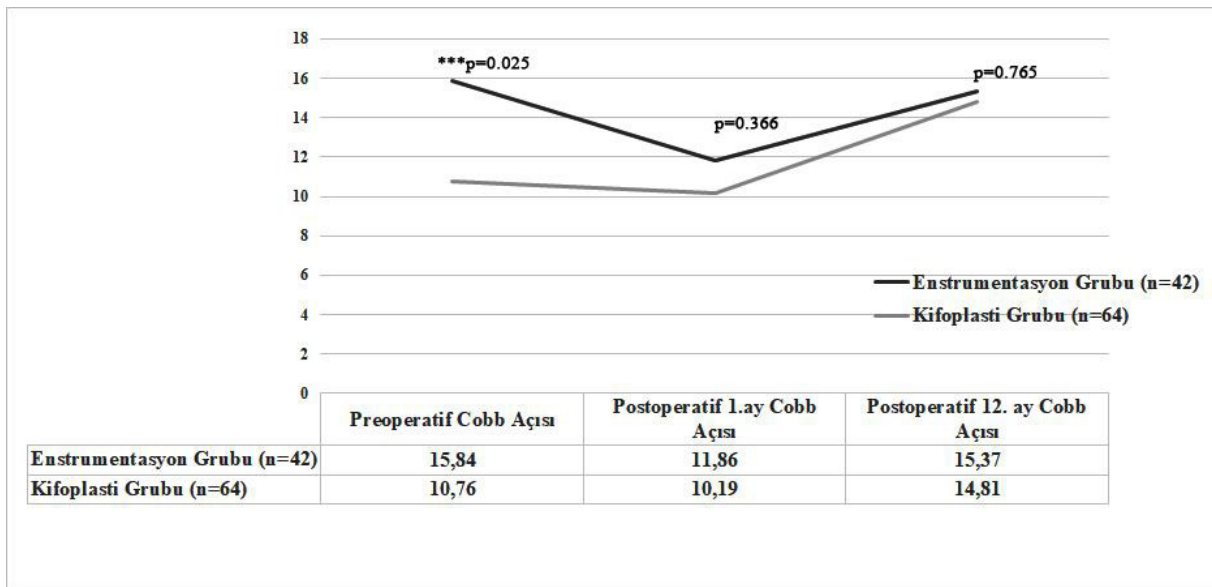


Figure 1: The comparison of preoperative, postoperative 1st and 12th month Cobb Angle values between groups.

neurological deficit in kyphoplasty group (ASIA E). The average stay on hospital was 6.53 ± 4.51 days, and Glasgow Coma Scale (GCS) on admission was 15. The mean preoperative cobb angle was 10.76 ± 11.67 degrees, which improved to 10.19 ± 10.66 degrees at postoperative 1th month. There were not significant differences between preoperative and postoperative cobb angles ($p=0.308$). The mean loss of correction was 4.62 ± 1.38 at the 12th month follow-up. In this group, the mean TLICS score was 2.65 ± 0.94 and LCS was 3.71 ± 0.81 . Beside this, the mean preoperative VAS score was 7.93 ± 0.68 then improved to 4.25 ± 0.77 and 2.75 ± 1.43 at postoperative 6th, 12th month follow-ups respectively. There were significant differences between these groups ($p < 0.0001$).

We enrolled the short and long segment stabilization patients in same group and called instrumentation group. There were 42 patients in this group and the average age was 40.11 ± 18.36 . The mean GCS was 14.76 ± 1.24 on admission. According to ASIA classification, there were 7 (16.7%) patients in A, 5 (11.9%) patients in C, 5 (11.9%) patients in D and 25 (59.5%) patients in E. The median ASIA scores in instrumentation

group was E, and interquartile range (25th and 75th percentiles) were C and E respectively. The mean TLICS and LCS were 5.71 ± 1.48 , 6.09 ± 0.95 respectively. The mean operation time was 1.66 ± 2.94 hour, and the mean hospitalization was 13.47 ± 10.43 days. The mean preoperative cobb angle was 15.84 ± 10.52 and it improved to 11.86 ± 8.15 degrees at the postoperative 1th-month follow-up. The mean difference between preoperative and postoperative cobb angles was 3.97 ± 7.92 and there was significant difference between groups ($p=0.002$). The loss of correction in this group was 3.51 ± 1.39 at 12th month follow-up. The preoperative VAS scores of the patients improved from 7.71 ± 0.71 to 4.09 ± 0.79 and 4.26 ± 1.23 at 6th and 12th month follow-ups. There was significant difference between these groups ($p < 0.0001$).

There was significant correlation between TLICS and LCS systems ($r=0.740$, $p < 0.0001$). The mean preoperative cobb angle difference was 5.07 degree and there was significant difference between kyphoplasty ($n=64$) and instrumentation ($n=42$) groups ($p=0.022$) (Figure 1). The mean postoperative 12th month VAS

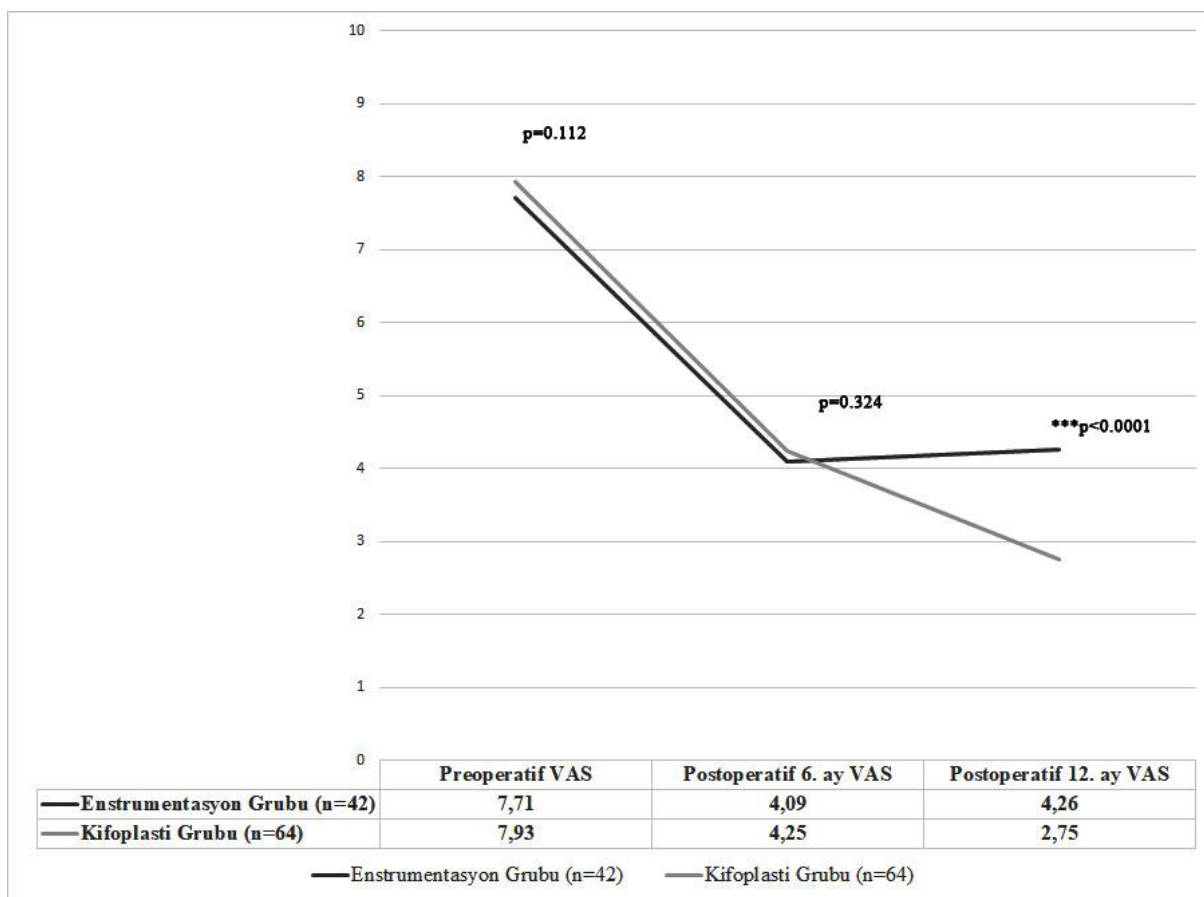


Figure 2: The comparison of preoperative, postoperative 6th and 12th month VAS values between groups. (VAS: visual analogue scale)

score difference between kyphoplasty (n=64) and instrumentation (n=42) groups was 1.51 and there was significant difference (p<0.0001). Although there were no significant differences in postoperative Cobb angles, preoperative and postoperative 6th month VAS values between two groups (p=0.392, p=0.109, p=0.321, Figure 2), the mean difference in loss of correction between kyphoplasty and instrumentation groups was 1.11 and there was significant difference between groups (p<0.0001, Figure 3). Beside this the mean operation time was 3.25 hours and the mean hospitalization was 6.94 days shorter in kyphoplasty group (p<0.0001 for both). The mean difference in TLICS score was 1.71 and it was fewer in kyphoplasty than instrumentation group (p<0.0001).

DISCUSSION

Management of neurologically intact thoracolumbar burst fractures remains controversial. Main purpose in spinal injuries is restoring normal and pain-free condition and provide dynamic-protective function of the spinal cord. Therefore, different approaches for different vertebrae fractures have been developed.

Although AO/Magerl⁽¹³⁾ classification system is usually preferred for the burst fracture classification, this system cannot give information about the patient neurologic condition. TLICS system seems to be reliable and gives morphological data about the fractures. In the literature, conservative treatment is recommended to patients

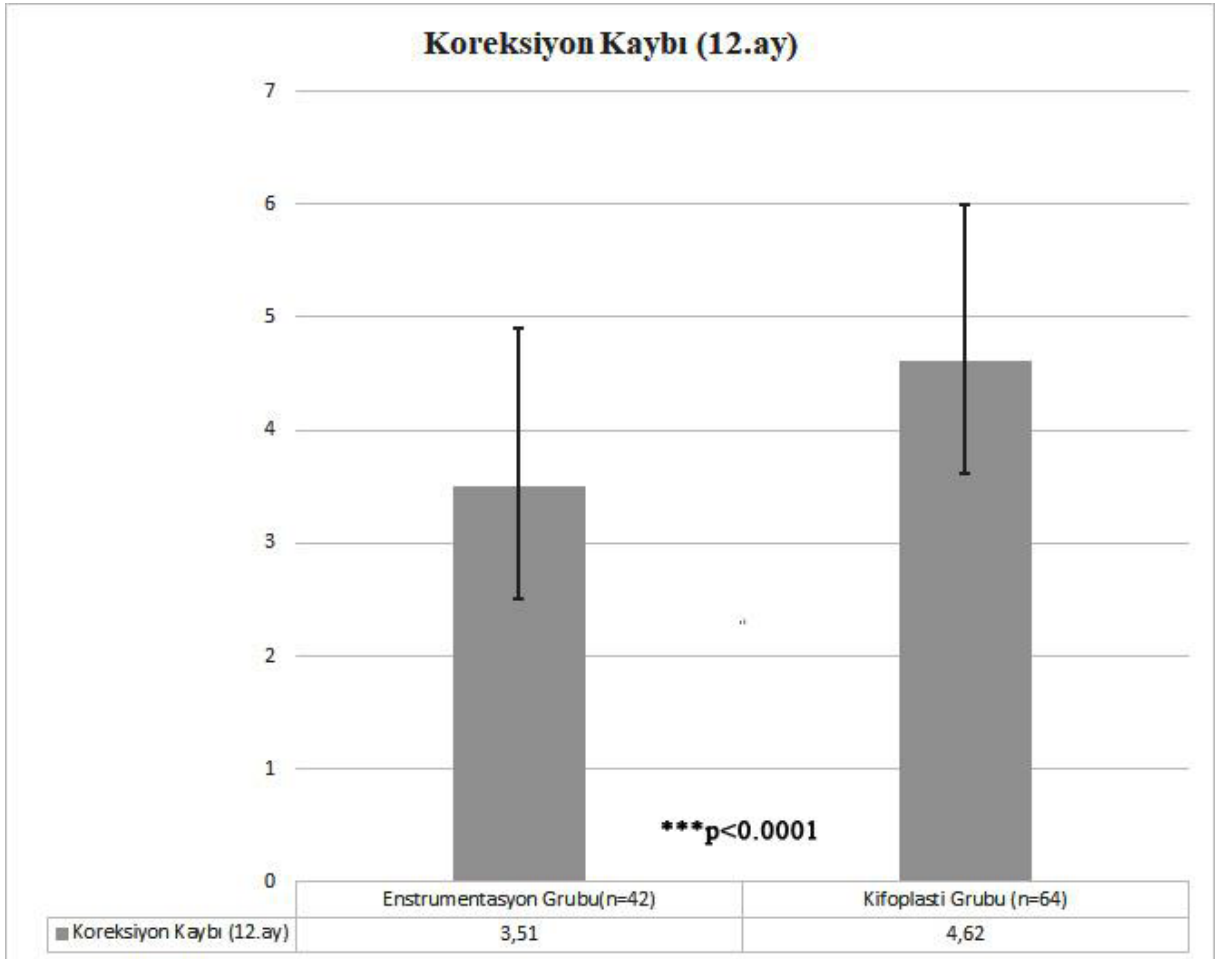


Figure 3: The comparison of 12th month loss of correction values between groups.

with TLICS scores less than 4 points. In our clinics kyphoplasty was performed to patients with TLICS score below of 4 points without neurological deficits. However, the type and duration of trauma, age, body mass index, socioeconomic status and comorbidities of patients should be taken into account while planning the treatment. Treatment options like polymethylmethacrylate augmentation techniques such as balloon kyphoplasty should also be considered.

Although described systems have many advantages, posterior longitudinal ligament injury and patients' neurological condition have important values for treatment decision. In literature, it is emphasized that TLICS points between 4 to 6 should be considered for posterior instrumentation techniques, while TLICS points

more than 5 and LSC scores more than 7 should be considered for anterior colon support in addition to posterior instrumentation^(8,22,23).

The long segment instrumentation and fusion showed reliable and better clinical and radiological outcomes^(5,11,16,20). Also, long segment instrumentation is one of the most effective treatments in burst fracture management by reducing pain and less loss of correction in long term. Loss of correction was found 3.51 degrees in our study. Tezeren et al. in 2009, compared the long segment instrumentation with and without fusion in the thoracolumbar burst fracture⁽¹⁹⁾; they showed that there was no difference between the two groups in parameters such as local kyphosis, sagittal index, and anterior vertebral height. In addition, the implant

failure rate was found to be low in both groups. Tezeren et al. ⁽²⁰⁾ in 2005, long and short segment instrumentation applications in thoracolumbar burst fractures were compared and it was found that long segment applications were better in radiological parameters and the results of the two groups were close to each other in clinical parameters.

Short segment instrumentation was preferred in patients whose fractured vertebrae was not close to thoracolumbar junction and the pedicle was unharmed. Advantages of short segment instrumentation over long segment instrumentation are less donor site morbidity, shorter operation time, and less surgical site bleeding. However, in long time hardware failure cannot be prevented. In a study that Sanderson et al. ⁽¹⁸⁾ reported 24 patients with thoracolumbar burst fractures treated with posterior short segment fixation without fusion with a mean follow-up time of 3.1 years, they observed implant failure in 4 (14%) patient's due to screw breaks. Yang et al. ⁽²⁶⁾ demonstrated the clinical and radiological positive results of indirect reduction and fixation without fusion treatment in thoracolumbar burst fractures. Wang et al. found no significant difference when comparing surgeries with and without fusion in 58 patients with thoracolumbar burst fractures. Dai et al. ⁽⁴⁾, Alanay et al. ⁽²⁾ and Jindal et al. ⁽⁷⁾ demonstrated that bone grafting was not necessary in short-segment pedicle instrumentation.

Although short segment instrumentation with or without fusion is under debate, after 1-year follow-up no implant failure was determined in our patients, however 3.51 ± 1.39 degree loss of correction was detected in posterior segmental instrumentation group. These patients' mean LSC score was 6.09 ± 0.95 , TLICS score was 5.71 ± 1.48 . These scoring systems are seem to be sufficient and ideal to provide transpedicular augmentation alignment and vertebrae anterior

height of the fractured vertebrae.

Nevertheless, kyphoplasty may be seen adequate in some osteoporotic vertebral compression fractures, however its application to burst fractures remains controversial. In our study, effective kyphosis reduction may be achieved with balloon kyphoplasty. In our series kyphosis of 10.76 ± 11.67 degrees were reduced to 10.19 ± 10.66 degrees, after 1-year follow-up loss of correction was observed as 4.62 ± 1.38 , but the mean VAS scores lower than instrumentation group. In our study loss of correction by the first year in short segment group was measured as 4.62 degrees which is similar to the literature. Also mean VAS scores were found significantly decreased. The correction in the kyphosis angle was reported between 3.9 - 16.5 degrees ⁽²⁵⁾. The lowest correction was reported in a group of patients with rheumatoid arthritis (Shim et al., 2016). Inserted PMMA decreases pain while stabilizing the fractured vertebrae. The amount of PMMA is important in kyphotic reduction and functional recovery. The volume of the cement (PMMA) to be injected had not been strictly defined, 2 – 6 ml of PMMA was usually suggested to repair a fractured vertebral body and up to 8 ml of PMMA was showed to remodel vertebral stiffness ^(12,15). However, no correlation could be shown between greater cement volume and pain relief ⁽¹⁰⁾. It was pointed out that higher bone cement volumes were accompanied with higher risk of leakage and increased stresses in the adjacent vertebral bodies, in particular in the cranial vertebral body ⁽³⁾. The cement leak was reported in a wide range between 4 – 45% ⁽¹⁷⁾. The average cement volume given in the 45% leak was relatively high (6.4 ± 1.8 ml) and all the patients had rheumatoid arthritis. Our average cement volume was 4.6 ± 1.3 ml, and we had relatively low rate of cement leak, only in 5 patients (4.4%). We observed 16 (14%) ASF, 10 (62.5%) of them were in the cranial vertebra. ASF was reported to be between 9.6 – 21.7 %, and majority of the fractures were in the cranial segment

CONCLUSION

In this retrospective comparative study pain and loss of correction values in patients with vertebrae fractures treated with either short/long segment instrumentation or balloon kyphoplasty were compared. In long term follow up the kyphoplasty group showed more loss of correction however lesser VAS scores comparing to the instrumentation group. Strong correlation between TLICS and LSC scores also were found. Posterior instrumentation was recommended to TLICS scores between 4 to 6 and for TLICS scores less than 4 points alternatively balloon kyphoplasty considering factors such as comorbidities, age, gender of the patient and type and duration of trauma should be kept in mind. Although evaluating TLICS scores to kyphoplasty patients is still based on case reports in our series it was performed to 64 patients.

Ethics Committee Approval: All procedures performed were in accordance with the 1964 Helsinki declaration. Ethical approval was taken from local ethics committee.

Conflict of Interest: All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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Informed Consent: Written informed consent for scientific purposes and clinical data collection was obtained according to institutional protocol.

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