EFFICACY OF IMPACTION OF RETRO-PULSED BONY FRAGMENTS IN LUMBAR BURST FRACTURES: COMPARISON WITH LIGAMENTOTAXIS

LOMBER PATLAMA KIRIKLARINDA KANAL İÇİNE GÖÇ ETMİŞ KEMİK PARÇALARININ ÇAKILMA YÖNTEMİNİN ETKİNLİĞİ VE LİGAMENTOTAKSİS İLE KIYASLANMASI

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SUMMARY:

Aim: Traumatic thoracolumbar burst fractures remain a challenge that have highly financial and social expenses. Burst spinal fractures are frequently related with neurologic deficit and in the young age group incidence of burst fractures is more frequent. We aimed to determine if the impaction of retropulsed fragments of burst fracture as a safe and effective method by the help of clinical and radiographic results.

Material and Method: 47 patients with thoracolumbar injury classification and severity score 4 or more, lumbar burst spinal fractures who underwent surgery in our clinic either posterior trans-pedicular stabilization and decompression with only ligamentotaxis (Group-1) (n= 28) or posterior trans-pedicular stabilization and decompression with ligamentotaxis and impaction of retropulsed fragments (Group-2) (n=19) were reviewed.

Results: The mean difference between preoperation and postoperation measurement of the retropulsed fragment in the only ligamentotaxis group was 1,189 ± 0,882099 mm and for the group ligamentotaxis with impaction was 4,752 ± 2,851291 mm. There is a significant difference between the two groups (p<0,05).

Conclusion: We conclude that for suitable patients impaction of retropulsed fragments of burst fracture can have better spinal canal restoration and decompression of neuronal elements.

Keywords: Burst Fractures, Impaction, Ligamentotaxis

Level of Evidence: Retrospective clinical study, Level III

ÖZET:

Amaç: Travmatik trokolomber patlama kırıkları yüksek finansal ve sosyal uğraşlar gerektiren bir sorundur. Spinal patlama kırıkları sıklıkla nörolojik defisitlerle karşımıza çıkar ve genç yaş grubunda spinal patlama kırığı görülme oranı daha yüksektir. Bu çalışmada kanal içine göç etmiş patlama kırığı parçalarının çakılma yönteminin güvenli ve etkili bir metod olduğunu klinik ve radyolojik verilerle ortaya koymayı amaçladık.

Yöntem ve Gereçler: Torako-lomber hasarlanma sınıflanması ve ciddiyeti skoru 4 ve üzeri olan 47 lomber patlama kırığı olan ve kliniğimizde ameliyata alınan hastalar çalışmamıza dahil edilmiştir. Hastalar posterior trans-pediküler stabilizasyon ve dekompresyonla birlikte sadece ligamentotaksis yapılan grup (Grup-1, n=28) ve posterior trans-pediküler stabilizasyon ve dekompresyonla birlikte ligamentotaksis ve kanal içine göç etmiş patlama kırığı parçalarının çakılması yöntemi uygulanan grup (Grup-2, n=19) olarak iki grupta incelenmiştir.

Sonuçlar: Kanal içine göç etmiş patlama kırığı parçalarının ölçüm ortalamalarının preoperatif ve postoperatif ortalama değerleri arasındaki fark sadece ligamentotaksis uygulanan grup 1'de 1,189 ± 0,882099 mm iken ligamentotaksis ve parça çakılması uygulanan grup 2'de bu değer 4,752 ± 2,851291 mm idi. İki grup arasında istatistiksel olarak anlamlı fark bulundu (p<0,05).

Yorum: Uygun hastalarda kanal içine göç etmiş patlama kırığı parçalarının çakılma yöntemi ile daha iyi spinal kanal restorasyonu ve nöral doku dekompresyonu sağlanabileceği görüşüne varılmıştır.

Anahtar Kelimeler: Patlama Kırığı, Çakılma, Ligamentotaksis

Kanıt Düzeyi: Retrospektif klinik çalışma, Düzey III

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INTRODUCTION:

Spinal fractures are one of the leading problems in the Modern World Era that have highly financial and social expenses. Spinal fractures mostly occur in the thoraco-lumbar region (approximately 60%) and 15% of them are burst fractures[10]. Burst spinal fractures are frequently related with neurologic deficit and in the young age group incidence of burst fractures is more frequent[7].

The injury mechanism of burst fractures could be illustrated as axially loaded adjacent inter vertebral disc transfer the energy to the superior end plate, which causes fracture of superior end plate and transfer of inter vertebral disc to the vertebral body. This shift reasons displacement of bony parts in to central canal. The retro-pulsed bony structures could endanger the neuronal elements[3,12].

The gold standard treatment strategy of thoracic and lumbar vertebrae fractures is an unanswered problem of spinal surgery. There are many controversies such as non operative bracing or operative management with or without fusion, timing of surgery, anterior approach or posterior approach. If the surgery is indicated, there have been debates about the management of the fracture (anterior management or posterior management)[3].

Table-1. Thoracolumbar injury classification and severity score (TLICS)

TLICS scoring	
Parameter	**Points**
Morphology	
Compression fracture	**1**
Burst fracture	**2**
Translational/rotation	**3**
Distraction	**4**
Neurologic involvement	
Intact	**0**
Nerve root	**2**
Cord, conus medullaris	
Incomplete	**3**
Complete	**2**
Cauda Equina	**3**
Posterior ligamentous complex	
Intact	**0**
Injury suspected/intermediate	**2**
Injured	**3**
Management as per TLICS score	
Nonoperative	**0-3**
Nonoperative or operative	**4**
Operative	**≥5**

Thoracolumbar injury classification and severity score (TLICS) is a classification system based on the morphology of the injury, posterior ligamentous complex integrity, and neurologic examination. TLICS are summarized in Table 1. The patients who had thoracolumbar injury classification and severity score 4 or more were included in this study[5].

Some of the thoraco-lumbar fractures are observed as fracture of anterior column without failure of posterior osteoligamentous complex. These types of fractures can be categorized in stable fractures and can be treated without surgical intervention. When unstable burst fracture is observed, generally surgical intervention is chosen treatment modality. Surgically treated burst can be characterized as posterior osteoligamentous column failure with extensive spinal canal compromise, loss of height in the anterior part of the vertebrae and frequent rate of neurological deficits[11].

The indirect reduction of retro-pulsed bony structures by application of distraction forces by the help of intact ligaments and capsule is called as ligamentotaxis[4]. Both in spinal fractures and also in some of the other skeletal fractures as like distal radius fractures, tibial pilon fractures etc. skeletal restoration can be achieved by the help of ligamentotaxis[2,4].

There have been reports about the impaction of retropulsed fragments of burst fracture in the literature. It can be concluded that restoration of posterior wall of the burst fractured vertebrae by using impaction can improve the healing of bone and reduction of future kyphosis[1,8].

We planned a retrospective matched cohort study between posterior trans-pedicular stabilization and decompression with ligamentotaxis only group and posterior trans-pedicular stabilization and decompression with ligamentotaxis and impaction of retropulsed fragments group was conducted to determine the impaction of retropulsed fragments of burst fracture was a safe and effective method by the help of clinical and radiographic results.

METHODS:

From May 2010 to December 2014, 47 patients with TLICs score 4 or more, lumbar 1, lumbar 2 or lumbar 3 burst spinal fractures who underwent surgery in our clinic either posterior trans-pedicular stabilization and decompression with only ligamentotaxis (Group-1) (n= 28) or posterior trans-pedicular stabilization and decompression with ligamentotaxis and impaction of retropulsed fragments (Group-2) (n=19) were reviewed.

The causes of the burst fracture were falling from height (n=17) and motor vehicle accident (n=30). The patients female/male ratio was 18/29.

The levels of injury in group 1 were lumbar 1 (n=19), lumbar 2 (n=6) and lumbar 3 (n=3). The levels of injury group 2 were lumbar 1 (n=13), lumbar 2 (n=4) and lumbar 3 (n=2).

All patients were operated within 36 hours after injury. The neurologic assessments were performed before surgery and a day after and 3 months after surgery and ASIA assessment score was used.

For the radiological assessment direct x ray graphs, computed tomography scans, and magnetic resonance imaging scans were used to determine the type of burst fracture and spinal canal measurements.

As complication three wound infections, one iatrogenic cerebrospinal fluid (CFS) leakage and two revision surgeries due to screw malposition were observed. The mean follow up time for group-1 was 25 ± 11,81 months and for group-2 24,85 ± 10,85 months. For this period of time, No evidence of implant breakage or pseudoarthrosis was detected.

Figure-1. Standard central canal impactor.

Operative technique:

In Group-1, thoracolomber midline incision was performed approximately extending two vertebral levels above and below the fractured vertebra. The fracture level was determined by using intraoperative fluoroscopy. Posterior lumbar instrumentation was performed by using pedicular screw system. We used pedicule screws 2 levels above and 2 levels below the fractured vertebra. Total laminectomy of posterior bony structures with facetectomy was performed and then distraction obtained with the help of the distractor. In group 2 the same procedure is performed and with the help of a standard central canal impactor the retropulsed fragments are impacted (Figure-1).

The harvestered autologous bone grafts were used to achieve the dorsolateral spinal fusion with the help of decortication of the transverse process, pars interarticularis and lamina. Before the incision closed drainage tube is left in the operation field. The day after operation patients without extremity fracture are mobilized with the help of thorocolumbar orthesis.

Radiologic Assessment:

Preoperative and postoperative compromise of the fractured vertebra level spinal canal was investigated on the Computed Tomography scans. We used a calculation system based on the retropulsed fragments initial and after surgery displacement by either ligamentotaxis or ligamentotaxis and impaction.

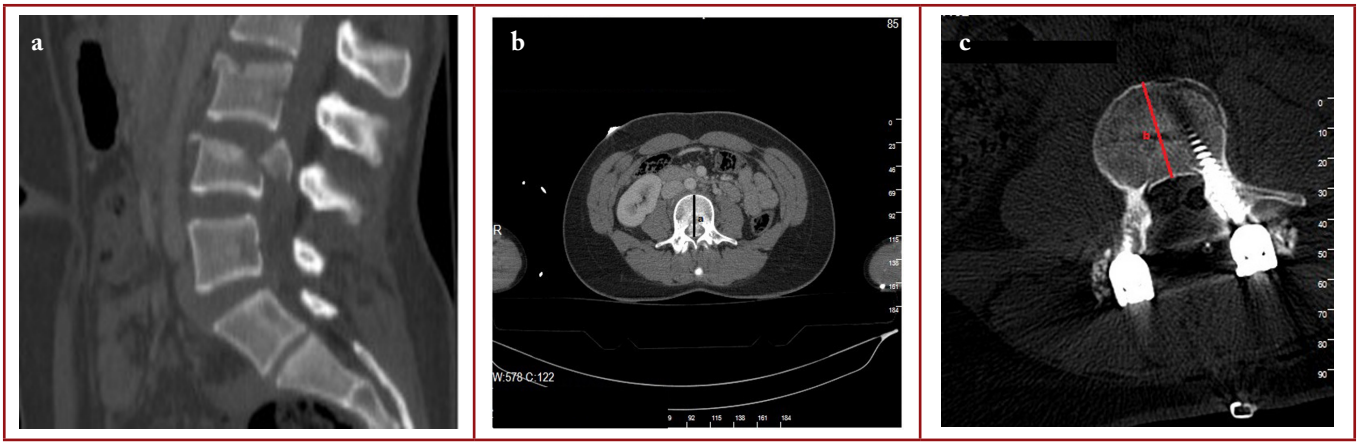

Figure-2. a) Preoperative sagital computed tomography scan of Lumbar 3 burst fracture **b)** Preoperative axial computed tomography scan of Lumbar 3 burst fracture. a: The distance between the most fore part of the vertebra body and most hind part of the retropulsed fragment. **c)** Postoperative axial computed tomography scan of Lumbar 3 burst fracture. b: The distance between the most fore part of the vertebra body and most hind part of the retropulsed fragment after ligamentotaxis with impaction.

We performed total laminectomy for all the fractures and there was no posterior margin to measure spinal canal so it was impossible to measure the exact anterio-posterior diameter of the spinal canal at the traumatic level. We used a new measurement technique. At the fractured level the most fore part of the vertebra body was used as a landmark. And the distance was measured between this landmark and most hind part of the retropulsed fragment (Figure-2.a, b, c).

After the selected operative procedure we performed the same calculation method for the postoperative measurement and the difference between the preoperative and postoperative measurements were used in the statistical analysis.

Clinical Assessment:

By the help of a blind observer who did not performed the operation, immediately preoperative and postoperative 1 and 3 days visual analog scores (VAS) were obtained. Also intraoperative blood loss was measured for the groups. Postoperative blood drainages of the groups were also investigated.

Stastical Analysis:

The data obtained from the study were evaluated using Statistical Package of Social Sciences for Windows 17.0. For the comparison of the groups non-parametric Wılcoxon signed rank test was used and $p<0.05$ was considered as a significant result.

RESULTS:

The mean follow up time of the only ligamentotaxis group was 25 ± 11,81 months and for the group ligamentotaxis with impaction was 24,85 ± 10,85 months.

The mean operation time of the ligamentotaxis group was 216,07 ± 46,54792 minutes and for the group ligamentotaxis with impaction was 237,36 ± 54,46 minutes. The difference between the two groups is not significant (p>0,05).

The average volume of intraoperative blood loss in the ligamentotaxis group was 1167,857 ± 218,0327 ml and for the group ligamentotaxis with impaction was 1286,842 ± 245,9365 ml. The difference between the two groups is not significant (p>0,05).

The mean difference between preoperation and postoperation measurement of the retropulsed fragment in the only ligamentotaxis group was 1,189 ± 0,882099 mm and for the group ligamentotaxis with impaction was 4,752 ± 2,851291. There is a significant difference between the two groups (p<0,05).

In group-I preoperative, postoperative first day and post operative third day mean VAS scores were 8,5 ± 0,86, 2,92±0,75 and 1,64±0,66 respectively. In group-II preoperative, postoperative first day and post operative third day mean VAS scores were 8,21 ± 0,76, 2,71 ± 0,73 and 1,63 ± 0,66 respectively. There was no significant difference between groups in terms of VAS (p>0,05).

Over all we can conclude that the ligamentotaxis with impaction of retropulsed fragments group had slightly more peroperative blood loss and longer operation duration. But no significant difference was observed in terms of these parameters. On the other hand the ligamentotaxis with impaction of retropulsed fragments group had significantly better radiological fragment measurements.

DISCUSSION:

Traumatic thoracolumbar burst fractures remain a challenge to treat and caused by a vertical load, with or without flexion. Kyphotic deformity, and spinal canal occlusion caused by retropulsion of the fracture segment mostly causes neurological deficit.

The aims of the surgical treatment are stabilization and restoration of vertebral column, decompression of neuronal elements, and early mobilization of the patient as soon as possible[7]. To achieve these goals, numerous studies have investigated different diagnostic, prognostic, and management approaches. For lumbar burst fractures, distraction and lordosation using transpedicular screws contribute to this restoration mostly by the way of ligamentotaxis. Ligamentotaxis can be helpful when only the retro-pulsed bony parts are connected with posterior longitudinal ligament and disc capsule. Posterior longitudinal ligament has superficial layers, which pulled back the bony fragments localized in the center of central canal and deep layers that pulled back the laterally localized fragments[2,4]. In the literature, the extent of spinal widening by ligamentotaxis shows a variation from 14% to 30% [6].

Dislocated fragments of the posterior vertebral body may cause spinal stenosis to some extent. Although tension on the ligament by distraction and ligamentotaxis may lead to repositioning, especially of smaller fragments, large fragments may resist reduction. Some studies are carried out to widen the spinal canal for large trapezoid-shaped fragments[6]. Scapinelli reported in 1995 on five adult patients with thoracolumbar spinal fractures with associated intracanal displacement of a large bone fragment[9].

In our study the mean difference between preoperation and postoperation measurement of the retropulsed fragment in the ligamentotaxis with impaction group was significantly higher. Widening of the spinal canal aim was achieved more in the ligamentotaxis with impaction group. There were no significant differences between two groups in terms of blood

loss and operation duration. VAS scores of impaction group were slightly higher at postoperative first day but there was no significant difference at postoperative third day.

Reposition of retropulsed fragments was achieved by the help of a standard central canal impactor in this study. Some authors argue that for such patients the risk of iatrogenic injury to the spinal cord is higher than the risk of suffering neurologic symptoms due to the accident. But in our study no additional neurological deficit was observed after operation. We suggest that because we performed total laminectomy of posterior bony structures with facetectomy the risk of iatrogenic spinal cord injury was minimal.

We believe that decompression of neuronal elements, restoration of spinal canal and stabilization of vertebral column are indispensable for the treatment of burst fractures. We conclude that impaction can have better spinal canal restoration and decompression of neuronal elements statistic data revealed that there has been a significant difference between these two groups.

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