

# SPINAL INSTABILITY FOLLOWING GUNSHOT WOUNDS

## Report of Two Cases

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### ABSTRACT

Gunshot wounds are the third most common cause of the penetrating spinal injuries. Most civilian gunshot wounds to the spine are accepted as biomechanically stable. The damage of spinal column and neural tissues depends on the kinetic energy of the projectile. Thus, high velocity missiles cause greater tissue damage than the low velocity missiles. Immediate surgical intervention is mandatory for multisystem injuries, and at the same time, extensive debridement is advocated for the spinal fracture as to prevent complications. Preoperative radiographic evaluation may not be enough to assess the stability, and both missile damage and debridement process may result in spinal instability.

**Key words:** Spinal instability, Gunshot wounds

### ÖZET

#### ATEŞLİ SİLAH YARALANMALARINI SONRASI SPİNAL İNSTABİLİTE

Ateşli silah yaralanmaları delici spinal zedelenmelerin üçüncü önemli nedenidir. Omurgadaki birçok sivil kullanımlı ateşli silah yaralanması biyomekanik olarak stabil kabul edilir. Spinal kolon ve nöral dokulardaki hasar, merminin taşıdığı kinetik enerjiye bağlıdır. Böylece yüksek enerjili mermiler, düşük enerjili mermilerden daha fazla doku hasarına neden olurlar. Multisistem yaralanmalarına yönelik acil cerrahi girişimler hayat kurtarıcı olmakla birlikte aynı zamanda komplikasyonlardan kaçınmak için omurga kırığına geniş bir debridman uygulanması önerilmektedir. Ameliyat öncesi radyolojik değerlendirme stabiliteyi saptamak için yeterli olmayabilir, hem merminin hasarı hem de debridman uygulanması spinal instabiliteye neden olabilir.

**Anahtar Sözcükler:** Spinal instabilite, Ateşli silah yaralanmaları

### INTRODUCTION

Gunshot wounds are the third most common cause of the penetrating spinal injuries after traffic accidents and falls, and the incidence increases during the wars and local military attacks (4).

The bullet fragments do not need to contact the spinal cord to cause injury; damage can result from cavitation and concussive effects of the bullet (10,11). The damage created by a bullet depends on the kinetic energy of the projectile, (kinetic energy can be

calculated by the formula  $KE=1/2mV^2$ , where m=mass of the projectile and V=velocity). Thus, increasing the bullet velocity results in a greater energy and greater wounding capacity than a similar proportional increase in bullet mass (11).

Gunshot wounds are associated with an increased infection rate and early surgical debridement with decompression is recommended(2,8). Surgical decompression also alters the neurologic prognosis. On the other hand, although neurologic injury is

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commonly present, most gunshot wounds to the spine are accepted as biomechanically stable injuries (3,11).

Here, we report two cases of spinal instability, after debridement for gunshot wounds to the spine.

#### CASE REPORTS

**CASE 1:** 26 year-old male was admitted to emergency service with thoracic gunshot wound. Physical examination revealed a missile-penetrating hole at the right thorax and an exit hole at the left thorax. Neurological examination revealed total paraplegia below the level of T6 and his total motor score was 50 (according to the American Spinal Injury Association-ASIA standard neurological classification of spinal cord injury). Cardiac and gross vascular trauma was not observed. Bilateral hemopneumothorax were detected. Radiographic evaluation showed T6 corpus fracture with dural

peroperatively. Inferior lobe of left lung was partially resected and chest tube with drainage system was placed. Postoperatively, the patient was immobilized in bed. Broad-spectrum antibiotics (Cephazoline 2gr/day and Gentamycine 80 mg/day) were used intravenously for infection prophylaxis. On the 14<sup>th</sup> day of the first operation, grafting and stabilization procedure was performed with Alici anterior spinal plate between T5 and T7. Thereafter, patient was referred to a rehabilitation center. During the 26 months follow-up, neurological status of the patient remained same.

**CASE 2:** 22 year-old male was admitted to emergency service with the thoracic and abdominal gunshot wounds. Neurological examination revealed bilateral incomplete motor and sensory loss at or below the level of L4. His total motor score was 71 and voluntary anal contraction loss was detected.

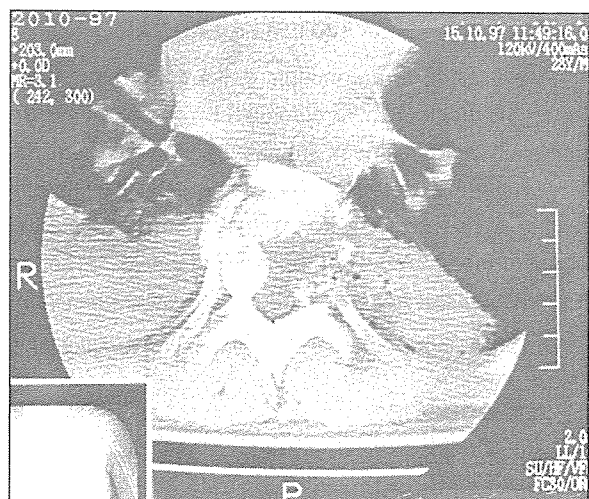
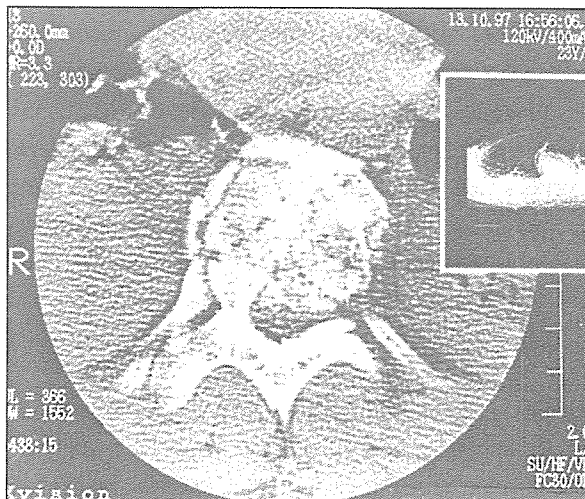


Figure 1a, b. Preoperative (a) and postoperative (b) CT images of the patient. The images were taken at the same level. Minimally displaced comminuted corpus fracture, intact right pedicle and intact posterior elements can be demonstrated.

Thoracotomy was performed via the seventh intercostal space. T6 left hemi-corpectomy was done for decompression. Pedicular fracture was detected on the left side and bone fragments inside the spinal canal were removed (Figure 1b).

Right pedicle was intact but the junction between pedicle and corpus was fractured. Dural tears were observed and repaired. Then, the fractured segment was evaluated as biomechanically unstable

Radiographic evaluation showed that a triangular bone fragment inside the spinal canal and minimally displaced corpus fracture at L4 (Figure 2a).

Laparotomy was done immediately and liver laceration, penetrating injury of right kidney and intestinal perforation was repaired.

At the same operation, right hemilaminectomy was performed by the posterior approach. Intracanalicular bone fragments was removed (Figure 2b).

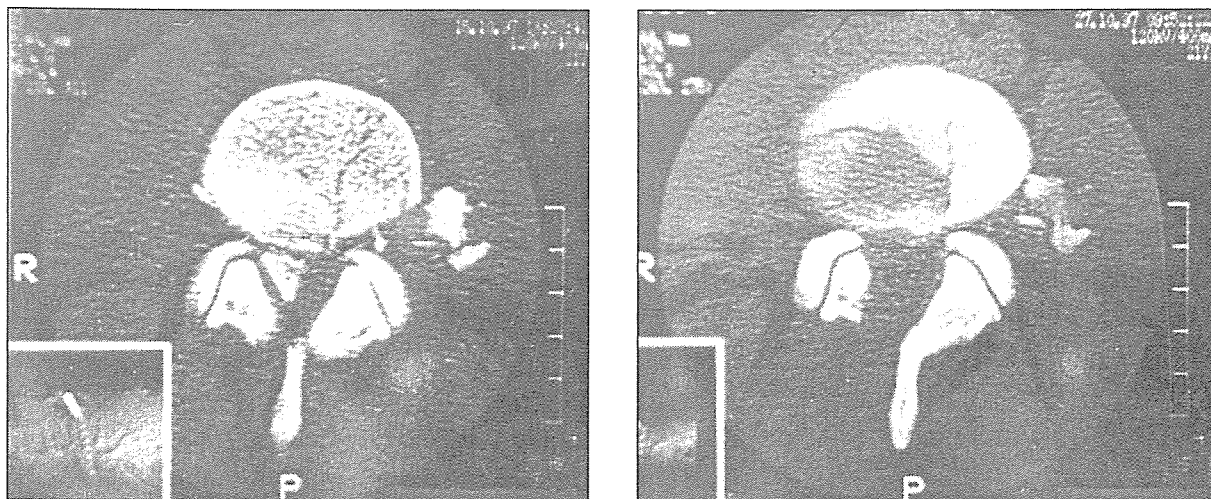


Figure 2a, b. Preoperative (a) and postoperative (b) CT images of the second case. Radiographic appearance of the fracture can be considered as biomechanically stable.

Both pedicles of L4 vertebra were fractured. The motion segment was hypermobile and unstable during peroperative evaluation. Dural defect was detected at the same level of the bone injury and repaired with dural grafting. The patient was taken to the bed rest with intravenous broad-spectrum antibiotics for infection prophylaxis (Cephazoline 2gr/day and Gentamycine 80 mg/day). On the 14<sup>th</sup> postoperative day, posterior stabilization with Alıcı spinal system and posterolateral grafting were performed. Patient was referred to a rehabilitation center, and at the last follow-up (28 months after operation) his total motor score improved from 71 to 85 and voluntary anal contraction was present.

#### DISCUSSION

Several studies were published after World War I and II regarding gunshot wounds to the spine. Increased studies after Korean War revealed some differences between civilian and military gunshot wounds in respect to mechanism, treatment and end-results (4,6,7,9).

A bullet or fragment does not need to penetrate the spinal canal in order to cause damage to the spinal cord; damage can result from the concussive effects of the bullet (10,11) Increasing the bullet velocity results in a greater kinetic energy transfer to the tissue

(11), so it is not surprising to detect extended necrotic areas adjacent to the wound.

Although removal of bullets from the spine is controversial, most of the reports suggest that the removal of bullet fragments is beneficial. This procedure allows the prevention of complications, which include cerebrospinal fluid leakage, infection, lead toxicity, pain and late cauda equina syndrome (1,10,11). Surgical decompression and removal of bullet fragments may help to neurologic recovery as well (10).

Most civilian gunshot wounds to the spine especially in the cervical region are accepted as stable injuries, although little has been published to support this common belief (3,11). Yoshida et al. have observed cases of both acute and chronic spinal instability after gunshot injuries to the lumbar spine. In these cases, the bullet passed transversely, fracturing both pedicles and facets, and they did not observe any instance of spinal instability if one pedicle and facet remained intact. They proposed that the spinal instability can be adequately determined from preoperative evaluation of the plain radiograms and CT scan (11). In our cases, spinal injuries are produced by military weapons (high-velocity missile). In first case, left pedicular fracture was observed but right pedicle was intact. However, multiple fracture at the corpus including the junction of corpus and pedicle

was present. Macroscopic instability was detected on peroperative evaluation and second stage stabilization was planned. In second case, both pedicles were fractured. But in this case, spinal instability could not be detected by preoperative radiographic evaluation. Military gunshot wounds are vital injuries for they are produced by high velocity bullets. Generally, immediate surgical intervention is mandatory for multisystem injuries. At the same time, debridement and decompression is advocated for the spinal fracture. These fractures which are produced by high velocity bullets generally are not in benign nature and it may not be possible to evaluate adequately with radiograms during the preoperative period.

Gunshot wounds of the spine are real emergencies in order to remove the bullets, decompression, debridement and irrigation of the wound, as to prevent infection (5,11). This point is especially true, for military wounds, which requires more extensive debridement. In our cases, we observed the instability increased throughout the debridement process, due to the removal of both bones and soft tissues, so both anterior and posterior stabilization were performed as the second stage of the treatment. In summary, we conclude that, preoperative radiographs may not be enough to assess the stability. and on the contrary to common belief, debridement process itself may result in instability, in gunshot wounds to the spine.

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