

Functional And Clinical Outcome Of Acute Traumatic Thoracolumbar Spinal Fractures

Akut Travmatik Torakolomber Omurga Kiriklerinin Fonksiyonel Ve Klinik Sonuçları

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SUMMARY

Aim: Disruptions of the thoracolumbar spine are often a result of high-energy injuries, the majority caused by motor vehicle accidents and falls. The sequelae of traumatic fractures of thoracolumbar spine injuries may be devastating, including paralysis, pain, deformity, and loss of function. Available therapeutic options for thoracolumbar vertebral fractures include conservative therapy, decompression, posterior reduction and instrumentation, and percutaneous vertebral augmentation procedures (VAP) with vertebroplasty or kyphoplasty. This study aims to see the acute spinal fractures surgical management's outcomes. **Materials and Methods:** Between January 2013 and August 2014, a total of 90 patients (47 males, 43 females; mean age: 53.68±17.96 years; range, 16 to 87 years) who were admitted to hospital with traumatic spinal injury were included. A careful neurological examination of both motor and sensory systems was performed. High-resolution spinal computed tomography (CT) was performed. A total of 43 consecutive patients treated with instrumentation for unstable spinal fractures and 47 patients with compression or burst vertebra fractures treated with VAP were followed. Pain was assessed using the Wong-Baker Face Scale (WFS). **Results:** Of all patients, 39 had osteoporosis (T score < -2.5). The injury types were traffic accident (32.2%), falling from a height (60%), and penetrating trauma (7.8%). A total of 24 patients had neurological deficits. Five of them were paraplegic. The mean postoperative pain score decreased and the majority of the patients returned to work earlier. The mean preoperative pain score was 5.51(±0.50), while the mean postoperative pain score was 2.38 (±0.57). After early stabilization, the motor strength scores improved. The mean preoperative motor strength (PREMS) was 3.84(±1.36), while the mean postoperative motor strength (POSTMS) was

4.081(±1.30). After stabilization surgery, one patient died due to pulmonary embolism and one patient had an infection with serosal fluid leakage in the surgical site. No other patients were lost to follow-up. We correlated the pain scores with stabilization group parameters (osteoporosis, number of fractured vertebrae, motor strength). In the osteoporosis group, there was no correlation between pain and the procedure performed. But both preoperative and postoperative motor strength were negatively correlated with pain scores (P < 0.05). The postoperative pain score was higher when the number of fractured vertebrae increased (p < 0.05). Osteoporosis and postoperative motor strength were the independent predictors of postoperative pain. **Conclusion:** In this study, both VAP and stabilization procedures reduced the mean pain scores and helped with earlier mobilization. The patients with incomplete spinal cord injuries with progressive deficits requiring decompression and instrumentation were treated as soon as they were medically stable, usually within the earliest time of injury, and this improved the postoperative motor strength.

Keywords: spinal cord injury, functional/clinical outcome, kyphoplasty, vertebroplasty.

ÖZET

Amaç: Torakolomber omurga (TLO) yaralanmaları genellikle yüksek enerjili kazalarla; çoğunlukla da araba kazaları ve yüksekten düşmeler nedeniyle oluşmaktadır. Travmatik TLO kırık yaralanma sekelleri; fonksiyon kaybı, deformite, ağrı ve paralizi gibi yıkıcı olabilir. TLO kırıklarının mevcut tedavi seçenekleri; konservatif tedavi, dekompresyon, arkadan düzeltme, enstrümantasyon ve perkutan vertebra büyütme usulleri (vertebroplasti ve kifoplasti)'dir. Bu çalışma akut spinal kırıklarının cerrahi tedavi sonuçlarını göstermeyi amaçlamaktadır. Materyal ve metod: Çalışma Ocak 2013- Ağustos 2014 arası hastanemize başvuran travmatik omurga yaralanmalı 90 hastayı içermektedir (47 erkek, 43 kadın, ortalama yaş 53.68 ± 17.96 , yaş aralığı 16 ile 87 arasındadır). Hastaların ayrıntılı nörolojik muayeneleri yapıldı ve yüksek çözünürlüklü bilgisayarlı tomografi ile tarandı. Toplam 43 ardışık hastaya hareketli omurga kırıkları için enstrümantasyon tedavisi uygulandı. Kırık yedi hasta, sıkıştırma veya patlamalı omurga kırıkları için vertebral yükseltme yöntemi ile tedavi edildi. Ağrı; Wong-Baker yüz skalası kullanılarak değerlendirildi. Bulgular: Tüm hastaların otuz dokuzunda osteoporoz mevcut idi (T skor < -2.5). Yaralanma tipleri; %32.2 trafik kazası, %60 yüksekten düşme ve %7.8 delici travmalar idi. Toplam 24 hastada nörolojik gerileme vardı. Beş hasta paraplejik idi. Operasyon sonrası ortalama ağrılar azaldı ve hastaların çoğunluğu işlerine erken döndüler. Operasyon öncesi ortalama ağrı skoru $5.51 (\pm 0.50)$ iken operasyon sonrası $2.38 (\pm 0.57)$ olarak bulundu. Erken stabilizasyon sonrası motor kuvvet skorları iyileşti. Operasyon öncesi motor kuvvet skoru ortalama $3.84 (\pm 1.36)$ iken, operasyon sonrası $4.08 (\pm 1.30)$ idi. Stabilizasyon grubunda ağrı skorlarını; osteoporoz, kırık omurga sayısı, motor kuvvet parametreleri ile korele ettik. Osteoporoz grubunda, ağrı ve yapılan girişim arasında korelasyon yoktu. Hem operasyon öncesi hem de operasyon sonrası motor kuvvetler ile ağrı skorları arasında ters korelasyon vardı ($p < 0.05$). Operasyon sonrası ağrı skorlarının, omurga kırık sayısı artması ile artmakta olduğu görüldü ($p < 0.05$). Operasyon sonrası bağımsız ağrı belirleyicileri osteoporoz ve operasyon sonrası motor kuvveti. Stabilizasyon cerrahisi sonrası bir hasta pulmoner emboli nedeniyle kaybedildi. Bir hasta isecerrahi alanda serozal akıntı nedeniyle enfeksiyon geçirdi. Başka hiçbir hasta takipte kaybedilmedi. Sonuç: Çalışma sonucunda hem vertebra yükseltme hem de stabilizasyon yöntemlerinin ortalama ağrı skorlarını azaltmakta ve erken mobilizasyona yardım etmekte olduğu tespit edildi. Dekompresyon ve enstrümantasyon gerektiren ilerleyici defisitli, stabil olmayan omurga yaralanmalarında hasta medikal olarak dengeli olduğu anda hemen tedavi edilmelidir.

Bu operasyon sonrası motor kuvvetin iyileşmesini sağlar.

Anahtar Kelimeler: Omurilik yaralanması, fonksiyonel-klinik sonuçlar, vertebroplasti, kifoplasti.

INTRODUCTION

Although the exact incidence of new cases of acute traumatic spinal cord injury (SCI) still remains to be elucidated, it is estimated that it ranges from 10 to 83 cases per million population annually worldwide (1). Spinal cord injury can occur at any age. Burst and compression fractures of vertebra account for more than half of all thoracolumbar vertebra fractures, and flexion distraction, dislocations fractures may cause a neurologic deficit and present a significant economic burden to family and society. The most common mechanism of injury is a sudden unexpected impact or deceleration due to a road traffic injury or domestic fall (1, 2, 3). Many are considered unstable from either a biomechanical or a neurological standpoint. Osteoporosis is a metabolic disorder of the bones (4, 5). Vertebral fractures (VF) are the most common complications of osteoporosis (4, 5). Of these fractures, 14% are traumatic, 83% are osteoporotic, and 3% are pathological fractures (5). The annual risk increases with age, ranging from 0.4 to 0.6% in women aged between 50 and 54 years to 1.2 to 1.35% in those 65 to 69 years old, and 2.9 to 3.8% in those aged 85 years or older (5, 6).

MATERIALS AND METHODS

A written informed consent was obtained from each patient. The study protocol was approved by the local Ethics Committee. The study was conducted in accordance with the principles of the Declaration of Helsinki. We obtained permission from ethical committee (Acceptance Nr: 25.12.2015-55727).

The traumatic spinal vertebra injury patients were admitted to the hospital between January 2013 and August 2014. A total 90 consecutive patients who were treated with either segmental instrumentation or VAP for spinal vertebral fractures were included in this prospective study. These patients represented the most severely injured subgroup of the overall trauma population treated at this level 1 regional trauma center. The treating surgeon selected each surgical treatment and instrumentation based on each patient's physical condition and the pattern and severity of spinal fracture.

All patients were victims of high-energy traumas. The mechanism of injury included motor vehicle accident for 29 (32.2%), fall from a height for 54 (60 %), and direct impact trauma (pedestrians struck by motor

vehicles) for seven patients (7.8%). Most injuries occurred between thoracic vertebra 6 and lumbar vertebra 5.

Patients with incomplete SCI with progressive deficits requiring decompression and instrumentation were treated, as soon as they were medically stable.

The different types of fractures included compression, burst, flexion-distraction, and dislocation fractures. Criteria for treatment of both operative and non-operative vertebral fracture are changing, according to kyphotic deformity, canal compromise, vertebral height loss, and neurological status (paresis, plegia).

Indications for surgical treatment included (1) three-column fractures or fracture/dislocation; (2) fractures with incomplete neurologic injuries and residual deformity or canal compromise; (3) complete spinal cord injury, in which the cast-bracing would predispose the patient ulceration; (4) abdominal or thoracic injuries which precluded the cast treatment; and (5) unstable fractures in polytrauma patients (7, 8, 9). Our treatment modality was decompression with laminectomy and long-segment pedicle screw fixation (2 above and 2 below). Oswestry disability index is an gold standard for measuring degree of disability and estimating quality of low back patient's life. We used the Wong Baker face scale (WFS) because we had language misunderstanding problems with the patients. We used Frankel scale (10). The patients were seen four weeks after surgery and two weeks after VAP. A final follow-up interview was conducted with each patient to assess the functional status after six weeks (i.e., daily activities, return to work, need for further surgery, pain level). Physical function was rated as normal, limited, severely limited, or limited by other conditions such as paralysis, amputation or head injury. Preoperative radiographs and computed tomography (CT) with or without magnetic resonance imaging (MRI) were used to categorize these three-column injuries according to the Denis classification system (11, 12). Preoperative and postoperative neurological deficits were recorded by the Frankel Grading System, and recovery or deterioration was recorded as grades of change. Preoperative motor strength (PREMS) and postoperative motor strength (POSTMS) were evaluated using the standardized motor examination rating scale (9). Pain was assessed using the Wong-Baker Face Scale (WFS).

Intraoperative fluoroscopy and radiographs were utilized to assess placement of hardware, reduction of kyphosis, and canal decompression.

Statistical analysis

Statistical analysis was performed using the SPSS for Windows v 20.00 (SPSS Inc., Chicago, IL, USA).

Descriptive data were expressed in mean \pm standard deviation, numbers and percentages. The Kolmogorov-Smirnov test was used to analyze the normal distribution of the variables. The means of related groups were compared with a paired-samples t test, while the means of unrelated groups were compared using an independent-samples t test. The Pearson's chi-square test was used to compare the qualitative data. A multiple logistic regression analysis was used to analyze independent predictor factors. The results were evaluated using a confidence interval of 95%. A p value of <0.05 was considered statistically significant.

RESULTS

In 47 VAP patients we used Spearman's nonparametric correlation variables of preoperative and postoperative pain scores, degree of vertebral height loss, osteoporosis, number of fractured vertebrae, and unilateral or bilateral VAP. Demographic characteristics patients (Table 1).

Table 1: Patient demographic characteristics.

	N (90)	%
Male	47	52,2
Female	43	47,8
Diabetes mellitus (DM)	11	12,2
Hypertension (HT)	30	33,3
Osteoporosis	39	43,3

There was only a correlation between osteoporosis and vertebral height loss percentage ($p = 0.043$, $p < 0.05$). According to preoperative and postoperative motor strength (PREMS-POSTMS), degree of height loss, degree of canal compromise (CCD), and column theory, there were correlations between degree of vertebral height loss and degree of canal compromise ($p = 0.003$) and column theory ($p = 0.00$).

There was a correlation between degree of vertebral height loss and degree of canal compromise ($p = 0.000$), as well as between vertebral height loss degree and column theory ($p = 0.014$). There were correlations between preoperative pain score (PREWFS) and postoperative pain score (POSTWFS) ($P = 0.00$), between PREWFS and PREMS ($p = 0.003$) and POSTMS ($p = 0.001$), and between PREWFS and degree of canal compromise ($p = 0.001$) and column theory ($p = 0.013$). There were correlations between number of fractured vertebrae and postoperative pain score ($p = 0.023$), degree of canal compromise ($P = 0.024$), and preoperative motor strength ($p = 0.001$). There were correlations between preoperative motor strength and degree of vertebral height loss ($p = 0.008$), postoperative motor strength ($P = 0.000$), degree of canal compromise ($p = 0.009$), and column theory ($p = 0.008$).

There were correlations between postoperative motor strength and canal compromise ($p = 0.015$) and column theory ($p = 0.0048$). There were correlations between canal compromise degree and column theory ($p = 0.000$).

Nonparametric correlation variables were used for all 90 patients. There were correlations between vertebral height loss degree (VHLD) and canal compromise degree (CCD) and column theory. There were correlations between PREWFS and POSTWFS, PRE-POST MS, CCD and column theory. There were correlations between number of fractured vertebrae and POSTWFS, PREMS, and CCD. There were correlations between PREMS and VHLD, POSTMS, CCD, and column theory. There were correlations of motor strength with canal compromise degree and column theory.

After both procedures, pain scores decreased. Both the VAP and stabilization groups were correlated with preoperative WFS and postoperative WFS ($p = 0.00$ and $p = 0.01$). In the stabilization group, there was a correlation between PREMS and POSTMS ($p = 0.000$). After stabilization, the motor strength also increased (Table 2).

Table 2: preoperative and postoperative WFS pain score and motor strength, T test

	PREMS mean	POSTMS mean	$p =$	PREWFS	POSTWFS	$p =$
VAP	4,96 (sd0.204)	4,96 (sd0.204)	-	5,47 (sd0.504)	2,30 (sd0.507)	0.00 0
STAB	3,84 (sd1.3602)	4,028 (sd1.306)	0.000	5,56 (sd0.502)	2,47 (sd0.631)	0.01

After both procedures with or without a decrease of osteoporosis pain scores, the pain scores of the osteoporotic patient group were higher than those of the non-osteoporotic group; however, there was no statistically significant difference in osteoporosis and pain scores according to the surgical procedures ($p > 0.05$) (Table 3).

Table 3: Osteoporosis and vertebral augmentation procedures and stabilization's pain score, T test

	VAP-PREWFS	VAP-POSTWFS	STAB-PREWFS	STAB-POSTWFS
Osteoporosis (-)	Mean 5.35 (sd 0.489) n:20	Mean 2.15 (sd 0.366)	mean 5.52 (sd 0.508) n:31	mean 2.39 (sd 0.495)
Osteoporosis (+)	Mean 5.56 (sd 0.506) n:27	Mean 2.44 (sd 0.506)	mean 5.67 (sd 0.492) n:12	mean 2.50 (sd 0.522)

In the Spearman's non-parametric correlation for the stabilization group there were correlations between the PREMS and POSTMS ($P=0.000$), degree of vertebral height loss ($P=0.008$), degree of canal compromise ($p = 0.009$), and column theory ($p = 0.008$). Higher PREMS resulted in improved POSTMS scores. More vertebral height loss and a higher degree

of canal compromise were negatively correlated with motor strength. There was a correlation between the POSTMS and degree of canal compromise ($P = 0.0015$) and column theory ($p= 0.048$). In addition, a correlation was found between the vertebral height loss and degree of canal compromise ($p= 0.000$) and column theory ($p = 0.014$). There was also a correlation between the degree of canal compromise and column theory ($p = 0.000$).

In addition, we correlated the preoperative and postoperative pain with VAP group parameters (i.e., osteoporosis, degree of height loss, number of fractured vertebrae, unilateral or bilateral VAP), and we found no statistically significant differences between the pain scores and parameters. However, the osteoporosis group had higher postoperative pain scores; but it did not reach statistical significance ($p > 0.05$) (Table 4).

Table 4: Pain score.

Parameters	PREWFS (pain score)		POSTWFS (pain score)	
	r	p value	r	p value
osteoporosis	0,204	0,170	0,273	0,063
Number of fractured vertebra	0,149	0,317	0,120	0,422
Vertebra height loss degree	0,097	0,517	0,077	0,608
VAP (side unilateral or bilateral)	0,173	0,245	-0,258	0,080

We correlate the preoperative and postoperative pain with stabilization group parameters (osteoporosis with the number of fractured vertebrae and preoperative postoperative motor strength; for the osteoporosis group there was no correlation ($p > 0.05$). Both preoperative and postoperative motor strength were negatively correlated with pain scores. The postoperative pain score was higher when the number of fractured vertebrae increased ($p < 0.05$) (Table 5).

Table 5: Motor strength and WFS grade

Parameters	Preop WFS		Postop WFS	
	r	p value	r	p value
osteoporosis	0,136	0,385	0,87	0,578
Number of fractured vertebra	0,272	0,077	0,345'	0,023
Preop motor strength	-0,437"	0,003	-0,485"	0,001
Postop motor strength	-0,498"	0,001	-0,605"	0,000

Physical function of the patients was normal in 47 (52.2%), limited in 32 (35.5%), severely limited in six (6.6%), and limited by other conditions, such as paralysis or head injury in five patients (5.5%). The thoracolumbar junction (T10 - L2) was the most common site of spinal column fractures (Table 5). L1 was the most common fracture site, appearing in 26.8 % of the patients. At the final follow-up, 55 patients (61.1%) were pain-free with no leg or back pain, while 34 (37.7%) reported only mild leg or back pain. One patient reported mid-upper back pain. In the VAP group, the majority of patients were over 60 years old (55.3%). The predominant sex was female (59.6%). As the study population in the VAP group was older, the percentage of osteoporotic patients was high (T score < -2.5). In this group, the rate of falling from a height was higher due to farming and riding horses. In the stabilization group (STAB), the predominant sex was male, and the percentage of the population aged lower than 40 years was higher than the others. In this group, the incidence of falling from a height was higher than that of traffic injuries, as there were more construction workers and farmers in this group. The number of fractured vertebrae were one (76.7%, n=33), two (20.9%, n=9), and three or more vertebrae (2.3%, n=1). We used eight pedicle screws in 35 patients (81.4%) (two above and 2 below the fractured vertebra), ten and more pedicle screws in seven patients (16.3%), and only four screws in one patient (2.3%).

DISCUSSION

This study's patients are a mixture of young, middle-aged and elders. They were most often employed in physical, labor-intensive occupations, such as farming (9). Osteoporosis is considered one of the major metabolic bone diseases in the world, as it leads to vertebral compression fractures, which dramatically increase morbidity and mortality (4, 13, 14). Vertebral fractures are the most common complications of osteoporosis, and the annual risk increases with age (5).

Among our patients, 43.3% had osteoporosis. Osteoporosis was particularly prevalent among female elderly patients in the VAP group.

Disruptions of the thoracolumbar spine are often a result of high-energy injuries (11, 12). Traumatic fractures of the thoracolumbar spine, particularly the thoracolumbar junction (T10-L2), are the most common fractures of the spinal column. The transition from the less mobile thoracic spine with its associated ribs and sternum to the more dynamic lumbar spine makes this an area of great biomechanical stress (10).

VF level and percentage results were similar to those in the literature (L1 = [26.8%], L2 = 21.1 %], T12 = [14.6 %], L3 = [13.8 %]).

In the present study, 90 patients had a total of 123 fractured vertebrae. The additional fracture rate (36.6 %, n = 33) was higher than in the literature, due to the presence of osteoporosis and high-energy injuries. In the stabilization group, there were nine patients with an additional fracture and one patient with three additional fractures. In the VAP group, there were 22 additional fractures (9). We found negative correlations between the motor strengths and vertebral height loss, canal compromise degree, and Denis column theory. The degree of canal compromise was shown to correlate poorly with neurological deficits (7, 8)

Most authors advocate a trial of a two to six week conservative treatment before resorting to vertebral augmentation (15, 16, 17). It appears that the kyphosis progresses and the vertebral body collapses gradually over time (12). After a four-week conservative treatment, we used minimally invasive VAP to relieve pain and prevent collapses.

Clinical comparative studies have demonstrated no difference between the unipedicular and bipedicular approaches in clinical or radiological parameters, and they have also shown pain reduction at a similar level to our study (18, 19). In this group, the population over 60 years old was the largest (55.3%). The predominant sex was female (59.6%) (13,14), and the percentage of osteoporotic patients was high (57.4%) (4, 13, 14). As women in the elderly population mostly worked on farms, particularly picking fruit from trees and riding horses, falling from a height in this population was more common than the other kinds of injuries. After the VAP, pain reduction improved, and all patients were able to ambulate without orthosis on the day of the procedure and were discharged home.

The advantages of VAP include reduced pain, improved cosmetic, lower postoperative morbidity and earlier return to activity. The duration of analgesic medicine use can be also reduced (12, 20). In the present study, the patients used pain killers, when required, during their four-week bed rest and after surgery.

Furthermore, we had seven (14.8%) cement leakages: three in the perivertebral area, three in the inter disc space, and one in the spinal canal. The rate of cement leakages was lower than reported in the literature, as we used a drill and curette to create a cavity in the vertebrae body and we used high-viscosity cement under low pressure (4, 21, 22, 23). All patients with cement leakages remained asymptomatic. Cement leakage, as shown in a meta-analysis, ranges from 18.1% in KP and 41.1% in VP up to 72% in VP (extravasation rates significantly vary between operators, as a result of different reporting techniques and modalities [CT versus X rays] (4, 21, 22, 23, 24).

In the stabilization group, the predominant sex was male and the percentage of the population aged lower than 40 years was higher than the others. In the stabilization group, the rate of falling from a height was higher than that of traffic injuries (9), as young construction workers and farmers were sometimes not careful working at a height (such as a fruit tree).

The different types of fractures included compression, burst, flexion-distraction, and dislocation fractures. Criteria for treatment of both operative and non-operative vertebral fracture are kyphotic deformity, canal compromise, vertebral height loss, and neurological status (paraparesis, paraplegia). When the neurologic involvement is significant, the choice of operative management is emergent (10).

After four-week conservative treatment consisting of postural reduction, bed rest, body cast/ orthosis, functional rehabilitation, or a combination treatment after conservative treatment, neurologically intact patients with thoracolumbar burst or compression fractures may have intractable pain. Minimally invasive vertebral augmentation procedures (VAP) such as vertebroplasty (VP) or kyphoplasty (KP) can be used.

The decision to perform surgery depends on the location of the fracture, the degree of vertebral destruction, the presence of neurological involvement, the degree of kyphosis, and the stability of the posterior column structures (12, 25). We had 25 flexion distraction fractures and 18 dislocation fractures. No patients experienced neurological deterioration following surgery. Five patients were still paraplegic, six patients with incomplete injuries improved at least 1 modified Frankel Grade during follow-up (range, 1 to 2 grades), and 32 patients had the same neurological state both in the preoperative and postoperative period.

We used posterior pedicle screw fixation systems for the thoracolumbar bursts and unstable fractures. The procedure was efficient, reliable, and safe for reduction and stabilization, in consistent with the previous findings (9, 10, 24, 26). The advantages of surgery

include improved correction of kyphotic deformity, improved initial stability and opportunity to perform direct indirect decompression of neural elements, decreased requirements for external immobilization, and earlier pain relief and earlier return to work (9, 10).

Although some patients with major neurological deficits returned to work, their functional outcome was clearly more related to the residual neurological integrity than any other social parameters. The VAP group patients returned to their previous levels of employment; however, in the stabilization group, 19 (44.1%) worked full-time but in a lighter work, 13 (30.2%) worked only part-time, and 11 (25.8%) were disabled and not working at all. Education, training, job satisfaction, criminal record, and other confounding variables on return to work after spinal trauma were the main reasons (9). Patients accepted lighter-duty works, due to back pain or leg pain. Female patients attained a significantly higher rate of return to work than men. Younger patients were more likely to return to full duty than their older counterparts (9).

Among patients with normal neurological function, residual radicular or neuropathic pain still impaired activity more frequently than did back pain, and among those patients whose residual back pain was severe enough to impair activity or work, the main causes were pseudoarthrosis, instability, or sagittal imbalance (9). At the final follow-up, 55 patients (61.1%) were pain-free with no leg or back pain, 34 (37.7%) reported only mild leg or back pain, and only one reported mid-upper back pain.

Despite the injuries and the extent of surgical treatment needed to treat them, morbidity and mortality were lower than expected. Early stabilization with minimal morbidity and rapid mobilization of patients decreased the complications including pneumonia, urosepsis, and infection of the surgical site (12). We had only one wound infection and one pulmonary embolism.

After both the VAP and the STAB procedures, postoperative pain scores decreased ($p < 0.05$) (27). After early stabilization procedures, motor strength increased ($p < 0.05$) (4, 5).

We correlated the pain scores with VAP group parameters of osteoporosis, degree of height loss, number of fractured vertebrae, and unilateral or bilateral VAP. There were not statistically significant differences between them ($p > 0.05$) (4, 5).

We correlated the pain scores with stabilization group parameters (osteoporosis, number of fractured vertebrae, motor strength). In the osteoporosis group, there was no correlation between pain and the procedure performed. But both preoperative and postoperative motor strength were negatively correlated with pain scores ($p < 0.05$). The postoperative pain score was higher when the number of fractured vertebrae increased ($p < 0.05$). Osteoporosis and postoperative motor strength were the independent predictors of postoperative pain.

On the other hand, this study has some limitations, such as the small sample size and short follow-up period. In addition, the patients were unable to be randomized to treatment, and there were no control subjects.

CONCLUSION

In conclusion, despite the sophistication of modern injury analysis schemes and modernized instrumentation techniques, the main goal of treatment remains unchanged; that is, to protect or recover neurological function, to prevent pathological collapses or deformities of the spinal column, to maximize clinical outcomes, and to maintain the patients independence and functional physical status, while avoiding prolonged hospitalizations and bed rest. According to our study results, both VAP and STAB procedures reduce the pain scores and allow earlier mobilization. Patients with incomplete SCI with progressive deficits requiring decompression and instrumentation were treated as soon as the earliest time of injury, and this improved their POSTMS.

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