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Evaluation of Safety and Accuracy of Decompression and Transpedicular Fixation of Dorsal Column in Traumatic Fracture

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Abstract: **Object**: Transpedicular instrumentation systems afford notable benefits, such as inflexible segmental stabilization, achieving stability of the three sophisticated elements comprising the structure of the spinal column, and it is crucial to emphasize the prospective assessment of the precision and safety of pedicle screw positioning analysis for unstable fractures management in the dorsal spine. **Methods and patients:** This prospective investigation was carried out over a duration of two years at Erbil Teaching Hospital, spanning from January 2015 to March 2021. A total of 46 patients, comprising of individuals of both sexes (38 males and eight females), Individuals spanning the ages of 16 to 70 were enlisted in the research, with an average age of 43 years among the participants. Stabilization of the fractures surgically on the posterior side was performed by using pedicular screws prior to being discharged. Each patient received postoperative thoracic CT imaging with 3mm axial sections and sagittal reconstructions for the assessment of pedicular screw placement. **Results**: Records documenting after-operation follow-ups within five months were reviewed. Out of the 402 pedicle screws inserted in the thoracic region, 266 (66.19%) were the entirety of them resided enclosed in the wall of the pedicle, whilst the residual 136 (33.8%) exhibited a deviation from the pedicle wall. Out of the total 136 cases of deviation, 72 (52.9%) were found to be lateral perforations, while 54 (39.7%) were identified as medial perforations, and 10 (7.35%) were categorized as anterior perforations. The prior-to-operation average of the vertebral body kyphosis was 29.50 with a standard deviation of ±5.10. The last follow-up measurement showed a reduction to 13.30 with a deviation from the norm of ±2.60. The average vertebral compression height prior to surgery was 0.2.1 with a deviation from the norm of ±0.03, whereas at the last follow-up, it was 0.16 with a standard deviation of ±0.02Prior to surgery. No detrimental neurological, vascular, or visceral impairments were identified during or after the procedure. Conclusion: Surgical intervention involving decompression and posterior instrumentation through the implementation of pedicle screws and rods has culminated in efficacious canal decompression and superior anatomic reinstatement; this study demonstrates that it is feasible to achieve a reasonably corrected kyphotic deformity in unstable fractures of the dorsal spine with a high degree of accuracy that is considered acceptable. However, it is important to note that even experienced surgeons may encounter the occurrence of an unacceptable screw placement.

Keywords: Pedicle screw; Transpedicular fixation; Dorsal column; Traumatic fracture; Decompression.

INTRODUCTION

The objectives of thoracic fracture treatment are to restore dorsal column stability as well as neural canal decompression. This should lead to the prompt early movement of the patients (Knop, C. *et al*., 2002). The suitable management of fracture of dorsal vertebrae continues to be a topic of debate (Yue, J. J. *et al*., 2002; Modi, H. N. *et al*., 2009). Various perspectives exist for each approach; the range of techniques used for stabilization has evolved over time, from conservative approaches that utilize positioning aids to more modern methods that involve the use of implantation systems posteriorly and anteriorly, you have demonstrated that both methods have their imperfections. And more work is necessary to achieve an optimal mode of administration (Yue, J. J. *et al*., 2002; Dai, L. Y. *et al*., 2008; Shin, T. S. *et al*., 2008). Injuries to the spinal column constitute roughly 3%-6% of all trauma cases (Looby, S. and Flanders, A. 2011). Approximately 30% of patients who have sustained multiple injuries (polytrauma) also suffer a spinal injury (Heinzelmann, M. and Wanner, G.A. 2008). Over 50% of thoracic and lumbar traumas take place within the intervertebral space of T11 and L1. In general, about 20 to 40 percent of these fractures are associated with functional impairments neurologically (Meena, S. *et al*., 2015).

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Research epidemiologically shows that fractures of the dorsal column are one of the most commonly occurring fractures in the youthful and vigorous demographic. Additionally, it is noted that such fractures are more prevalent in males (2/3) as compared to females (1/3). The highest incidence of spinal fractures occurs during the age range of 20 to 40 years. Numerous epidemiological studies have demonstrated that fractures affecting the thoracic and lumbosacral regions of the spine are considerably more prevalent than those involving the cervical spine. A comprehensive analysis conducted by Sekhon and Fehlings discovered that a majority of spinal injuries, amounting to 55% and encompassing all spinal injury types, afflict the cervical spine. Moreover, the thoracic, lumbar, and lumbosacral spines were afflicted in 15% of cases each (Heinzelmann, M. & Wanner, G.A. 2008). The thoracolumbar vertebrae exhibit the utmost rigidity and strength among all the vertebrae, necessitating a substantial amount of force to cause disruption at this level (Gumm, K. *et al*., 2012). Nonetheless, the zone at which the thoracic and lumbar regions meet is frequently susceptible to axial skeleton damage. This area is susceptible due to being the anatomical and mechanical transitional zone amidst the comparably inflexible thoracic and the more elastic lumbar spine (Dai, L.Y. 2012). The forces running through the rigid, curved thoracic spine suddenly transition to the flexible, inwardly curved lumbar vertebrae at the point where the two meet – the thoracolumbar junction (Muralidhar, B.M. *et al*., 2014). Fractures may lead to neurological impairments stemming directly from the damage incurred to the spinal cord. Failure to make a prompt diagnosis could result in a gradual decline in neurological functioning. Typically, fractures within the vertebral region are marked by a high degree of instability, leading to a pronounced kyphotic deformity (Singh, R. *et al*., 2011). Fractures of the spine, particularly those that are accompanied by injury to the spinal cord, present a complex surgical, social, and economic challenge. Until approximately three decades ago, spinal fractures were exclusively managed through non-operative means, with no implementation of surgical stabilization. This form of therapy necessitated extended immobilization in a cast, thereby leading to a variety of complications (Milenkovi, S. *et al*., 2010). The contentious issue of managing traumatic dorsal column fractures and lumbar spine persists. Fractures may receive treatment through either operative or conservative approaches. Surgical intervention is a contemporary approach to managing fractures of the spinal column (Verlaan, J.J. *et al*., 2004).

The optimal outcomes can be achieved through surgical intervention, which is regarded as a secure and efficacious mode of treatment. The decompression and transpedicular screw fixation procedure are considered one of the most remarkable approaches in surgical treatments (Milenkovi, S. *et al*., 2010). Non-surgical interventions are generally discouraged for individuals with noteworthy instability or neurological compression. Surgical intervention is typically contemplated for thoracolumbar fractures that are deemed unstable or possess the capability of producing additional neurological impairment. The breach of the posterior longitudinal ligament has been linked to heightened spinal instability, signifying the requirement for surgical intervention, as these anatomical structures demonstrate insufficient regenerative capacity (Good, C.R. 2011). The utilization of transpedicular instrumentation systems was considered highly advantageous owing to their distinct benefits, such as robust segmental fusion and stabilization of all columns of the spine, fewer incidences of implant-osseous interface failure, prompt post-operative early movement facilitated with skilled and expert nursing, and little risk of complications. Furthermore, the use of a screw for fusion in the pedicle and the presence of undamaged vertebral elements posteriorly are not compulsory. The pedicle sustains the complete range of stresses transmitted correlated with the rotational, lateral flexion, and extension movements of the vertebral column. Neurological damage is a crucial determinant of the magnitude of spinal injury. The occurrence of a neurological deficiency is a compelling sign that surgical intervention is necessary (Ravikanth, M. *et al*., 2016). Surgical spinal canal decompression is presently a globally embraced therapeutic method for traumatic fractures affecting the thoracolumbar spine that exhibit neurological deficits and/or evident indications of severe spinal instability. The justification for this practice is based on the conviction that such an intervention is capable of inducing or amplifying neurological recuperation (Wang, L. *et al*., 2014).

The concept of safety becomes ambiguous when it is related to PSF, which presumably possesses a low probability of occurrence of disastrous incidents. Accuracy can serve as an alternative to guarantee safety. Considering the potentially augmented hazard of inappropriate screw

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placement that could arise in thoracic trauma cases, accuracy in identifying the safety of this methodology becomes significant, particularly in a sample exclusively composed of patients suffering from precarious fractures in their thoracic spine structure. Our research delves into examining the precision and safety factors of utilizing pedicular screws during reduction by the open wound as well as the internal fixation surgery, specifically in instances of severe damage related to the thoracic spine.

METHODS

This analysis constitutes a prospective assessment of a group of individuals encountering unstable fractures in the dorsal column who were treated using the spinal fusion by the posterior method. The concept of instability which remains a topic of debate. The determination was made through a comprehensive clinical and imaging assessment, adhering to the TILCS classification system (Joaquim, Andrei F. MD. *et al*., 2011). This prospective investigation was carried out over duration of six years at Erbil Teaching Hospital, spanning from January 2015 to March 2021. A total of 46 patients, a group of individuals representing both genders (38 males and eight females), with ages spanning from 16 to 70 years, were enlisted for the research. The average age of the participants was 43 years. Surgical stabilization of the fractures on the posterior side was performed using pedicular screws. Each patient received a postoperative dorsal CT arm with 3-mm axial cuts and sagittal reconstructions to assess the placement of the pedicular screws prior to discharge.

Twenty-two patients exhibited preserved neurological status, eighteen endured complete neurological impairments, and six had sustained incomplete neurological injuries. The fracture patterns comprised of fracture dislocation type in 24 instances, burst fracture type in 18 cases, and flexion-distraction in 4 instances.

Exclusion criteria encompassed patients who necessitated PSs beyond T-11 or above T-1, necessitated anterior decompression, or exhibited non-traumatic or delayed posttraumatic pathological spinal conditions.

Surgical observations during the procedure, the nature of the surgery performed the timeframe of hospitalization, and the mortality record. The examination of diverse parameters was conducted in accordance with conventional statistical analysis. The results were carefully examined utilizing the Statistical Package for the Social Sciences (SPSS) version 20.0 the classifications of outstanding and commendable were deemed acceptable, whereas the classifications of average and substandard were regarded as inadequate.

Imaging Evaluation

CT scans were procured from all the patients through helical acquisition, with each slice having a breadth of 3 mm. The aforesaid slices were subsequently reassembled with a thickness of 1.5 mm. The CT postoperatively analysis involved the assessment of the placement of the pedicular screws. The pedicle screws (PSs) in the current investigation were grouped as positioned wholly inside the confines of the pedicle or transgressing the wall of the pedicle. Moreover, the screws were additionally categorized based on the site of the perforations (lateral, medial, and anterolateral, anteromedial, inferior, superior, and anterior) and the extent of perforation. The assessment of the extent of perforation was conducted through four discrete categories, namely: Grade one (ranging from 0 to 2.0 mm), Grade two (ranging from 2.1 to 4.0 mm), Grade three (ranging from 4.1 to 6.0 mm), and Grade four (ranging from 6.1 to 8.0 mm).

After being discharged from the hospital, each patient was scheduled for follow-up appointments at five-month intervals, ten-month intervals, and fifteen-month intervals following the surgical procedure. At every subsequent visit, a thorough clinical assessment of the wound, a comprehensive neurological evaluation, and anterior-posterior radiographic views in an upright position were performed to assess the degree of kyphotic angulation, the advancement of fracture consolidation, and the progression of post-operative deformity and instrumentation failure.

RESULTS

Records documenting after-operation follow-ups within five months were reviewed. Out of the 402 pedicle screws inserted in the thoracic region, 266 (66.19%) were the entirety of them resided enclosed in the wall of the pedicle, whilst the residual 136 (33.8%) exhibited a deviation from the pedicle wall.

Among these 136 cases of deviation, 72 (52.9%) were observed to be lateral perforations, 54 (39.7%) were medial perforations, and 10 (7.35%) were anterior perforations Figure 1.

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No perforations of inferior, superior, anteromedial, or anterolateral nature were found within the cortical region.

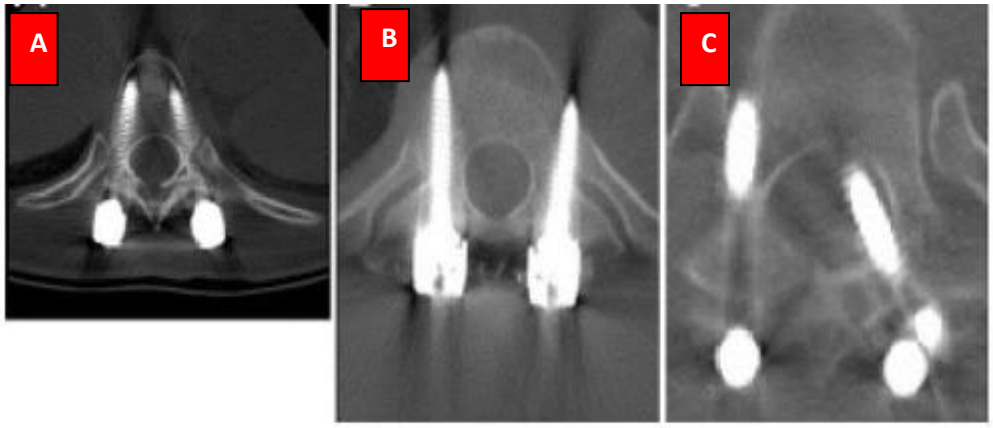

Figure 1: Postoperative computed tomography (CT) scan exhibiting

A: placement of pedicle screws (PSs) completely within the confines of the pedicle walls.
B: PSs placement with violation of the lateral wall.
C: PSs placement with penetration of the medial wall.

A total of 402 PSs were placed. In terms of PS distribution between thoracic spine-1 and thoracic spine-12, the majority of screws were positioned between dorsal (thoracic)-3 and dorsal (thoracic)-10 (Figure 2,3,4,5)

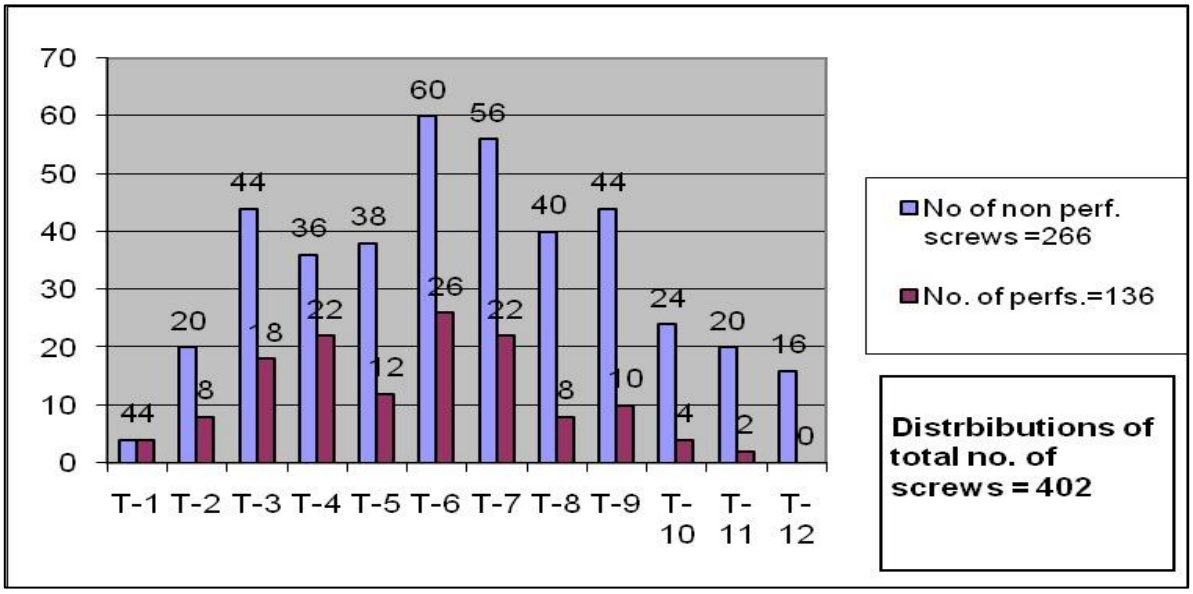

Figure 2: Comparison of the total number of screws to the number of perforations. Screws

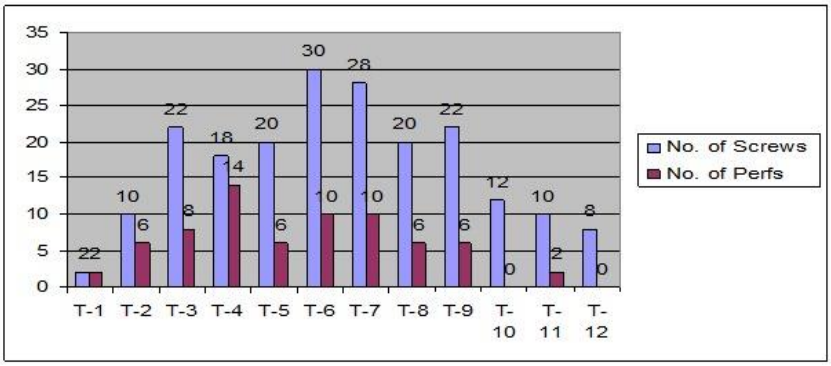

Figure 3: Comparison between the total number of screws and the number of perforations on the right side. Total number of screws on the right side is 202.

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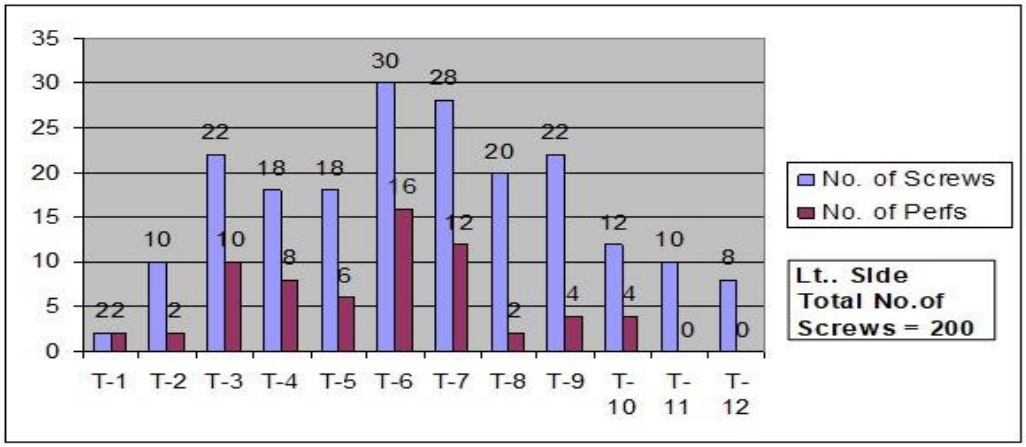

Figure 4: Comparison of the total number of screws with the number of perforations: the total number of screws on the left side is 200.

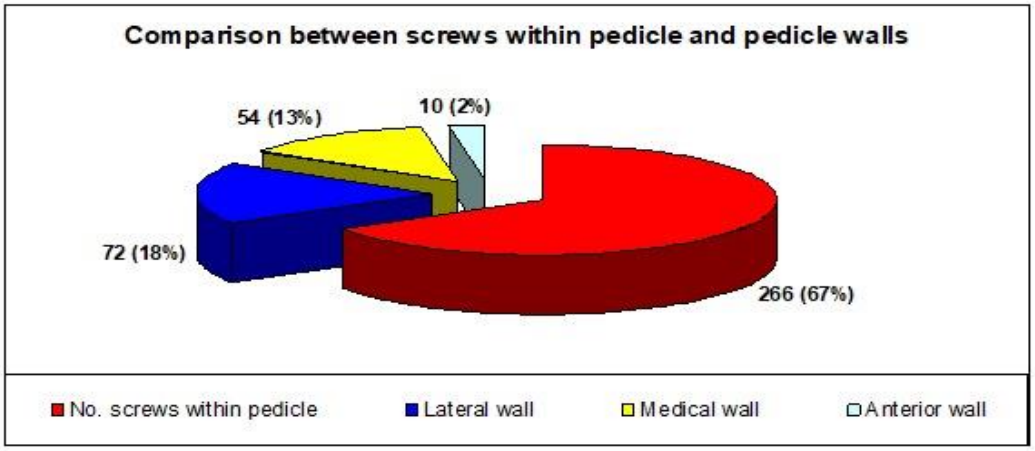

Figure 5: Comparison between screws within and pedicle walls

72 (17.9%) of the 402 PSs were found to have lateral wall violations. Of the 72 screws, 38.8% (28 screws) contained a Grade One violation, while 38.8% (28 screws) had a Grade Two violation. Additionally, 19.4% (14 screws) featured a Grade three violation, while only 2.773% (2 screws) contained a Grade four violation. Notably, the Grade Four violation was situated within a short distance of 6.5 mm from the body of vertebrae in the lateral border, as indicated in Figure 6 (A&B).

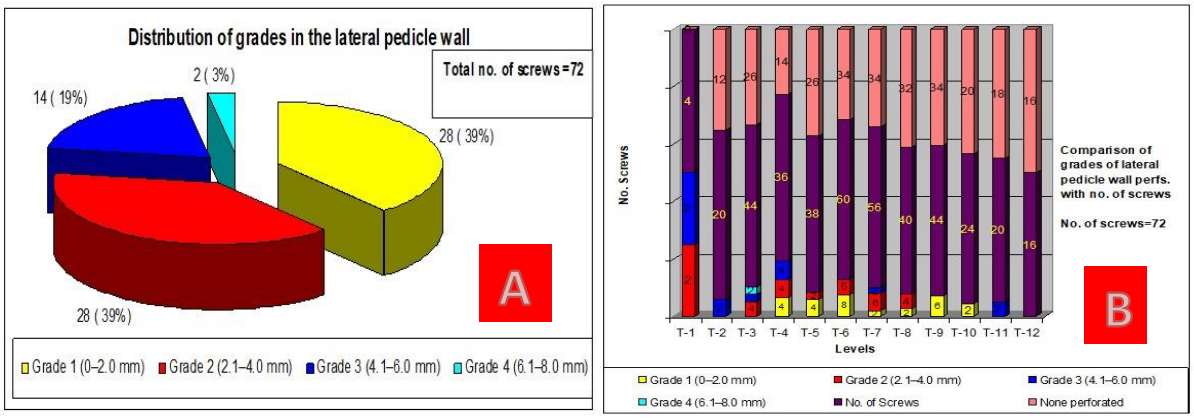

Figure 6: (A&B) Comparison of the location and degree of lateral pedicle wall perforation with the number of screws used.

54 (13.4%) of the 402 PSs were found to have violations of the medial wall. Among these, 32 screws (59.2%) exhibited a Grade one violation, 18 (33.3%) exhibited a Grade two violation, 2

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(3.7%) exhibited a Grade three violation, and 2 (3.7%) exhibited a Grade four violation.

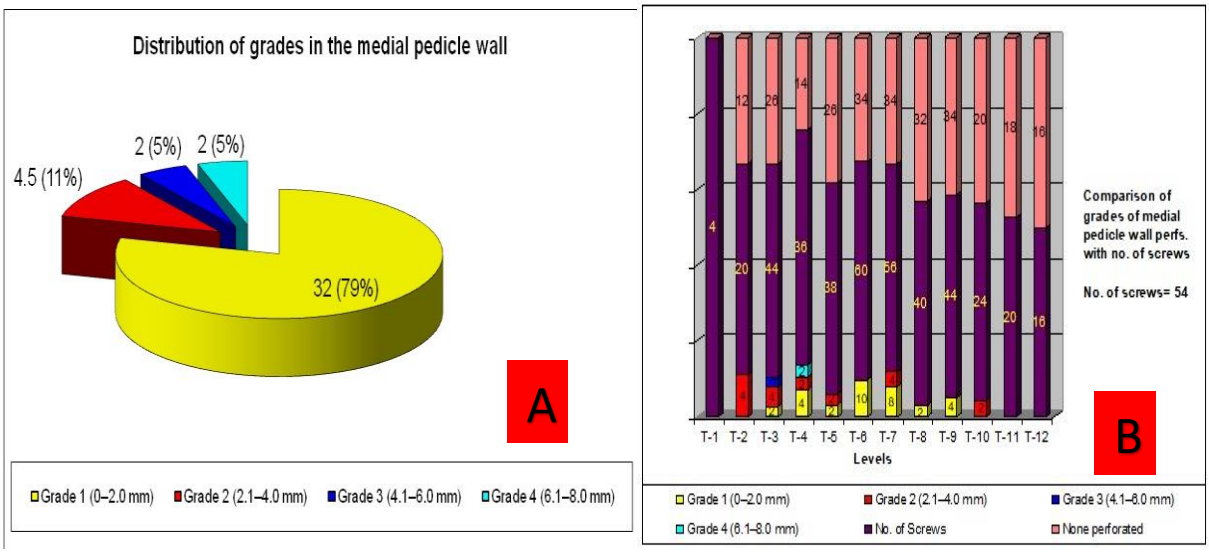

Figure 7: (A&B) Comparison of location and degree of medial pedicle wall perforation with number of screws.

Ten (2.5%) of the 402 PSs exhibited anterior wall violations. Among them, 80.0% had Grade one violations, and the remaining 20.0% had Grade two violations Figure 8 (A&B).

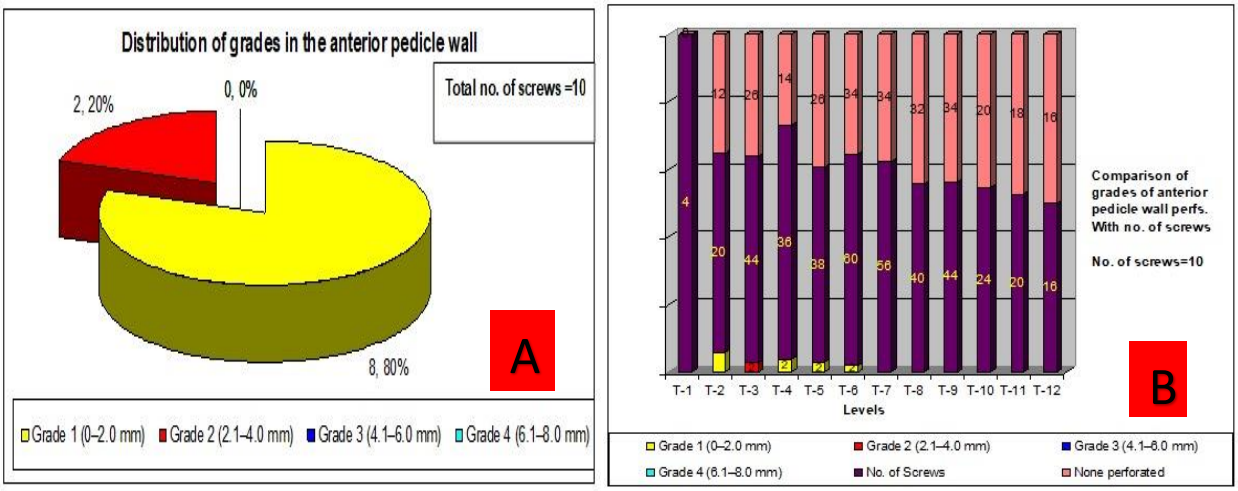

Figure 8: (A&B) Comparison of the location and extent of medial pedicle wall penetration with the number of screws used.

The pre-operative average of the vertebral body kyphosis was 29.10, with a standard deviation of ±5.10. The final follow-up measurement showed a reduction to 11.30 with a standard deviation of ±2.70. The Mean vertebral compression height prior to surgery was 0.2.1 with a standard deviation of ±0.03, whereas, at the final follow-up, it was 0.16 with a standard deviation of ±0.02Prior to surgery (Table 1). No detrimental neurological, vascular, or visceral impairments were identified during or after the procedure.

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Table 1: Measurement of deformities in the affected vertebral segment of the study patients (n=46) was conducted preoperatively, immediately postoperatively, and during final follow-up after 15 months.

Variable	preoperative	Postoperative Immediate	Last follow-up After 15 months	P value
Kyphotic deformation of the vertebral body	29.1±4.4	7.4±1.4	11.0±2.7	<0.05s
Measurement of compression deformity	0.21±0.05	0.10±0.05	0.12±0.06	<0.05s

s= significant, Level of significance= 0.05 (5%) P-value reached from F-test (ANOVA)

DISCUSSION

Every day, we confront the perilous likelihood of experiencing traumatic injuries to our spinal column. Regrettably, traumas concomitant with spinal cord impairments constitute one of the most incapacitating pathologies that a patient and a physician may confront. Following non-invasive interventions, there are numerous accounts of spinal stenosis exacerbation, leading to augmented pressure on the vertebral body and worsened neurological function. Nevertheless, proponents of surgical intervention indicate that patients can anticipate prompt mobility, carry out remedial measures, ameliorate anatomical fractures, rectify lordosis, and improve, in the majority of situations, neurological function via decompression and fixation (Singh, R. *et al.*, 2014). Surgery is recommended for thoracolumbar fractures that are unstable in order to alleviate pressure on neural components, forestall the potential for future neurological afflictions resulting from these unstable fractures, and enable rapid mobility to circumvent the ramifications of prolonged immobilization (Rehman, R.U. 2011).

According to Khan *et al*., (2008), the objective of treating a thoracolumbar fracture is to attain expeditious neurological decompression and stabilization, with the aim of promoting prompt rehabilitation. The pedicle provides a robust junction for the posterior elements with the vertebral corpus. The employment of pedicle screw fixation transformed the arena of spine surgery (Khan, A.A. *et al*., 2008). It is regarded as biomechanically superior to alternative stabilization constructions or parapedicular screws and exhibits remarkable rigidity. It has swiftly emerged as one of the most favored approaches for achieving a robust fusion. So, instrumentation utilizing pedicle screws is a frequently employed procedure for the purpose of rectifying deformity and providing stabilization to the spine until osseous fusion transpires (Khan, I. *et al*., 2008).

Spinal trauma is a prevalent occurrence amongst the youthful, predominantly male population of our nation, despite their good physical state. Such is the revelation of this study, as indicated by the average age of patients being 43 years (with a range of 16-70 years). Around 24 (52.17%) of the patients are situated in the age bracket of 16-32 years, constituting the highest proportion of the sample. Alam and colleagues (2011) executed a study on a group of twenty-two patients whose average age was 32.13 years, and their ages ranged from 17 to 66 years old. This finding corresponds with the present study (Alam, M.S. et al., 2011). In terms of gender distribution, the study revealed that there were 38 male participants (82.60%) and eight female participants (17.39%), resulting in a ratio of 4.75 males to each female (M: F). Ovalle, Rios, and Balbuena (2013) evinced those 43 cases (71.7%) belonged to the male gender, whereas 17 individuals (28.3%) were women. The patients' age range spanned from 16 to 84 years, with a median age of 35 years recorded. The age bracket ranging from 31 to 45 years constituted the most sizable cohort within the demographic group of patients (Ovalle, F.A.T. *et al*., 2014).

This study, which analyzed 402 thoracic PS placements, did not reveal any neurological, vascular, or visceral injuries. Nevertheless, it is noteworthy that the research power was limited when examining safety issues. These findings are in line with the only other published studies that have evaluated the placement of thoracic PS. Yue and colleagues conducted a prospective study on the implantation of 222. The of dorsal pedicle screws among trauma patients was devoid of any unfavorable occurrences. Nonetheless, their findings may be deceptive as neither our investigation nor that of Yue *et al*. possessed adequate power to examine the safety aspect (Yue, J.J. *et al*., 2002).

Ensuring safety entails considering a broad range of outcomes, where death or paralysis represents the direst consequences. Given the gravity of these

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outcomes, a large cohort would be necessary to analyze their frequency. To gauge safety, however, we opted to measure accuracy instead. Although Yue and colleagues conducted an evaluation on the efficiency of dorsal pedicle screws, they didn't evaluate the precision of their insertion. Notably, their study excluded patients with pedicle diameters smaller than 7 mm, and all three surgeons employed the same surgical technique with the aid of fluoroscopy.

(Kuntz *et al*., 2004). also examined the effectiveness of pedicle screws in a series of surgical procedures performed by a single surgeon who employed the C arm in all instances. Nevertheless, the analyzed research sample presented a heterogeneous assemblage of patients with varying etiologies and levels of severity. Consequently, approximately ½ of the 209 screws scrutinized in the study were restricted to the dorsal spine.

66.2% (266 screws) of the inserted screws exhibited PS containment, while 33.8% (136 screws) portrayed pedicle wall violation. These rates are quite commendable when compared to the literature, Whereas the utilization of anatomical landmarks and fluoroscopy as surgical tools yielded a success rate of merely 42% (White, A.A. & Panjabi, M.M. 1979).

Observations revealed violations of the wall of the pedicle were exclusively observed in the medial, lateral, and anterior orientations. It is intriguing to detect the absence of any inferior perforations that could potentially jeopardize the safety of the nerve root at the exiting site. This discovery is consistent with the existing body of literature (Belmont, P.J. 2001). as reported, Grade one perforations were observed in 16.9% of the screws (68 out of 402), while Grade two, three, and four perforations were detected in the remaining 16.9%.

According to our findings, the predominance of the anterior perforation was mainly attributable to the tapered tip of the screw, situated at an appropriate spatial separation from the visceral components. While the current position is deemed suitable for grading criteria, we recommend utilizing a screw with a length 5mm shorter than what is indicated on the depth gauge to avoid perforating the anterior cortex. We do not recommend bicortical purchase and advice against it.

The violation of the lateral cortex was probably caused by wrong assessments of the transverse angle of the pedicle, leading in the adoption of an "in-and-out" processes for the inserting of screws in the pedicle; this technique has been recognized in the literature as an insertion method located outside of the pedicle.

The study conducted by Dvorak and colleagues (29) demonstrated the safety and biomechanical stability of this insertion technique. Moreover, it is noteworthy to mention its remarkable resilience against external impacts due to its efficient safeguarding by the rib heads enclosing the thoracic cavity. Surgeons often prioritize avoiding the spinal canal when inserting screws, particularly in cases where the thoracic pedicles are small. However, this can increase the likelihood of lateral wall violations, as noted in the research carried out by Kuntz and associates (Kuntz, C. IV. *et al*., 2004). While our own study did not report any anterolateral violations, it is important to note this potential risk when utilizing this technique. Ensuring a bony endpoint whilst conducting depth-gauge assessment and opting for a significantly smaller screw it is paramount to avert the occurrence of. Any potential injury to the aorta on its side.

Medial perforations exceeding 2 mm possibly arose due to evaluated wrongly of the angle between transverse processes and the pedicle. It is plausible to consider medial penetrations over 4 mm as significant, as a hypothetical "safety zone" must be taken into account before encountering neurological complications (Gertzbein, S.D. & Robbins, R.E. 1990).

Based on the information available, our records are indicated that two screws were positioned in the medial aspect, surpassing the safe distance of 4 millimeters. One screw was situated at dorsal spine three and was classified as a Grade three infringement (4.1–6.0 mm), while the other was located at dorsal spine four and was labeled as a Grade four violation (6.1–8.0 mm). These occurrences happened to the same case, who had suffered from complete neurological damage before the operation. The physician carrying out the operation detected this medial wall perforation during the surgery; still, given the patient's neurologically complete damaged, and the firm grip of the screws, he chose not to inspect the screws. Upon thorough examination of the CT scans, the aforementioned surgeon deduced that the supervision of the patient was adequate, and the screws did not require modification. Although the veracity of this strategy is arguable, the

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determination to uphold the utilization of screws is founded on a discernment of the potential risks versus benefits, which takes numerous factors into account, leading to further observation. It is crucial to bear in mind that even experienced surgeons can misposition screws. Therefore, it is essential to be cautious, maintain meticulous techniques, and conduct diligent clinical and imaging follow-up protocols.

Gertzbein and Robbins (Gertzbein, S.D. & Robbins, R.E. 1990). Initially hypothesized that a medial pedicle screw violation of around 4 mm would be an appropriate position for the thoracic region, as it leaves sufficient space in the safety zone consisting of a 2 mm gap for the extradural area and another 2 mm for the subarachnoid space filled with cerebrospinal fluid. However, this hypothesis was solely based on a T-8 CT myelogram acquired from a single patient. Based on post-mortem examinations, lateral perforations of more than 6.8 mm may be deemed acceptable, as the rib head provides protection against screw penetration to the chest cavity (Dvorak, M. *et al*., 1993).

Despite the parameters, our study results indicate that out of 402 screws, only 266 (66.2%) were completely contained within the pedicle. However, upon further examination, we discovered that a total of 396 screws (98.5%) were acceptably positioned, with only three screws being deemed unacceptable due to one anterior perforation and two medial perforations.

The determination of a satisfactory screw placement is a topic of debate. The magnitude of the sample used in this analysis was determined utilizing an anticipated clinical failure rate of 15% for the insertion of PS. This percentage was derived from the existing literature (Belmont, P.J. *et al*., 2001; Gertzbein, S.D. & Robbins, R.E. 1990).

The inability to successfully insert a PS is commonly defined as a Grade 1 wall violation, which is measured to be greater than 2 mm. Nevertheless, the detrimental clinical effects may not become evident until a Grade 2 wall violation, which is greater than 4 mm, takes place. According to a study (Belmont, P.J. *et al*., 2001)' the frequency of this degree of wall penetration is significantly lower in surgical procedures that are performed to fix deformities. For this reason, the present research lacks sufficient power to accurately determine the actual prevalence of "clinically safe" transgressions of the pedicle wall.

Localization of pedicle screws through radiography can be rather arduous. Prior researchers have conveyed imprecise detection of misaligned screws while utilizing unenhanced radiography (Berlemann, U. *et al*., 1997).

The utilization of a CT arm is the most advantageous modality employed to determine the size and malposition of the implant. The assessment criteria of CT scans utilized to establish accuracy in this study have been subjected to scrutiny regarding their dependability and authenticity. Despite the kappa statistics reported being commendable, the CT scans' positive predictive value during validation testing amounted to 95%, whereas the negative predictive value was merely 62%. As a result, the evaluation of CT scans may lead to an exaggerated estimation of improperly positioned screws, coupled with a predisposition to favorably skew the precision of screws beyond their authentic reported values. [(32)] The findings of the current research divulged no connections between the surgical factors and precision. Nonetheless, it lacked the necessary potency to achieve this task.

The pre-operative average height of vertebral compression was recorded as 0.21 with SD±0.03, while at the final follow-up, it reduced to 0.12 with SD±0.02. Notably, Sapkas *et al*. (2010) demonstrated that prior to surgery, the Cobb angle was 17.5, which reduced to 6 degrees at the last follow-up. Similarly, the kyphotic deformation of the vertebral body prior to the operation was 29.50 degrees, which decreased to 13.30 degrees at the final follow-up. Moreover, the pre-operative Beck index was recorded at 0.60, which increased to 0.92 at the last follow-up, which is in close proximity to the findings of my study (Sapkas, G. *et al*., 2010).

However, Proficiency in anatomical intricacies and potential ramifications is indispensable for those practicing this technique. The results of our study, which revealed the presence of two improperly positioned medial screws and one anterior screw that was excessively extended, emphasize the critical importance of receiving adequate training and being cognizant of potential complications. Tips derived from this and analogous research works should be incorporated to avoid screw misalignment. Moreover, it should be borne in

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mind that safety cannot be entirely equated with accuracy.

CONCLUSION

Surgical intervention involving decompression and posterior instrumentation through the implementation of pedicle screws and rods has culminated in efficacious canal decompression and superior anatomic reinstatement; this study demonstrates that it is feasible to achieve a reasonably corrected kyphotic deformity in unstable fractures of the dorsal spine with a high degree of accuracy that is considered acceptable. However, it is important to note that even experienced surgeons may encounter the occurrence of an unacceptable screw placement.

REFERENCES

1. Knop, C., Fabian, H. F., Bastian, L, *et al*. "Fate of the transpedicular intervertebral bone graft after posterior stabilisation of thoracolumbar fractures." *Eur. Spine J*. 11.3 (2002): 251-257.
2. Yue, J. J., Sossan, A., Selgrath, C, *et al*. "The treatment of unstable thoracic spine fractures with transpedicular screw instrumentation: a 3-year consecutive series." *Spine* (Phila Pa 1976) 27.24 (2002): 2782-2787.
3. Modi, H. N., Chung, K. J., Seo, I. W, *et al*. "Two levels above and one level below pedicle screw fixation for the treatment of unstable thoracolumbar fracture with partial or intact neurology." *J Orthop Surg Res* 4.1 (2009): 28.
4. Dai, L. Y., Jiang, L. S., Jiang, S. D. "Conservative treatment of thoracolumbar burst fractures: a long-term follow-up results with special reference to the load sharing classification." *Spine* (Phila Pa 1976) 33.22 (2008): 2536-2544.
5. Shin, T. S., Kim, H. W., Park, K. S., Kim, J. M., Jung, C. K. "Short segment pedicle instrumentation of thoracolumbar burst compression fractures: short term follow-up results." *J Korean Neurosurg Soc*. 42.4 (2007): 265–270.
6. Looby, S. & Flanders, A. "Spine Trauma." *Division of Neuroradiology, Department of Radiology, Thomas Jefferson University Hospital, Philadelphia, USA*, 49.1 (2011): 129–63.
7. Heinzelmann, M. & Wanner, G.A. "Fundamentals of diagnosis and treatment." *Thoracolumbar Spinal Injuries, Spinal Disorders* 2 (2008): 883-924.
8. Meena, S., Sharma, P. & Chowdhury, B. "Management of Thoracolumbar Fractures." *Indian Journal of Neurosurgery* 4 (2015): 56-62.
9. Gumm, K., Page, P., Judson, R. & Kennedy, M. "Thoracolumbar spine guideline." *The Royal Melbourne Hospital Trauma Service Guidelines, Trauma Service* 2.1 (2012): 01-04.
10. Dai, L.Y. "Principles of Management of Thoracolumbar Fractures." *Department of Orthopaedic Surgery, Xinhua Hospital, Shanghai Jiaotong University School of Medicine, Shanghai, China, Review Article* 4.2 (2012): 67-70.
11. Muralidhar, B.M., Hegde, D. & Hussain, P.S.B. "Management of Unstable Thoracolumbar Spinal Fractures by Pedicle Screws and Rods Fixation." *Journal of Clinical and Diagnostic Research* 8.2 (2014): 121-123.
12. Singh, R., Taylor, D.M., Souza, D.D., Gorelik, A., Page, P. & Jan, P.P. "Mechanism of injury and clinical variables in thoracic spine fracture: a case-control study." *Hong Kong Journal of Emergency Medicine* 18.1 (2011): 05-11.
13. Milenkovi, S., Saveski, J., Trajkovska, N., Vidić, G. & Radenković, M. "Transpedicular Screw Fixation of Thoracolumbar Spine Fractures." *Scientific Journal of the Faculty of Medicine in Niš* 27.2 (2010): 63-68.
14. Verlaan, J.J., Diekerhof, C.H., Buskens, Tweel, I.V.D., Verbout, A.J., Dhert, W.J.A. & Oner, F.C. "Surgical treatment of traumatic fractures of the thoracic and lumbar spine. A systematic review of the literature on techniques, complications, and outcomes." *Spine Journal* 29.7 (2004): 803–814.
15. Good, C.R. "Thoracolumbar Spine Trauma." *Journal of the SRF* 6.2 (2011): 19–24.
16. Ravikanth, M., Babu, T.V.S. & Chandrasekaran, A. "Comparison between short and long segment transpedicular fixation of thoracolumbar burst fracture." *Journal of Evidence-Based Medicine and Healthcare* 3.22 (2016): 996-1001.
17. Wang, L., Li, J., Wang, H., Yang, Q., Lv, D., Zhang, W., Tang, K., Shang, L., Jiang, C., Wu, C., Ma, K., Wang, B., Liu, Y., Zhang, R., Shang, X., Kou, D., Jia, X., Yang, X., Tang, Y., Zhang, M., Wang, P., Xu, Y. & Wang, S. "Posterior short segment pedicle screw fixation and TLIF for the treatment of unstable thoracolumbar/lumbar fracture." *BMC Musculoskeletal Disorders* 15.40 (2014): 1-11.
18. Joaquim, Andrei F. MD*, Fernandes, Yvens B. PhD, MD*,†, Cavalcante, Rodrigo A. C.

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MD‡, Fragoso, Rodrigo M. MD†, Honorato, Donizeti C. MD, PhD§, Patel, Alpesh A. MD. "Evaluation of the Thoracolumbar Injury Classification System in Thoracic and Lumbar Spinal Trauma." *Spine* 36.1 (2011): 33-36.
19. Singh, R., Rohilla, R.K., Kamboj, K., Magu, N.K. & Kaur, K. "Outcome of pedicle screw fixation and monosegmental fusion in patients with fresh thoracolumbar fractures." *Asian Spine Journal* 8.3 (2014): 298-308.
20. Rehman, R.U., Azmatullah, Azam, F., Mushtaq, & Shah, M. "Treatment of traumatic unstable thoracolumbar junction fractures with transpedicular screw fixation." *Journal of the Pakistan Medical Association* 61 (2011): 1005-1008.
21. Khan, A.A., Khanzada, K., Ayub, S. & Ali, M. "Surgical outcome of transpedicular screw fixation for thoracolumbar fracture." *Journal of Ayub Medical College Abbottabad* 20 (2008): 63-71.
22. Khan, I., Nadeem, M. & Rabbani, Z.H. "Thoracolumbar junction injuries and their management with pedicle screws." *Journal of Ayub Medical College Abbottabad* 19.4 (2008): 7-10.
23. Alam, M.S., Islam, S.S., Karim, M. & Roy, U. "Transpedicular screw fixation in thoracolumbar spine fracture." *The Journal of Bangladesh Orthopaedic Society* 26 (2011): 104-107.
24. Ovalle, F.A.T., Ríos, E.C. & Balbuena, F.R. "Incidence and functional evolution of traumatic injuries of the spine." *Coluna/Columna* 13.3 (2014): 223-227.
25. Yue, J.J., Sossan, A., Selgrath, C., Deutsch, L., Wilkens, K., Testaiuti, M, *et al*. "The treatment of unstable thoracic spine fractures with transpedicular screw instrumentation: a 3-year consecutive series." *Spine* 27 (2002): 2782–2787. [Medline]
26. Kuntz, C. IV, Maher, P.C., Levine, N.B. & Kurokawa, R. "Prospective evaluation of thoracic pedicle screw placement using fluoroscopic imaging." *Journal of Spinal Disorders & Techniques* 17 (2004): 206–214.
27. White, A.A. & Panjabi, M.M. "The basic kinematics of the human spine: a review of past and current knowledge." *Spine* 3 (1979): 12.
28. Belmont, P.J. Jr, Klemme, W.R., Dhawan, A. & Polly, D.W. Jr. "In vivo accuracy of thoracic pedicle screws." *Spine* 26 (2001): 2340–2346.
29. Dvorak, M., MacDonald, S., Gurr, K.R., Bailey, S.I. & Haddad, R.G. "An anatomic, radiographic, and biomechanical assessment of extrapedicular screw in the thoracic spine." *Spine* 18 (1993): 1689–1694.
30. Gertzbein, S.D. & Robbins, R.E. "Accuracy of pedicular screw placement in vivo." *Spine* 15 (1990): 11–14.
31. Berlemann, U., Heini, P., Muller, U., Stoupis, C. & Schwarzenbach, O. "Reliability of pedicle screw assessment utilizing plain radiographs versus CT reconstruction." *European Spine Journal* 6 (1997): 406–411.
32. Rao, G., Brodke, D.S., Rondina, M., Bacchus, K. & Dailey, A.T. "Inter- and intraobserver reliability of computed tomography in the assessment of thoracic pedicle screw placement." *Spine* 28 (2003): 2527–2530.
33. Sapkas, G., Kateros, K.M., Papadakis, S.A. & Macheras, G. "Treatment of unstable thoracolumbar burst fractures by indirect reduction and posterior stabilization: Short versus long segment." *The Open Orthopaedics Journal* 4 (2010): 7-13.

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