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Comparison of the Outcomes of Open Versus Minimally Invasive Spinal Surgery For the Treatment of Thoracolumbar Traumatic Spinal Injury

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Abstract

Objective: To compare the outcomes of open versus minimally invasive spinal surgery for the treatment of thoracolumbar traumatic spinal injury.

Study Design: Descriptive observational study.
Duration of Study: January 1, 2021 to June 30, 2022

Subjects and Method: A total of sixty consenting patients of either gender between ages 18-75 years diagnosed as thoracolumbar traumatic spinal injury (TLSI) underwent for surgical decompression, fusion or stabilization with pedicular screw fixation via open or minimally invasive spinal surgery (MISS) were included. These patients were divided into two groups via lottery method. Laminectomy in either group was done if needed. Surgery was performed by experienced neurosurgeons in presence of the researcher. Findings like intra operative blood loss, operative time, post-operative hospital stay in days and Oswestry Disability Score on 1month follow-up was noted. Data was analyzed by using SPSS 26.0.
Results: Age range in this study was from 18 to 75 years. Mean age in open group was 56.6 ± 14.6years and in MISS group was 52.2 ± 13.8 years. Significant difference was observed in intra-operative blood loss and operative time; however, no significant difference was observed in duration of hospital stay and Oswestry Disability score.

Conclusion: Our study documents favorable patient and radiographic outcomes with the use of MISS for thoracolumbar trauma.

Introduction:
The global incidence of traumatic spinal injury (TSI) is about 10.5 cases per 100,000 people. It is mostly found in middle and low income countries rather than high income countries, out of which 48.8% of these injuries need surgical intervention[1]. Thoracolumbar injury makes up the largest incidence amongst all spinal injuries[2].

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About 2-4% patients with blunt trauma have thoracolumbar spinal injury (TLSI) but these injuries are mostly associated with high risk of mortality and morbidity[3]. The most common causes observed for traumatic TLSI injury were Road Traffic Accident (46%) followed by incidents of fall (30%), assault (6%) cases with other causes making 11%[3]. TLSI can be divided into more rigid thoracic spine (T1-T10), transitional and flexible area with maximum number of injuries (T11-L2) and lumber spine (L3-L5)[2].

The Denis Classification uses three column systems (anterior, middle and posterior) that subdivide TLSI fractures into minor and major. Major spinal injury is further classified into compression fractures, burst fractures, flexion-distraction/seat-belt-type injury and dislocation fracture[4, 5].

In compression fracture and flexion-distraction injury, the canal is not usually compromised leading to conservative management. If needed, both fractures can be surgically corrected using spinal fusion preferably by posterior approach[18-37]. Burst and dislocation fractures are dealt with surgical decompression using anterior, posterior or anterior-posterior approach followed by fusion. Stabilization of spine is achieved by pedicle screw fixation in flexion-distraction injury, burst and fracture-dislocation[6,7].

Operative interventions are used for spinal fracture correction. The need for spinal surgery for aged patients is increasing with time; a new method had to be drawn forward to overcome the morbidity commonly observed with traditional open approach for spinal fracture repairs. Parameters like substantial blood loss, surgical site infection and longer hospital stay exposed patients to surgical complications[8,9,10].

Minimally invasive spinal surgery (MISS) v/s open approach has shown results of intra-operative blood loss (136 + 18 vs 364 + 23ml), post-operative length of hospital stay (5 + 2.25 vs 9.3 + 3.4 days) and post operating time (100 + 25 vs 175 + 2 mins) Assessment of neurological outcome on follow-ups were better with MISS rather than open approach measured via mean Oswestry Disability (ODI) Score (15.9 + 1.23 vs 32 + 2.4).

Instrumented spinal fusion and stabilization via pedicular screw fixation can be accomplished through open or MISS. To assess which operative procedure is better, not many studies have been done in our country. The focus of this study was to compare peri-operative blood loss, operative time duration, post-operative length of hospital stay and neurological status on 1 month follow-up using Oswestry disability index (ODI) between patients undergoing open technique versus MISS. If this study could show that MISS would have better intra-operative and post-operative outcomes, then this could help in better recovery of the patients in the future.

Methodology:

This study was conducted over a period of 6 month from January 1, 2020 to June 30, 2020 in the department of Neurosurgery, Civil Hospital Karachi. A total of sixty patients of either gender between ages 18-75 years, diagnosed as TLSI underwent for surgical decompression, fusion or stabilization with pedicular screw fixation via open or MISS were included. Non-probability consecutive sampling technique was used.

Non-consenting patients, patients with revision surgery, patients with co-existing morbidities or other spinal conditions like disc herniation, spondylolisthesis or degenerative scoliosis, patients undergoing spinal surgery for non-traumatic indications and gun-shot/penetrating trauma history were excluded.

These patients were divided into two groups via lottery method. Group A included patients who are operated via open method. Group B included patients operated via MISS. Laminectomy in either group was done if needed. Surgery was performed by experienced neurosurgeons in presence of the researcher.

Findings like intra operative blood loss, operative time, post-operative hospital stay in days and ODI Score on 1 month follow-up was noted. Data was analyzed using SPSS 26.0. Mean and standard deviation was calculated for quantitative variables like age, height, weight, BMI, intra operative blood loss, operative time, post-operative hospital stay and ODI Score. Frequency and percentages were calculated for qualitative variables like gender, mechanism of

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injury and classification of fracture type as per Denis Classification. T-test was applied to compare the outcomes between two groups.

Results:

Age range in this study was from 18 to 75 years. In Group-A, mean age was 56.6 ± 14.6years and mean BMI was 27.1 ± 4.5kg/m^2, whereas, in group-B, mean age was 52.2 ± 13.8 years, and mean BMI was 25.7 ± 4.5**.** In Group-A, 19(63.3%) were male and11 (36.6%) female patients; however, Group-B included 17(56.6%) male and 13(43.33%) female patients. Regarding the side of fracture, in Group-A, 09(30%) had anterior side, 10 (33.33%) had middle side and 11 (36.6%) had posterior side. Whereas, in Group-B, 09(30%) had anterior side, 13 (43.33%) had middle side and 08 (26.6%) had posterior side fracture. The most common causes observed for traumatic TLS injury in Group-A were RTA in 15(50%), incidents of fall in 09 (30%), assault in 02(6%) cases while other causes included 04(13.3%) cases. In Group-B, most common causes were RTA in 14(46.6%), incidents of fall in 10 (33.3%), assault in 01(3.3%) cases while other causes included 05(16.6%) cases, as **shown in table # 01.**

When outcome variables were compared, significant difference was observed in intra-operative blood loss and operative time; however, no significant difference was observed in duration of hospital stay and ODI score, **shown in table # 2.**

Table#1: Demographic data and clinical spectrum of the patients:

Demographic data and clinical spectrum	**Group-A**	**Group-B**
Age (mean + sd)	56.6 ± 14.6	52.2 ± 13.8
BMI (mean + sd)	27.1 ± 4.5	25.7 ± 4.5
Gender:		
• Male	19(63.3%)	17(56.6%)
• Female	11 (36.6%)	13(43.33%)
Classification of Fracture:		
• Anterior	09(30%)	09(30%)
• Middle	10 (33.33%)	13 (43.33%)
• Posterior	11 (36.6%)	08 (26.6%)
Mechanism of Fracture:		
• RTA	15(50%)	14(46.6%)
• Falls	09 (30%)	10 (33%)
• Assaults	2 (6%)	01 (3.3%)
• Other Causes	4 (13.3%)	05 (16.6%)

Table#2: Comparison of outcomes of open versus minimally invasive spinal surgery for the treatment of thoracolumbar traumatic spinal injury

Outcomes	Group-A (n=12)	Group-B (n=19)	P-value
Intra-operative blood loss	349+43ml	141+ 15	0.000
Operative time	6.8 ± 3.4	3.2 ± 2.9	0.000
Post-operative hospital stay	181.8 ± 45.4	166.4 ± 52.1	0.2519
ODI Score	20.6 ± 17.2	24.6 ± 18.2	0.385

Discussion:

The operative treatment of thoracolumbar fractures requires choice by the treating physician regarding optimal approach and means of fixation. Alvine et al and Esses et al both demonstrated good clinical and radiologic outcomes following the open instrumentation of thoracolumbar fractures[11,12]. Advocates of the percutaneous technique, cite decreased operative time, decreased blood loss, and decreased disruption of the already traumatized soft tissues. Conversely, opponents of the MIS technique, cite the long surgeon learning curve and the possibility of inadequate restoration of VBH and local kyphosis.

In this study, we investigated the effects of MISS for thoracolumbar trauma on patient out- comes. Our patients had an average age of 54.4±14.2 years. Most of our patients were men, and motor vehicle collisions and accidental falls made up 80% of cases. Our patient population was therefore similar to that of Wang et al.'s[13] epidemiological study on traumatic spinal fractures

A systematic review of minimally invasive versus open surgery for the treatment of types B and C thoracolumbar injuries was carried out and found that the MISS can significantly reduce the blood loss, length of hospital stay, and complications; however, the fusion rate and operative time was similar[14]. Another meta-analysis found that the MISS not only reduced the blood loss more than open surgery but also had significantly lower VAS of back pain and ODI scores[15].

In our study, less intra-operative blood loss and shorter operative time has been found in cohort treated with MISS group as compared to the cohort treated with open surgery, however, no significant difference was observed in duration of hospital stay and ODI score.

In 2016, Zhang et al[16] published the results of a prospective randomized clinical trial comparing 29 patients randomly assigned to MISS (type A: 7, type B2: 5, and type C: 17) and 30 who

underwent open surgery (type A: 8, type B2: 5, and type C: 17). Follow-up was in 12 months. Operative time was longer in the MISS group (218 vs 190 minutes), but this difference was nonsignificant (P = 0.165). Blood loss (302 vs 536 mL, P = 0.011) and length of hospital stay (18.6 ± 10.3 vs 27.5 ± 15 days, P = .011) were significantly less in the MISS group.

Grossbach et al.[17] prospectively compared patients with flexion-distraction injuries between May 2003 and March 2013. A total of 38 patients with type B fractures (11 MISS and 27 open surgery) were followed for an average of 13 months (9–18 months). Patients who had undergone MISS had a shorter operative time (195 vs 257 minutes, P = 0.07) and less blood loss (93 vs 498 mL, P = 0.003). The other measured parameters (kyphotic angulation correction, length of hospital stay, and neurologic recovery) were no different in the 2 groups.

Studies conducted in the past have analyzed the retrospective series of the patients with thoracolumbar traumatic spinal injury and there could have been a significant chance of biasness. We, therefore, conducted a prospective study to compare the outcomes of open versus minimally invasive spinal surgery for the treatment of thoracolumbar traumatic spinal injury.

Limitations of our study included use of non-probability consecutive sampling technique as this may not allow generalization of results to the population. Furthermore, though, the sample size used for study was evident based but still, it was small to establish the minimally invasive spinal surgery choice of technique for the treatment of thoracolumbar traumatic spinal injury. We suggest that more studies with larger sample size should be conducted.

Furthermore, shorter follow up period and single centered study may question the generalizability of the results.

Conclusion:

Our study documents favorable patient and radiographic outcomes with the use of MISS for thoracolumbar trauma. Recent study revealed significant difference in intra-operative blood loss and operative time, however, no significant difference was observed in duration of hospital stay and ODI score. Thus, from this study, it could not be concluded that the MISS have better intra-operative and post-operative outcomes. More studies with larger sample size should be done to recommend the practice of MISS in the future.

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