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Research Article

Clinical and Radiographic Outcomes of Thoracolumbar Spine Fractures Treated with the USS Fracture System: A Retrospective Analysis

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Abstract

Introduction: Thoracolumbar spine fractures are common, often requiring surgical intervention for deformity correction and early mobilization. The USS Fracture System is widely used for instrumentation and stabilization of these fractures. However, there is a paucity of literature comparing its efficacy to other fixation systems.

Aim: This study evaluates clinical and radiographic outcomes of patients treated with the USS Fracture System for thoracolumbar fractures.

Methods: A retrospective review of 30 patients who underwent posterior spinal instrumented fusion with the USS Fracture System was conducted. Pre- and postoperative radiographic outcomes, complications, and reoperations were analyzed.

Results: Significant postoperative improvement in kyphotic angle was observed (P = 0.0006), with 100% radiographic fusion. Complications included inadequate pain control (23%) and device failure (6%), though no revision surgeries were required.

Conclusion: The USS Fracture System effectively improves kyphotic angle and fracture stability in thoracolumbar fractures, with favorable clinical outcomes and minimal reoperations.

Keywords: Spine Fractures; USS Fracture System

Introduction

Spine fractures have an incidence of 32 per 100,000 [1], with most occurring in the thoracolumbar region, particularly between T11-L2, an area of high mobility and stress concentration [2,3].

The incidence of spine fractures is rising due to increased high-energy trauma such as motor vehicle accidents and falls from heights [4]. Fracture severity and morphology are influenced by the forces act-ing on the spine and the energy absorbed by the vertebrae. Com-pression fractures, which are the most common

type, pression fractures, which are the most common type, result from an axial loading mechanism [5]. More severe fractures, notably burst fractures, constitute about 20% of spinal fractures and are often deemed unstable requiring surgical fixation [6].

Surgical management is believed to provide better pain relief and functional outcomes compared to non-operative treatment, al-though studies show mixed results regarding functional outcomes and quality of life, particularly in mid- and long-term follow-ups [7]. The goal of management has shifted to early mobilization, work, and daily activities. Surgery is gaining popularity as it facilitates early mobilization, corrects kyphotic deformities, restores verte-bral height, and improves nerve function [8-10].

Unstable thoracolumbar fractures are commonly treated with posterior instrumentation using fixed-angle devices, pedicle screws, and rods. One frequently used fixation system is the USS Fracture System by DePuy Synthes, which employs Schanz screws. Fixation can be achieved through either the traditional posterior approach or minimally invasive techniques [11,12].

Recent studies comparing the USS Fracture System with other fixation systems for thoracolumbar fractures have shown varied results. The USS Fracture System has been found superior to mini-mally invasive systems for unstable fractures [13] and offers bet-ter fracture reduction compared to the Legacy system (Medtronic, Minneapolis, MN, USA), although pain control and neurological outcomes are similar [14].

This study aims to retrospectively review patients treated for thoracic and lumbar fractures with the USS Fracture System at our institute, analyzing clinical outcomes and radiological parameters pre- and post-operatively.

Methods

Study design

This retrospective study analyzes the clinical and radiographic outcomes of patients who underwent posterior spinal instrumented fusion for thoracic and lumbar spine fractures using the USS Fracture System. The study was approved by the ethics committee and conducted at the Montreal General Hospital, Montreal, Canada. Data were collected through electronic medical records (EMR) and clinic notes. Patient information was gathered and stored in a secure, password-protected Microsoft Excel spreadsheet, with access limited to re-search participants to ensure patient privacy.

Inclusion and exclusion criteria

All patients who underwent posterior spinal instrumented fusion with the USS Fracture System between January 2018 and June 2022 were included in the study. Patients treated with or without cement augmentation were also included. Patients with undocumented age in their medical records or those treated with the USS Fracture System for indications other than trauma were excluded from the study.

Data abstraction and outcome measures

Baseline demographics were recorded on a spreadsheet for all patients, including age, gender, diagnosis (including AO fracture classification), date range of index surgical interventions, number of treated levels, and whether cement augmentation was used.

Clinical and radiographic assessments were conducted at the first and last follow-up visits. Data were categorized by patients with and without bone cement. Outcome measures included segmental kyphotic angle, improvement in kyphosis angle, segment height, radiographic fusion or fracture consolidation, number of re-operations, and adverse events related to the device or procedure.

Statistical analysis

The statistical analysis was performed using Microsoft Excel was used for statistical formulas. Data were presented as mean and standard deviation (Mean ± SD). An unpaired t-test was used to compare the means of specific variables. Statistical significance was set at a $p < 0.05$ with a 95% confidence interval.

Results

The study included 30 patients, with the majority being male (21 males and 9 females). The mean age of the participants was 42.5 ± 17.4. Most fractures were classified as AO type A4. The time from injury to index surgery ranged from 24 to 48 hours. The mean number of treated levels was 1.1. Cement augmentation was used in only one patient. Basic patient demographic information is presented in Table 1.

Demographic Data	
Number of patients	30
Age (Mean ± SD)	42.5 +/- 17.4
AO classification (n)	A3 (6) , A4 (21), B2 (4)
Date range of index surgery (days)	1.4 +/- 1.4
Number of treated levels	1.1 +/- 0.3
Cement augmentation	1

Table 1: Patient demographic data.

Radiographic data were collected pre- and postoperatively, as shown in Table 2. We compared the kyphotic angle of the treated vertebrae before and after surgery, observing a significant improvement postoperatively (P = 0.0006). The mean segmental height postoperatively was 11.8 ± 3.7 cm. All treated vertebrae achieved radiographic fusion at follow-up.

Radiographic Parameters			
Kyphotic angle	Pre-operative	17.5 +/- 9.1	p= 0.0006
	Final post-operative	10.1 +/- 8.5	
Segmental height (cm)	11.8 +/- 3.7		
Radiographic fusion (%)	100%		

Table 2: The table shows the radiographic data of the patients. There is a significant improvement of kyphotic angle postoperatively.

The majority of complications were related to inadequate postoperative pain control (23%). Patients with poor pain control were defined as those who did not respond to the standard postoperative pain regimen or whose pain hindered their rehabilitation. However, these numbers may be inflated due to some patients presenting with polytrauma, where additional injuries and fractures could complicate the postoperative course. Table 3 provides an overview of the different postoperative complications in patients treated with the USS Fracture System for fractures.

Postoperative Complications	
Pain	7 (23%)
Spine infection	1 (3%)
Pulmonary complications	1 (3%)
Device failure	2 (6%) Rod breakage Schanz screw handle failure after rod attachment
Planned reoperation	2 (6%)
Unplanned reoperation	1 (3% due to surgical site infection)
Revision surgeries	0

Table 3: List of postoperative complications and frequency.

There was one case that required an unplanned reoperation due to a surgical site infection, which was treated with irrigation and debridement without implant removal. Additionally, two cases of device failure occurred: one involved a breakage of the Schanz screw handle during rod fixation, and the other involved a fracture of the left rod. However, neither case required revision surgery. Two patients underwent planned reoperations for implant removal after achieving satisfactory bone healing and fusion.

Discussion

The incidence of spine fractures has been steadily increasing, highlighting the need for effective treatment options that promote rapid recovery [1]. Surgical intervention has consistently demonstrated superior pain relief and faster return to function compared to nonoperative management [7]. The USS Fracture System, utilized since 1990, offers a flexible fixation system providing adequate posterior stabilization with minimal instrumentation [11,12].

Though limited studies compare different fixation systems, research has suggested the USS Fracture System's superiority in managing spine fractures. For instance, Kubosch., *et al*. [13] found that the USS Fracture System better tolerates torsional forces compared to minimally invasive systems, concluding it is a reliable option for managing unstable thoracolumbar fractures by preventing early correction loss and maintaining fracture reduction. However, in polytrauma settings, where orthopedic damage control is prioritized, minimally invasive approaches may be more favorable than traditional open techniques for managing spine fractures [15].

Further supporting the USS Fracture System's efficacy, a study by Barakat., *et al*. [14] in Kuwait demonstrated better fracture reduction and significantly improved vertebral height and kyphotic angle with the USS Fracture System compared to the CD Horizon Legacy (CDH) fixation system. These findings align with our study, which also showed significant postoperative improvement in kyphotic angle with the USS Fracture System. This is particularly advantageous, as numerous studies emphasize the importance of restoring sagittal alignment to achieve better fusion rates [16-20], improved pain control, and enhanced quality of life [21,22].

However, achieving near-perfect fracture reduction does not necessarily result in better pain control outcomes [14]. In our study, poor postoperative pain control was the most common complication (23%), which hindered rehabilitation and prolonged hospital stays. As a major trauma referral center, these figures may be inflated due to patients presenting with polytrauma and additional injuries, potentially complicating the postoperative course.

Our analysis of the USS Fracture System in managing spine frac-tures demonstrated its reliability in achieving deformity correc-tion, fracture reduction, and bone healing, with favorable clinical outcomes and only one case requiring unplanned reoperation due to a surgical site infection. There were no revision surgeries due to hardware concerns or complications.

While the USS Fracture System has shown effectiveness, further comparative studies are needed comparing various fixation sys-tems to ensure optimal patient care.

There are several limitations to this study that should be acknowledged. First, as a retrospective study, the data are prone to selection and recall bias. Second, some data were missing from the chart review, as the charts were not specifically designed for research data collection. Third, the sample size is relatively small, with only 30 patients included. Fourth, the study reports outcomes of the USS Fracture System without comparing it to other acceptable fixation devices. To mitigate these limitations in future studies, a prospective design could minimize bias, and implementing standardized data collection methods would ensure comprehensive information is recorded. Increasing the sample size by including data from multiple centers could enhance statistical power, while comparing the USS Fracture System to other fixation devices would offer a broader understanding of system efficacy.

Conclusion

Our study demonstrates that the USS Fracture System is a reliable and effective option for managing thoracolumbar spine fractures. The system provided significant improvements in kyphotic angle and segmental height, with successful fracture reduction and bone healing in all cases. Although some complications, such as poor postoperative pain control, were noted, the USS Fracture System showed favorable clinical outcomes with no revision surgeries required and minimal unplanned reoperations. These findings affirm the USS Fracture System's efficacy in providing robust stabilization and facilitating recovery.

Declaration of Conflicting Interests and Funding

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