The Egyptian Journal of Hospital Medicine (April 2024) Vol. 95, Page 2177- 2180

Pedicle Screw and Rod Fixation with TLIF in a Series of 14 Patients with Recurrent Lumbar Disc Herniation

Amr Adel Abd-Elaal, Mohammed Abd-EL-Baset Hegazy*, Mahmoud Elsayed Massoud
Spine Surgery Department, Helmeya Military Hospital, Military Academy, Cairo, Egypt
* Corresponding author: Mohammed Abd-Elbaset Hegazy, Email: moh7503174@gmail.com, Phone: +201271402041

ABSTRACT

Background: Lower back and leg pain (LBP) is a leading cause of disability. Degenerative lumbar spine conditions pose significant treatment challenges. Transforaminal lumbar interbody fusion (TLIF) with pedicle screw and rod fixation has emerged as a promising surgical technique for recurrent lumbar disc herniation.

Objective: To determine the therapeutic efficacy and clinical outcomes associated with TLIF utilizing pedicle screw and rod fixation in patients presenting with recurrent lumbar disc herniation.

Patients and Methods: A retrospective cohort study was undertaken, encompassing a sample of 14 patients presenting with recurrent lumbar disc herniations, all of whom underwent a singular level of lumbar surgical intervention during the period from 2022 to 2023. Imaging assessments encompassed lumbar radiography, CT scans, and MRI for the comprehensive evaluation of the cases. For comparative analysis, a retrospective evaluation was conducted on 19 patients who underwent single-level lumbar fusion for analogous indications within the same period

Results: All patients experienced significant improvements in mobility and life quality. The TLIF group exhibited superior clinical outcomes compared to the control group, with reduced perioperative blood loss and accelerated rehabilitation. The mean VAS declined from 6.8 ± 1.2 (range 6.0– 8.5) to 3.1 ±1.2 (range 2.6–6.5) ($p < 0.001$). In the control group, the mean VAS decreased from 7.2 ±1.2 (range 5.5–9) to 3.5 ±1.1 (range 3–6.8).

Conclusion: TLIF alongside PS and RF demonstrates a reliable and effective method for treating patients with recurrent lumbar disc herniation.

Keywords: Lumbar disc herniation; Transforaminal lumbar interbody fusion; Erosive osteochondrosis; Clinical outcomes.

INTRODUCTION

Lower back and leg pain (LBP) stands as a significant cause of orthopedic impairment, often resulting from diverse types of spinal degenerative conditions. Epidemiological estimates indicate that LBP affects up to 80% of individuals at some point in their lifetimes, thereby emphasizing its considerable impact on socio-economic aspects [1].

The spectrum of degenerative changes occurring in the lumbar spine involves a complex array of interconnected pathologies, spanning from disc herniation, spinal stenosis, degenerative disc disease, scoliosis, to spondylolisthesis. A crucial and clinically significant hallmark of lumbar spine degeneration is erosive osteochondrosis (EO), characterized by its focal impact on the vertebral endplate and subchondral bone marrow. EO often emerges as a primary culprit in the genesis of lower back pain, underlining its pivotal role in assessing lumbar spine health [2].

EO is delineated and quantified by Modic alterations, segregated into three distinct types (I, II, and III) according to their morphological manifestations on MRI and histopathological characteristics. The complex pathophysiology underlying degenerative spinal conditions (DS) complicates the therapeutic landscape [3,4].

Numerous conservative non-operative management strategies are available; however, surgical stabilization via spondylodesis and instrumentation continues to be a well-established therapeutic modality. Lumbar fusion is a frequently advocated therapeutic measure for cases of recurrent prolapsed discs and degenerative spinal stenosis that exhibit resistance to conservative management strategies [5,6].

The open transforaminal lumbar interbody fusion (TLIF) technique provides operative times comparable to alternative methods, alongside favourable clinical and radiological results. Notably, it confers additional benefits including diminished perioperative blood loss and alleviated pain, expedited rehabilitation, and abbreviated durations of hospitalization [7]. Over the years, a multitude of TLIF methodologies incorporating transpedicular screw fixation has evolved for addressing lumbar and thoracolumbar disorders. This strategy is especially pertinent for the management of lumbar spine degeneration characterized by EO (Modic type I–II) and recurrent disc herniations [8,9].

This investigation sought to assess the clinical efficacy and outcomes of TLIF employing pedicle screw and rod fixation in patients diagnosed with recurrent lumbar disc herniation.

PATIENTS AND METHODS

Study design and population

Fourteen patients, each presenting with multiple instances of recurrent disc herniation, who underwent monosegmental lumbar surgical interventions within the timeframe of 2022 to 2023, were subjected to a retrospective evaluation. Selection of patients was executed consecutively throughout this duration. Universally, the singular criterion for surgical intervention was recurrent lumbar disc herniation coupled with dorsal disc degeneration, concomitant

Received:27/12/2023
Accepted:27/02/2024

with EO Modic grades I–II attributed to antecedent surgical procedures. Exclusion was mandated for patients failing to satisfy both specified criteria.

For comparative analysis, a retrospective evaluation was conducted on 19 patients who underwent single-level lumbar fusion for analogous indications within the same period, from 2022 to 2023. This review entailed a comprehensive examination of patient data, encompassing medical charts, clinical records, operative narratives, and imaging studies such as lumbar radiographs, CT scans, and MRI of the lumbar region. Following standardized protocols in the outpatient milieu, we methodically conducted clinical evaluations encompassing pain assessments and inquiries into health-related quality of life via structured questionnaires. Additionally, neurological examinations were systematically performed at predetermined intervals post-operation (at 3 months, 6 months, and 12 months), supplemented by radiographic assessments.

These assessments were meticulously analyzed for all 14 patients.

Clinical Outcome and Imaging

Clinical outcomes and neurological status were meticulously evaluated utilizing established metrics, including the VAS [10], Oswestry Disability Index (ODI) [11], and Mac Nab criteria [12], aiming to gauge fluctuations in pain intensity, functional limitations due to pain, and overall patient contentment [13]. Multimodal imaging techniques, encompassing initial radiographic studies, CT scans, and MRI of the lumbar spine, were meticulously scrutinized, supplemented by subsequent X-ray assessments at the 3-month mark and CT imaging at the 6-month interval. These exhaustive evaluations were universally administered to discern the extent of disc herniation, Modic grading of osteochondrosis, spinal stability, and the degree of osseous fusion of the lumbar vertebrae post-instrumentation.

Ethical Consent

Authorization for the study was procured from the Academic and Ethical Committee of Helmeya Hospital. Each participant provided informed written consent for data collection prior to inclusion in the study. This research was meticulously conducted in strict alignment with the ethical standards delineated by the World Medical Association's Declaration of Helsinki concerning human subject research.

Data Management:

Analytical procedures were executed utilizing SPSS software, version 25 (IBM, Armonk, New York, USA). Student t test was used to compare continuous variables (X-ray exposure time, blood loss, surgical time, length of hospital stay). In all analyses, a $p < 0.05$ was considered to
be significant.

RESULTS

The duration of the surgical procedure for the minimally invasive cohort was with a range spanning from 95 to 190 minutes. The time of X-ray exposure was 2.35 minutes ranging from 1.5 to 3.5 minutes, and the median postoperative hospital stay was documented at 5 days, within a range of 3 to 7 days. Postoperative improvements in pain relief and mobility were assessed using the VAS, demonstrating a reduction in scores from 6.9 to 3.0, and the Oswestry Disability Index (ODI), which indicated an improvement from 6.8 to 2.4. All patients exhibited significant postoperative benefits at follow-up assessments. These results were markedly superior in numerous aspects when compared to those observed in the standard surgery cohort. In the study group, all patients showed distinct improvement with a significant reduction of pain. The mean VAS declined from 6.8± 1.2 (range 6.0– 8.5) to 3.1 ±1.2 (range 2.6–6.5) ($p < 0.001$). In the control group, the mean VAS decreased within one year from 7.2 ±1.2 (range 5.5–9) to 3.5 ±1.1 (range 3–6.8). This decrease was also significant ($p < 0.001$) **(Figure 1).**

The decrease of ODI from 6.8 +- 0.8 (range 5.8–8.6) to 2.4 ±1.0 (range 2.0–7.0) ($p < 0.001$) over 12 months. These results were similar to those of the control group with an ODI decrease from 6.4 ±1.3 to 2.7 ± 1.4 ($p < 0.001$).

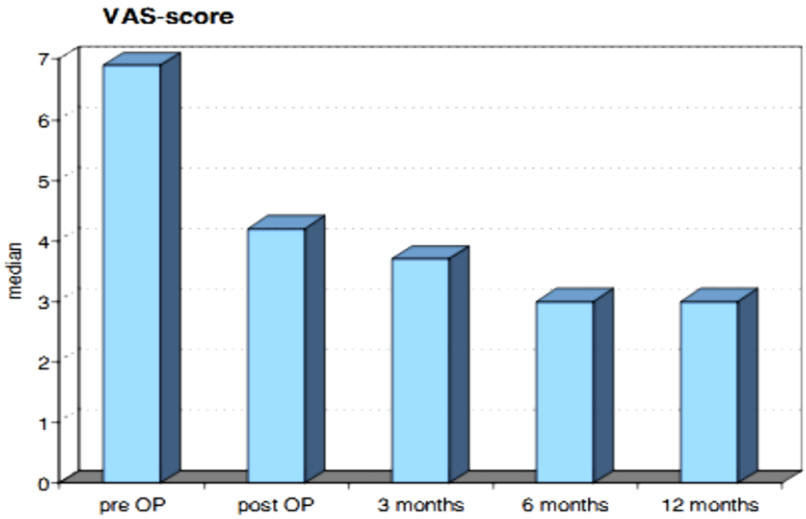

Figure 1: Reduction in pain during follow up.

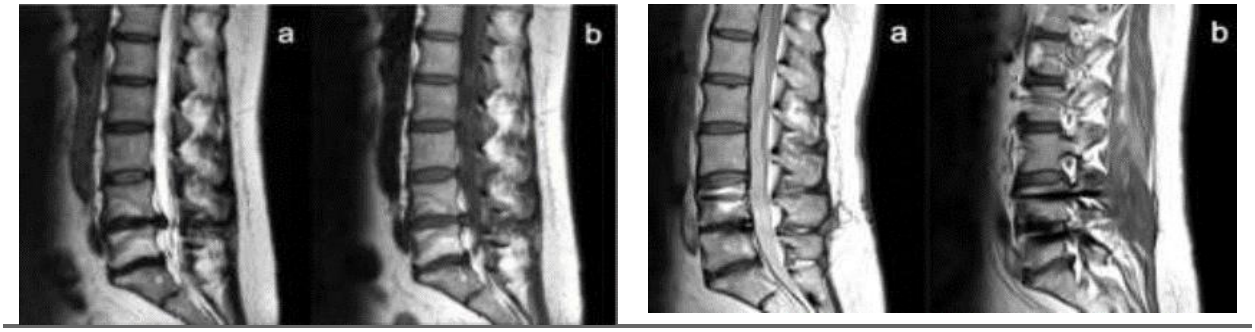

Figure 2: Preoperative (Left) and postoperative (Right) MRI showing the excision of the recurrent disc and the implants.

DISCUSSION

The treatment of recurrent lumbar disc herniation remains a significant challenge in orthopedic and spinal surgery [14,15]. Various surgical techniques have been developed and refined over the years to address this complex condition, with the goal of minimizing patient discomfort and improving long-term outcomes. Transforaminal lumbar interbody fusion (TLIF) with pedicle screw and rod fixation has emerged as a viable option due to its potential to provide stable and durable results [16,17]. Understanding the benefits and limitations of this approach is crucial for optimizing patient care and advancing surgical practices in the management of degenerative spinal conditions.

In this series, we present the TLIF procedure as a treatment modality for recurrent lumbar disc herniation with clinical symptoms in 14 patients diagnosed with erosive EO of Modic type I–II. This technique facilitates the utilization of pedicle screw and rod fixation alongside TLIF for lumbar spondylodesis, providing heightened precision, stabilization, and a fusion rate comparable to traditional methodologies [13,18,19]. In instances of recurrent disc herniation among patients diagnosed with EO of Modic grades I–II, posterior surgical techniques are predominantly adopted for the instrumentation and stabilization of the lumbar spine, thereby maintaining structural integrity and enhancing therapeutic outcomes (12)

The evaluation of this traditional open surgical method, which involves considerable trauma to soft tissues, spinal ligaments, facet joints, capsular structures, and neural elements, reveals the osseous framework of the spine and facilitates ample space for lateral-to-medial screw orientation to ensure precise placement. This technique is correlated with a heightened incidence of postoperative pain and morbidity, resulting in significant functional disruptions [20].

Compared to the conventional technique, our study demonstrates that the TLIF procedure affords an operative duration at least equivalent to that of traditional dorsal instrumentation while markedly diminishing intraoperative blood loss, thereby mitigating the risk of anemia and circulatory complications. The minimally invasive nature of the TLIF approach results in decreased postoperative pain and fewer wound healing complications, as well as a reduced reliance on analgesic and anesthetic medications [19,21]. This facilitates more efficient and enhanced postoperative mobility.

Owing to the substantially minimized dissection and retraction of the paraspinal musculature, the wound healing process is characterized by reduced cicatrization and decreased muscle denervation. This amelioration in postoperative mobility and functional outcomes can be further ascribed to the fact that

extended muscle retraction intensifies muscular impairment via innervation or circulatory disruptions, as quantified by heightened pathological signals in electromyography (EMG) [22,23].

The constraints of this study stem from its retrospective design and limited sample size, factors that potentially affect the extrapolation of the findings to a broader population.

CONCLUSIONS

TLIF in conjunction with pedicle screw and rod fixation constitutes a secure and highly effective surgical strategy for individuals suffering from recurrent lumbar disc herniation and EO Modic type I-II. This technique provides significant pain relief, improved mobility, and high patient satisfaction, making it a valuable alternative to conventional lumbar fusion procedures.

Financial support and sponsorship: Nil.
Conflict of interest: None.

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