

## Radiological Evaluation of the Lumbar Disc Height Changes in Pre and Post-Operatives of Degenerative Lumbar Disorders Underwent Computer Navigated MIS-TLIF

Jamal Ahmad Saleem Alshorman\*

Department of the Spine and Osteopathic Surgery, First Affiliated Hospital of Hainan Medical University, Hainan-Haikou, China

\*Corresponding author: Alshorman JA, Department of the Spine and Osteopathic Surgery, First Affiliated Hospital of Hainan Medical University, Hainan-Haikou, China, E-mail: jamalking61@yahoo.com

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### Abstract

#### Purpose

This retrospective study to assess the disc height changes pre and post-operation for the patients with degenerative lumbar disease whether the disc height improved by discectomy and cage implantation by MIS-TLIF procedure.

#### Methods

Between the periods of January to June 2016 a retrospective study of 40 patients (21 Female, 19 Male) with mean age 52.6 years old who underwent MIS-TLIF have compared pre and postoperation of MIS-TLIF through calculating disc height by the digital tool using X-ray image.

#### Results

This study includes 56 segments of the lumbar spine. The X-ray post-operatively showed significant physiological changes in disc height with the disc height average 14.38 mm compared with the disc height pre-operatively with the average disc height 9.83 mm, in addition, the T-test result was 2.050. The disc height improves significantly after MIS-TLIF,  $P > 0.001$ , There was no serious complication found after performing the operation.

#### Conclusion

The MIS-TLIF procedure elevates the disc gap. Supported with cage and bone graft can restore the disc height to keep the normal lumbar function that may play an important role in relieving the symptoms of degenerative lumbar disorders.

**Keywords:** MIS-TLIF; Disc height; Computer navigation system; Disc degenerative disease

### Introduction

Disc degeneration disorders are the most common reason for low back pain [1]. A short overview of spinal anatomy so that can understand how a lumbar herniated disc can cause lower back pain and leg pain [2]. Herniation occurs when the gel substance bulge out and press the nerve root or the spine itself [3]. The disc shapes look like a circle and from outside is fibrous covering the gel substance disc [2]. Many cases require operation if the conservative treatment doesn't improve the symptoms [4], placement cage in the lumbar spine operation allow greater restoration [5]. Dynamic stabilization devices are employed with the assumption that they will decrease the inter-vertebral disc loading at the treated level thereby decreasing pain and restrict more degeneration while reducing the degenerative influence on the adjacent levels [6]. Using minimal invasive procedure to treat the disc herniation disorders showed much improvement and

advantages versus open procedures [7]. The prevalence of spine surgery has steadily been on the rise over the last two decennium and this direction in prospect to spread over the next twenty-five years, and the number of implanted medical devices that have been developed and the clinical indications for their use have expanded over the last ten years [8].

Disc height decrease and degenerate with aging. Restore the disc height is important in keeping the normal structure of the lumbar spine [9]. A lot of patients may require surgery and the procedures that diversified from preservative treatment, dynamic stabilization implant systems to fusion the spine supported with or without supplementary devices [10]. Some methods have some obvious advantages over other procedures [11] we aim in this study to test whether the disc height restored and the patient's symptoms disappear after MIS-TLIF.

## Methods

### Patient's characteristics

This retrospective study between the period of January-June 2016 included 40 patients (21 F, 19 M) with mean age 52.6 years .56 segments of lumbar vertebra were treated by MIS-TLIF divided as (12 segments L3-L4, 32 segments L4-L5, 12 segments L5-S1). 40 patients were with a clear history, no previous spinal operation, no hypertension or diabetes, none of the patients was having a disease prevent the MIS-TLIF to be performed.

### Operative technique

Using the minimally invasive procedure involves two small incisions in the backside. Using the ambulant X-ray machine, the surgeon defines the diseased vertebral levels. Making the smallest incision possible, the surgeon uses a combination of dilators and tubular retractors to access the vertebra and remove the degenerative disc. An implant with bone graft in place in of the degenerative disc, this procedure relieves pressure on the nerve roots.

Minimally invasive transforaminal lumbar interbody fusion depends on the use of micro-tools and graduated dilators to approaches the spine, and then cut through the muscle tissue to gateway the influenced vertebrae. With MIS technique, the incision is made to side the spine with minimal incision size of about 4-5 cm. Graduated dilators are used to aside the vertebral muscle in the stand of cutting them. MIS- TLIF needs a part of the vertebral bone to be removed. This is the lamina of the vertebra-and a part of the facet joint. Through this opening can do the discectomy so the fusion can take place. Minimally invasive TLIF usually depend on using the pedicle screws and rods to fix the vertebral bodies.

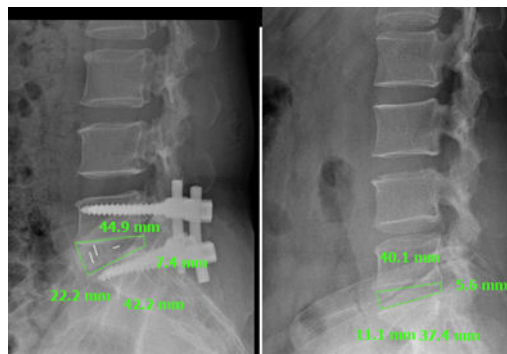
A cage is placed between the vertebral bodies with **bone graft** to help stimulate bone growth. It retrieves the height of the spine and establishes the vertebrae as they fuse together. In an effective fusion, the bone expands around and through the cage over time, making it the only place in the body where the material is cultivated and active in the reparative process which raises the disc height after the MIS-TLIF procedure. In addition, the cage and the material it is made out of play an active role in the growth of the bone that forms the fusion.

Bone graft material come in many kinds often, the patient's bone is taken from the hip bone, and sometimes the surgeon will use the allograft to reduce the recovery time for the patient. Bone morphogenetic protein can also be used.

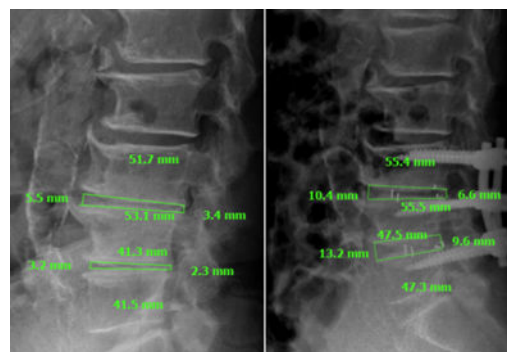
### Radiological assessment

Radiographic examinations were performed pre and postoperative, Radiographic data were collected and evaluated by the same observer (Figure 1). In all patients, X-Ray performed in our radiology department in order to calculate the intervertebral height index (DHI) preoperative and postoperative using digital tools. The intervertebral disc height is expressed as an average of the sum of the measurements at the anterior and posterior regions of the disc (anterior line +posterior line/2) (Figure 2).

| DHA | DHB | ALA | ALB | PLA | PLB |
|-----|-----|-----|-----|-----|-----|
|-----|-----|-----|-----|-----|-----|



**Figure 1:** This X-Ray showing the disc height pre and post-MIS-TLIF: Secondary spinal stenosis due to lumbar disc herniation L5-S1, Disc height pre=(5.6+11.1)/2=8.35 mm Disc height post=(7.4+22.2)/2=14.8 mm.



**Figure 2:** MIS-TLIF operation of 2 segments (L3-L4, L4-L5) Disc height is calculated by using a digital tool (Anterior line+posterior line)/2.

### Statistical analysis

For comparing the differences between the preoperative and postoperative disc height we use the T-test. Statistical significance was set at a P value<0.001. The statistical analysis was performed using SPSS software.

### Results

All the cases showed improvement on the disc height after MIS-TLIF. Though the average of the posterior line pre-post (6.76 mm-10.61 mm), and the anterior disc line average was pre-post (12.9 mm-18.16 mm), and the mean of disc height pre- MIS-TLIF was 9.83 mm compared with the disc height post MIS-TLIF with average 14.38 mm the patient's complaints improved after MIS-TLIF with no complication. The postoperative X-ray showed no subsidence or collapse of the cage or bars, and none of the pedicle screws show a sign of loosening position (Table 1).

|      |      |      |      |      |      |
|------|------|------|------|------|------|
| 10   | 8.95 | 14.3 | 12.4 | 5.7  | 5.5  |
| 11.8 | 5    | 16.8 | 5.6  | 6.7  | 4.4  |
| 14.1 | 8.45 | 16.7 | 12.8 | 11.5 | 4.1  |
| 14.8 | 8.35 | 22.2 | 11.1 | 7.4  | 5.6  |
| 13.3 | 10.7 | 14.9 | 9.3  | 11.6 | 12.1 |
| 12.5 | 9.1  | 15   | 10.3 | 10   | 7.9  |
| 15.8 | 11.5 | 23.5 | 13.5 | 8    | 9.4  |
| 15.8 | 11.4 | 18.9 | 14.5 | 12.6 | 8.2  |
| 14.4 | 8.7  | 17.7 | 10   | 11.1 | 7.4  |
| 12.2 | 10.7 | 15.1 | 12.5 | 9.2  | 8.9  |
| 8.5  | 4.45 | 10.4 | 5.5  | 6.6  | 3.4  |
| 11.4 | 2.75 | 13.2 | 3.2  | 9.6  | 2.3  |
| 13.9 | 6.3  | 14.6 | 10.2 | 13.2 | 2.4  |
| 11.6 | 10.7 | 12.6 | 15.8 | 10.6 | 5.5  |
| 14.8 | 11.7 | 19.6 | 16.7 | 9.9  | 6.7  |
| 17.6 | 13.2 | 23.5 | 19.9 | 11.7 | 6.5  |
| 15   | 10.9 | 16.6 | 10   | 13.3 | 11.7 |
| 13.7 | 9.4  | 18.4 | 15.1 | 9    | 3.7  |
| 13.3 | 12.1 | 17.4 | 16.6 | 9.2  | 7.6  |
| 12.8 | 9.45 | 15.8 | 11.7 | 9.8  | 7.2  |
| 10.6 | 7.7  | 13.2 | 11.1 | 7.9  | 4.3  |
| 17.4 | 11.7 | 19.5 | 15.6 | 15.3 | 7.7  |
| 11.6 | 10.2 | 13.1 | 11.4 | 10.1 | 9    |
| 19   | 11.6 | 27.2 | 17.4 | 10.7 | 5.7  |
| 15.2 | 9.75 | 17.6 | 12.4 | 12.8 | 7.1  |
| 16.9 | 9.15 | 23.2 | 14.8 | 10.5 | 3.5  |
| 13   | 4.6  | 18.9 | 5.4  | 7    | 3.8  |
| 12.7 | 9.7  | 13   | 7.9  | 12.3 | 11.5 |
| 11.9 | 7.2  | 14.6 | 8.7  | 9.1  | 5.7  |
| 13.4 | 9.25 | 17.6 | 11.4 | 9.1  | 7.1  |
| 12.2 | 10.9 | 15.8 | 14.7 | 8.5  | 7    |
| 14.1 | 12.4 | 19.3 | 18.5 | 8.8  | 6.2  |
| 15   | 9.7  | 15.5 | 13.4 | 14.4 | 6    |
| 12.5 | 7.3  | 16.5 | 10.4 | 8.5  | 4.2  |
| 14.4 | 10.4 | 18   | 14.9 | 10.8 | 5.9  |
| 17   | 11.8 | 19.3 | 13.7 | 14.7 | 9.8  |

|   |      |      |      |      |      |
|---|------|------|------|------|------|
| 12.4  | 7.7  | 15.9 | 12.3 | 8.8  | 3.1  |
| 16.6  | 11.3 | 20.6 | 13   | 12.6 | 9.5  |
| 14.8  | 9.1  | 19.1 | 11.3 | 10.4 | 6.9  |
| 17.6  | 11.2 | 19.9 | 11.1 | 15.3 | 11.2 |
| 10.3  | 6.5  | 13.8 | 10   | 6.8  | 3    |
| 16.3  | 12.1 | 18.8 | 18.1 | 13.7 | 6.1  |
| 19  | 5.9  | 25.7 | 7.2  | 12.2 | 4.6  |
| 19.5  | 14.5 | 25.1 | 20.2 | 13.9 | 8.8  |
| 16.5  | 11.4 | 22.2 | 17.1 | 10.8 | 5.7  |
| 14.5  | 13.4 | 17.3 | 18.4 | 11.7 | 8.4  |
| 19.6  | 13.4 | 23.4 | 16.4 | 15.7 | 10.3 |
| 18.2  | 12.7 | 21.1 | 17.1 | 15.3 | 8.2  |
| 17.5  | 12.7 | 24.1 | 15   | 10.8 | 10.3 |
| 11.8  | 10.6 | 15   | 14   | 8.6  | 7.1  |
| 12.2  | 9.55 | 15.4 | 14.8 | 9    | 4.3  |
| 16.6  | 10.3 | 21.3 | 15   | 11.9 | 5.5  |
| 15.3  | 9.05 | 20.2 | 12.3 | 10.4 | 5.8  |
| 13.4  | 7.5  | 19.1 | 10.3 | 7.6  | 4.7  |
| 14.5  | 11.6 | 18.6 | 12.7 | 10.4 | 10.4 |
| PLA: Posterior Line After the Operation; PLB: Posterior Line Before the Operation<br>ALA: Anterior Line After the Operation; ALB: Anterior Line Before the Operation<br>DHB: Disc Height Before the Operation; DHA: Disc Height After the Operation |      |      |      |      |      |

**Table 1:** Improvement on the disc height after MIS-TLIF.

## Discussion

Inter vertebral discs undergo age-related degenerative disorders that contribute to one of the most common causes of impairment and disability for many old people: spine stiffness, neck and back pain .

Disc aging lead to overall loss of water content and conversion to fibrocartilage especially there is a decrease in the water content [12], nutritional support, proteoglycans, and PH. Many ligaments and muscle attach to the back of the spine to provide power movement which will help the disc tissue to stand longer any disorder will affect the anatomical structure will lead to more pressure on the disc tissue and end with disc degeneration [13]. Degenerative disc disease can occur in any place in the spinal cord, but mainly its happen in the low back and it's a condition more than disease cause the disc will lose their flexibility of courser age related to disc tissue include the disc dry and shrink small tears occur in the annulus, bone spurs appear and the disc became thinner in addition to spinal cord stenosis [14].

Degenerative disc disease develops as a result of the effects of aging on your spine and specifically on your intervertebral discs. It can also be associated with an injury to the lower back, but even in that scenario, your discs usually lose its ability with age, discs lose water content, becomes thinner; both of which can change the strength and

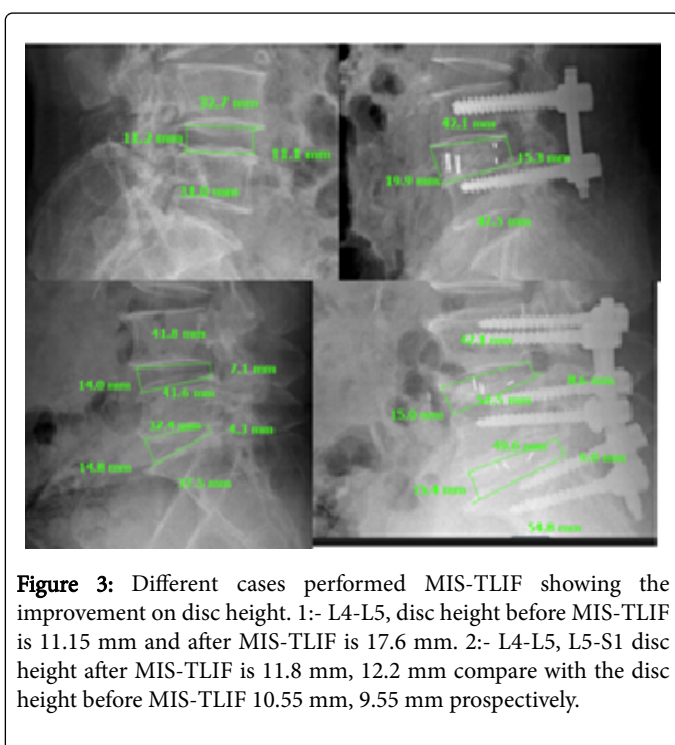
shape of the discs. Before the person can feel the result of Degenerative disc disease, pain and other symptoms the discs and other spine structures becoming abnormal. This is simply the natural outcome of the stress and strains each of us puts our spine through every day [3].

In this retrospective study, the cases were selected randomly, the next step to have the patients history from the hospital system to collect the database, X-Ray was the image to calculate the disc height cause all the patients made it pre and post MIS-TLIF procedure then use the SPSS to get the T-test result and write the result.

Forty patients pre and post MIS-TLIF and after calculating the disc height it's clear that MIS-TLIF is a successful procedure to treat the patients complain of low back pain and the disc height showed significant improvable Some of the spine degenerative disorders that require surgical intervention such as degenerated discs. The surgical process providing a solution to remove the problem of lower-back pain only more than fix it [15]. The perfect treatment technique would include returning the physical and mechanical functionality of the disc. However, current research has been able to identify only MIS-TLIF to solve this complaint. MIS-TLIF is also an effective method to treat lumbar spine deformity and avoid complications with minimum blood loss, smaller incision, less damage to the tissue, short time surgical

procedure, early discharge from the hospital compare with TLIF, provide pleasant clinical outcomes many patients will show improvement on their symptoms directly after the operation [7]. This method has some clear advantages over convention surgeries [11]. It is a technique with more advantages than other procedure treats spinal disorders. In the treatment of patients with spinal disorders, the cage can be placed between the vertebral bodies which prevent the pressure on the nerve root. After inducing the supplementary instrumentation, it can result in convenient postoperative stability [5]. Most of the authors support the use of MIS-TLIF in the treatment of the lumbar spinal disorders results in significant improvement of disc height.

Patients will need to start the exercise and TLIF is a beneficial procedure that can provide an improvement in spinal stability and reduce pain [16].



**Figure 3:** Different cases performed MIS-TLIF showing the improvement on disc height. 1:- L4-L5, disc height before MIS-TLIF is 11.15 mm and after MIS-TLIF is 17.6 mm. 2:- L4-L5, L5-S1 disc height after MIS-TLIF is 11.8 mm, 12.2 mm compare with the disc height before MIS-TLIF 10.55 mm, 9.55 mm prospectively.

In this prospective study we hypothesized not to find any subsidence or collapse, and any worse outcome, any complication during the operation, the patients who performed the MIS-TLIF have shown improvements after the operation and the symptoms disappear (Figure 3) and they get back to their normal life after a short hospital stay [17]. The drawback of MIS-TLIF are a prolonged learning period, it demands a specialist with considerable experience, the medical instruments which are used in the operation is very expensive not every hospital can have it, and increase the risk of surgery failure [18]. from this all points, we can find the MIS-TLIF is more convenient for the patients and that's what we are looking for improving it.

## Conclusion

The MIS-TLIF procedure evaluates the disc gap sported with cage and bone graft can restore the disc height to keep the normal lumbar function. MIS-TLIF operation is highly safe procedure in treating the disc degenerative d conditions, and improve the patients symptoms with less blood loss during the operation, less pain, short healing time, and the patient can get back to his normal life after a short period,

MIS-TLIF is a successful procedure for primary cases as well as for revision cases with an expressive increase in disc height and reduce in patients complaints.

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