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Research Article

Unilateral Versus Bilateral Facetectomy and its Effect on Segmental Lordosis and Disc Height in MIS TLIF

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Abstract

Background: Minimally invasive transforaminal lumbar interbody fusion (MIS TLIF) techniques have allowed for improved recovery and other metrics compared to its open counterpart. Our expanding literature has increasingly demonstrated the importance of spinopelvic parameters. One of the concerns with MIS TLIF is that the limited exposure and existing technology make it difficult to restore lumbar lordosis at the degenerative level requiring surgery. We hypothesize that bilateral facetectomy with MIS techniques will allow for increased ability to restore segmental lumbar lordosis versus traditional unilateral facetectomy.

Methods: This is a retrospective chart review of all patients who underwent single level MIS TLIF between 2017 and 2018. We collected baseline characteristics and reviewed operative records to determine whether unilateral or bilateral facetectomies were performed. We used intraoperative CT (O-Arm) sagittal reformatted images to measure segmental lordosis as well as anterior, middle, and posterior disc heights.

Results: Forty patients were identified. Eighteen underwent bilateral facetectomy, and 22 had unilateral facetectomy. We found a significantly increased middle disc height in the bilateral facetectomy group of 3.6 mm

vs 2.8 mm in the unilateral group (p=0.04). We also found increased lordosis (4.4 vs. 3.7, respectively) as well as anterior (4.5 vs 3.5) disc height in the bilateral facetectomy group but neither reached statistical significance.

Conclusion: Bilateral facetectomy is a tool that can help achieve maximal lordosis and disc height restoration in MIS TLIF surgery. Benefits besides lordosis and disc height restoration include increased autograft for fusion. Across various papers there seems to be a trend toward greater lordosis and disc height restoration, however most papers including ours have been underpowered to find significance.

Keywords: MIS TLIF; Facetectomy; Lordosis

1. Introduction

The transforaminal lumbar interbody fusion (TLIF) procedure has gained popularity with spine surgeons over the past couple of decades and the techniques and technology involved in this procedure have evolved over this time. One of the most significant advances has been the ability to perform the procedure in a minimally invasive fashion (MIS). A concern with the MIS TLIF surgery is the ability to achieve significant segmental lordosis. With our growing knowledge over the past 10 years, a need to restore lumbar lordosis has become a priority. Over the past year or so, the investigator has adapted the procedure by going to the side opposite the decompression on a MIS TLIF and drilling out the facet joint prior to putting in the contralateral instrumentation. This provides three benefits. First, it provides additional autograft for the interbody fusion. Secondly, it helps to mobilize the segment, allowing the surgeon to restore disc height with the interbody graft. Finally, it removes the resistance created by the facet joints as they are compressed at the end of the procedure, thus allowing for more segmental lordosis. Other authors [1, 2] have compared segmental lordosis with unilateral and bilateral facetectomies. There is scant clinical literature comparing bilateral and unilateral facetectomies with minimally invasive techniques and evaluating segmental lordosis and change in disc height.

2. Materials and Methods

2.1 Study design

We performed a retrospective chart review of all patients who underwent single level MIS TLIF between 2017 and 2018 by the senior author, JM. After identifying all patients, we collected baseline characteristics including age, sex, comorbidities (nicotine use, diabetes mellitus), and presence of spondylolisthesis. We reviewed operative records to determine unilateral or bilateral facetectomies. We then reviewed and measured the intra-operative sagittal reformatted O-Arm™ (Medtronic) images pre and post facetectomy, status blinded to the reviewer. Each patient had two intraoperative scans; one before and one after instrumentation. Change in segmental lordosis as well as anterior, middle, and posterior disc height on the sagittal reconstructed images were then measured.

2.2 Surgical technique

Patients are positioned on the Jackson spinal table (Orthopedic Systems, Inc.) with a chest pad and four post-hip pads. Following prep and drape, the posterior superior iliac spine is palpated, and a percutaneous pin is placed in a medial to lateral trajectory allowing the reference arc to be placed facing the feet and leaning toward the midline of the sacrum. After the reference arc is placed, the O-arm™ (Medtronic) image is obtained. Skin incisions are planned based on navigation. If a bilateral facetectomy is to be performed,

a 22mm METRx tubular retractor (Medtronic Sofamor Danek) is initially placed over the facet contralateral to where the interbody is being placed, and the facetectomy is performed. This is done using a combination of high-speed drill and kerrisons. The bone dust collector is utilized to capture bone removed during drilling, and a funnel is packed with this autograft in order to deliver it into the disc space. After the contralateral facetectomy, an awl-tip navigated tap is used to tap the pedicles and measure screw size based on the navigated image, and the plans are saved. Then the screws are placed. We do not place the screws on the ipsilateral side until the decompression and interbody placement are complete, but we do tap the pedicles prior to the ipsilateral facetectomy. Once the ipsilateral decompression is complete, the disc space is prepped thoroughly making sure endplates are exposed. The small kit (4.2 mg) of Infuse™ (Medtronic Sofamor Danek) sponges are wrapped around the harvested local autograft and passed through the annulotomy defect to the far side of the disc space.

The remainder of the harvested autograft is then packed into the disc space pushing the sponges even further away from the annulotomy. The bone dust funnel is inserted into the disc space, and the space is filled as much as possible. An expandable PEEK interbody cage (Medtronic Sofamor Danek, Elevate™) packed with bone is then inserted in the standard fashion placing it to the anterior margin of the intervertebral space. The procedure is completed by placing the ipsilateral screws and passing the rods down into the screw heads, followed by compression and set screw final tightening. Closure includes the fascial layer, followed by subcutaneous tissues, and finally the dermal layer.

2.3 Statistical methods

Descriptive statistics comparing groups are reported as means and p values for post op change. Categorical variables were compared using a fixed-effect linear model with significance set at alpha < 0.05. We used a normal parametric test for analysis. The input variables in our final model included the level as well as bilateral facetectomy.

3. Results

Forty patients were identified in our review. Twenty-two underwent unilateral facetectomy and 18 underwent bilateral facetectomy. Table 1 illustrates baseline characteristics. There was more follow up in the unilateral group (13.3 vs 8.9 months) as the bilateral technique is more recent. Otherwise there were no significant differences between the groups. The majority of patients in both groups had surgery at L4/5 (55% and 72%), with second most common level L5/S1 (27% and 22%; unilateral versus bilateral, respectively). There were more patients in the unilateral group who had spondylolisthesis (77% vs 39%). There were no grade II or higher spondylolisthesis in the patients identified. L5/S1 level was found to be a significant predictor of change in lordosis with a p value of .0322. As shown in Table 2, there was a higher change in lordosis in the bilateral group of 4.4 degrees vs 3.7 degrees in the unilateral, although this difference was not significant with a p value of .652. There was a significant difference in the middle disc height. The bilateral facetectomy group had an increase of 3.6mm vs 2.8mm in the unilateral group. Anterior and middle disc height changes had a nonsignificant trend toward greater disc height change in the bilateral facetectomy group.

	Unilateral	**Bilateral**	**p-value**
Age	55.5 ± 10.2	56.8 ± 10.4	0.687
BMI	29.5 ± 5.3	28.1 ± 4.8	0.375
Diabetes	32%	17%	0.272
Nicotine use	23%	17%	0.640
Follow up (months)	13.3	8.9	0.070
L5/S1	27%	22%	0.257
L4/L5	55%	72%	0.257
L3/L4	14%	6%	N/A
L2/L3	5%	0%	N/A
Spondylolisthesis	77%	39%	0.126

Table 1: Summary of patient characteristics between groups. Age is reported as mean years ± standard deviation. BMI is reported as mean ± standard deviation.

	Unilateral	**Bilateral**	
Preop			
Lordosis	8.6	7.4	
Anterior disc height	9.7	8	
Middle disc height	9.3	7.5	
Posterior disc height	5.4	4.8	
Postop			
Lordosis	12.3	11.7	
Anterior disc height	13.2	12.5	
Middle disc height	12.2	11.1	
Posterior disc height	7.9	7.1	
Change			**P value**
Lordosis	3.7	4.4	0.652
Anterior disc height	3.5	4.5	0.133
Middle disc height	2.8	3.6	0.047
Posterior disc height	2.4	2.3	0.279

Table 2: Results of unilateral versus bilateral facetectomies on lordosis and disc height, reported as means.

4. Discussion

This study examined the ability of the bilateral facetectomy to provide increased disc height space and improved segmental lordosis as compared to a unilateral facetectomy in single level MIS TLIF constructs. MIS techniques provide numerous improvements over open techniques with reduced blood loss, improved recovery, mobility, lower infection, and lower adjacent level spondylosis [3-7]. These techniques are optimal in patients requiring a 1 or 2 level fusion. However, indications and superiority for the MIS TLIF application is controversial, as reports vary in its ability to provide lordosis comparable to open TLIF [8, 9]. Wide variations in technique further distort the indications and superiority of this common surgery. A unilateral facetectomy is considered part of the standard technique, but some have concerns regarding its inability to achieve optimal lordosis correction. Robertson found that unilateral TLIF was not able to significantly increase lordosis using a cadaveric model [10]. There have been inconsistent findings in the literature with regard to the ability of bilateral facetectomy to help improve lordosis achieved in open TLIF surgery [1, 2, 11, 12]. The goal with bilateral facetectomy is to increase segment mobilization and subsequent disc height restoration as well as increased ability to compress across the posterior elements. Other suggested benefits include increased autograft for interbody fusion. There is minimal extra operative time in order to perform this as well. It is unclear if or how many of these benefits translate to the MIS TLIF.

Our findings demonstrated a trend toward greater lordosis in the bilateral facetectomy group but we were unable to reach statistical significance. Other groups have had similar findings [10]. Cadaveric studies have suggested that the extent of posterior element resection is the limiting factor for maximum lordosis creation. This limits the maximum lordosis possible in MIS TLIF due to preservation of the posterior elements. A more recent cadaveric study was able to demonstrate significant differences in lordosis as well as foraminal disc height improvements with a bilateral facetectomy compared to a unilateral [13]. Of note, neither of these studies used expandable interbody grafts which have demonstrated a greater ability to increase segmental lordosis as well as disc height in MIS TLIF [14]. Others have reported the inability to provide improved lordosis or ineffectiveness of the TLIF with regards to restoring disc height, albeit these were performed with a unilateral facetectomy [10, 15-17]. Limitations of our study include the small number of subjects and inherent lack of power due to this. We did not capture patient reported outcomes and our follow up span was short, however the ability to restore lordosis and increase disc height and maintain these parameters at follow up supports our initial theory of the benefits of this surgical technique.

5. Conclusion

Bilateral facetectomy is a tool that can help achieve maximal lordosis and disc height restoration in MIS TLIF surgery. Benefits besides lordosis and disc height restoration include increased autograft for fusion. Across various papers there seems to be a trend toward greater lordosis and disc height restoration, however most papers including ours have been underpowered to find significance.

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