MICROSURGICAL LANDMARKS IN MINIMALLY INVASIVE TRANSFORAMINAL LUMBAR INTERBODY FUSION

INTRODUCTION

In 1982 Harms and Rolinger suggested placing bone graft and titanium mesh in the intersomatic space distracted by a transpedicular instrumentation previously through direct transformaminal route; this approach could be completed by exposing the ipsilateral foramen and with minimal retraction of the thecal sac. The approach was called transformaminal lumbar interbody fusion (TLIF) and emerged as an alternative to posterior lumbar interbody fusion (PLIF), with the intention of achieving a circumferential fusion with minimal risk to the neural structures, and avoid two surgical times.\(^1\)\(^\text{3}\) Minimally invasive TLIF (MI-TLIF) was described by first time by Foley et al, in 2003.\(^4\) The approach is less traumatic, it has a more rapid recovery compared with conventional open TLIF, the more lateral exposure of the intersomatic space allows less manipulation of neural elements, preserves the posterior tension band, and reduces injury to the paraspinal muscles.\(^1\)\(^2\)\(^5\)\(^6\) The indications of MI-TLIF ideally are: refractory disc herniation, lolisthesis grade 1 and 2, degenerative disc disease and recurrent disc herniation.\(^1\)\(^4\)\(^5\) However something weak in the technique is the lack of microanatomical orientation because the standard anatomical landmarks are not visible and is technically difficult to work through a small surgical access.\(^1\) The perioperative time is longer compared to conventional open TLIF and exposure to radiation during surgery is higher.\(^2\) This work was done with the purpose of defining the most relevant microanatomical landmarks of microsurgical target in the MI-TLIF, facet joint complex.
MATERIAL AND METHODS

We performed an observational study during MI-TLIF procedures; L4-L5 intersomatic left side levels were photographed under a microscope and edited in OSX (1983-2015, Apple Inc.) system and then we compared it with diagrams and anatomical models in order to show the microsurgical landmarks used by the Senior author (JASS) for access to the lumbar interbody space through the foramen during MI-TLIF technique. All surgeries were operated by the Senior author (JASS) and assisted by the Principal author (JQO). The study was approve by the Soriano Institute of Minimally Invasive Spine Surgery (JQO012015ISCCMI)

PROCEDURE

The patient was placed in prone position on a radiolucent operating table. Conventional fluoroscopy is performed to locate the radiological landmarks in MI-TLIF; in order to make the incision and the accesses to placement the percutaneous pedicle screws. We started doing real shots with C-arm. In anteroposterior fashion the upper endplate of adjacent vertebral body and upper endplate of underlying vertebral body of the segment to be fused must be aligned and in a true lateral shot with C-arm the surgical vector of the approach will be the intersomatic space (L4-L5, in this case). Then we perform a longitudinal incision in the skin between 1.7 to 2 cm in most cases, and dissect by planes subcutaneous tissue, thoracolumbar fascia, subfascicular tissue and common muscle fascia, until visualize the boundary between longissimus and iliocostalis muscles. Subsequently blunt dissection is done with the index finger to feel and recognize the facet joint (L4-L5 left, in this case). Then the tubular retractors are placed progressively until the last retractor is positioned and fixed to the surgical table. Then begins the microscopic stage, which will aim to make the transforaminal decompression, interbody space preparation and placement of bone graft and interbody cage.

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The first microscopic image that we see through the tubular retractor is the remains of adjacent tissue to the facet joint; these can be easily coagulated and removed with forceps disc. We must subsequently define the limits of drilling, which will enable us to access the foramen from an angled posterolateral tubular approach. The upper microsurgical limit is the apex of the superior articular process; which is the most cephalic point of the superior articular process of the underlying vertebral body of the segment to be fused. The lower limit is the transverse-facet junction that is at the same height, as the inferior pedicle of the segment to be fused. Its intraoperative recognition is critical to avoid transgressing the upper limit of the inferior pedicle where will be placement the inferior screw. (Figure 1) The medial limit of the microsurgical transforaminal access is the articular cleft, which it is generally visible when the adjacent facet joint tissue is removed. (Figures 2 and 3) Having located the three microanatomical landmarks, it will be completed with drill system the lateral facetectomy of the segment to be fused to achieve the intervertebral disc safely and perform microdiscectomy, endplates preparation and placement of bone graft and intersomatic cage. Finally positioned the percutaneous pedicle screws and the rod, as well as correction of lordosis if the case requires.

Figure 1. White star in the transverse-facet junction.

Figure 2. a) Three landmarks were exposed in the surgical field: apex of left L5 superior articular process superiorly, the articular cleft medially and transverse-facet junction inferiory. b) Diagram performed to illustrate the landmarks described c) View through the tubular retractor on an anatomical model, the neural structures are observed: exiting root and traversing root and below both the intervertebral disc.

DISCUSSION

In 1982 Harms and Rolinger developed the open technique of transforaminal lumbar interbody fusion as an alternative to PLIF. Foley et al., in 2003 described a minimally invasive technique for performing the same approach. However the technique has progressed at the same time with technological development and has advantages as the fusion of the three columns, better lateral interbody space view and the ability to prepare the intervertebral space through a unilateral approach, less retraction of the thecal sac, preserving the posterior tension band and minimal paraspinal muscles transgression. When comparing the length of hospital stay, intraoperative bleeding and perioperative use of narcotics between the MI-TLIF versus conventional open TLIF, the first one has better results. The MI-TLIF is superior...
The MI-TLIF is a technical challenge especially during the time that the surgeon takes to become familiar with the technique. This approach requires deep knowledge of microanatomy, microsurgery and long learning curve. Microsurgical landmarks proposed in this paper allow security and orientation to enter the foramen during the tubular retractor. Secure access to foramen is achieved when drilling the upper facet and entered to security area within Kambin’s triangle bounded by two cathetuses and a hypotenuse: the medial cathetus is the dural sac and traversing root, the lower cathetus will be the intervertebral disc and the hypotenuse is the exit root of segment to be fused. The drilling of the upper facet combined with laterality and angulation of tubular access, minimize the drilling of the medial posterior arch. Minimally invasive techniques have been limited due to insufficient exposure area compared to open surgical spine, a situation that becomes less important when you have a specific and defined surgical target as proposed in this work. The reasons why young spine surgeons do not decide to do the MI-TLIF over conventional open TLIF are: (1) a longer learning curve, (2) prolonged surgical time compared to open surgery, (3) it is difficult to manage bilateral symptoms using a unilateral approach, (4) requires longer radiation exposure than conventional lumbar fusion. However there are numerous reasons to use the MI-TLIF technique over conventional open TLIF: return to normal activity in less time, cosmetic improvement, decreased postoperative pain, decreased length of hospital stay, reduced postoperative analgesic dependence and less intraoperative bleeding. Besides that pathological changes in paraspinous muscles after open surgery are well documented and have been associated with poor outcome.

CONCLUSIONS

The MI-TLIF is a technical challenge especially during the time that the surgeon takes to become familiar with the technique. This approach requires deep knowledge of microanatomy, microsurgery and long learning curve. Microsurgical landmarks proposed in this paper allow security and orientation to enter the foramen during microscopic stage of MI-TLIF.

All authors declare no potential conflict of interest concerning this article.

REFERENCES