MINIMALLY INVASIVE TUBULAR APPROACH FOR FORAMINAL AND EXTRAFORAMINAL DISC HERNIATION; SURGICAL TECHNIQUE AND CLINICAL RESULTS

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ABSTRACT

Background: *To present our Tubular minimally invasive approach for foraminal and extraforaminal disc herniation, AKA known as far lateral disc herniation using the Medtronic MetRx tubular system along with a surgical microscopic and to report our clinical results.*

Aim of the Work: *Our study aims to evaluate patients that underwent MIS FLD herniation surgery with the tubular retractors in terms of clinical improvement, intraoperative blood loss, operative time, complications and post operative hospital stay.*

Patients and Methods: *Retrospective analysis of data collected from our case series of patients that underwent minimally invasive tubular discectomy for far lateral disc herniation in the period from 2/2018 to 9/2021 We assessed pre and post VAS for leg pain, neurological status and complications.*

Results: *The study included 23 patients; the mean follow up time was months. Motor weakness improved in 75 % of patients that had weakness pre operatively. Sensory deficits improved in 62.5% of patients. The mean VAS for leg pain showed marked improvement from 8.5 before surgery to 2 after surgery (P value <.01). Complications included one patient with CSF leakage that was intraoperatively with fat graft and surgical glue on top, there was no CSF leakage in the post operative course.*

Conclusion: *Our results propose that MIS tubular discectomy for far lateral disc herniation is safe, efficient and might be a good alternative for open approaches.*

Key words: *far lateral disc herniation, radiculopathy, minimally invasive approach*

INTRODUCTION:

Far lateral disc prolapse represents 0.7-1.7 of all disc herniations and 7 % of lumbar disc herniations[(1)]. It usually occurs at the L4-5 level; however, in our series, it was more common at the L3-4 level[(2)]. Most disc herniations occur posterolateral compressing the traversing nerve root in the lateral recess [(3)]; however, the far lateral disc herniation affects the exiting nerve root, for example L4-5 far lateral disc affect the L4 nerve root, instead of the L5 nerve root in case of the usual posterolateral disc herniation [(3)]. There is no uniform description for the term far lateral disc herniation FLDH in the literature. Benini used the term FLDH for a disc prolapse lateral to the medial pedicle wall[(4)]. Hodges et al used the term FLDH for disc herniation at the level of the facet joint or lateral to it [(5)]. Foley et al. Considered FLDH to be a disc that compresses the exiting nerve root lateral to the nerve root foramen[(6)]. Some authors like Postacchini, Montanaro and Frankhal used the term extreme lateral disc herniation [(7,8&9)] Many approaches have been described for Far-lateral disc herniation including median,

paramedian and intertransverse approaches[10&11]. Paramedian approach is challenging due to difficulty in tissue retraction using the regular retractor and hence requires longer skin incision and more tissue dissection along with more blood loss [12]. To overcome those challenges, we present our technique using the minimally invasive retractors to manage cases with far lateral disc herniations.

AIM OF THE WORK:

Our study aims to evaluate patients that underwent MIS FLD herniation surgery with the tubular retractors in terms of clinical improvement, intraoperative blood loss, operative time, complications and post operative hospital stay.

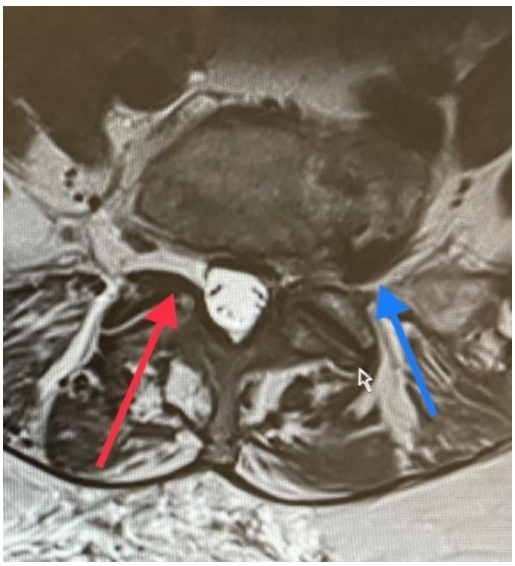

Figure 1: MRI lumbar spine at the L4-5 level showing left far lateral disc compressing the left L4 nerve root in the foraminal and extraforaminal area (blue arrow). Red arrow point toward the right L4 nerve root.

PATIENTS AND METHODS:

We retrospectively analyzed data of all patients who underwent MIS tubular far lateral discectomy by our Ain shams group in the period between 2/2018 to 9/2021. Inclusion criteria were typical radicular pain and neurological deficits that could be explained by the compressed nerve root in the foramen or extra foraminal area in the imaging studies, figure 1. All patients were assessed by MRI of the lumbar spine along with a CT scan to assess any osteophytes compressing the nerve root in the foramen area. Neurological examination was performed by the neurosurgery resident and the staff member. Exclusion criteria were previous surgery, central and lateral recess stenosis.

Demographic data and preop and post op data were listed in table number 1. We operated on 26 patients with far lateral disc herniation, 3 were excluded because they were lost to follow up. The study group included 11 males and 12 females with age ranging from 29 to 68 years old. All patients had preoperative radicular pain and 34 % had pre operative motor weakness. The duration of symptoms before surgery was 2 weeks to 4 months. Preoperative assessment includes VAS for leg pain and neurological status. Post operative VAS and neurological assessment were done immediate post operative and at 2 weeks, 3months and 6 months. Some follow up were done over the phone due to the COVID 19 pandemic.

Surgical technique:

All patients received one dose of third generation Cephalosporin IV one hour before surgery. All procedures were done under general anesthesia. After induction of anesthesia, patients were flipped prone on the Wilson frame with adequate padding of all pressure points and making sure that the abdomen is hanging free to avoid any venous

engorgement during surgery. Surgical level is identified using a spinal needle and C arm. We first take an AP shot to see the facet joint and then insert the needle lateral to it. The skin is then infiltrated with local anesthesia and then 2 cm skin incision is made. Skin incision could be done longitudinally or horizontally, we prefer the horizontal one from a cosmetic perspective. After hemostasis of the skin and subcutaneous tissue, the lumbar fascia is incised longitudinally the monopolar cautery. With finger dissection, we fell the septum between the longissimus and multifidus muscle and then we insert the first small dilator of the Metrex system (Medtronic sofamor danek, Memphis, TN, USA) making sure to be lateral to the septum in order to land on the cranial transverse process, for example for L4-5 far lateral disc, we dock the tube on the L4 TP. We take a C arm shot to verify the level then we sequentially insert the larger dilators and finally we insert the tube over the dilators and confirm the location with an X ray shot before we pull out the dilators. We usually use the 20 mm diameter tube and the length varies from patient to another according to how obese or slim they are. Figure 2. Then the tube is secured to the table with a specific arm that has two joints giving us room to direst the tube in different directions during the procedure. The surgical microscope is then brought to the field and we switch to the longer monopolar tip. All next steps were done under the microscope. With the monopolar and pituitary forceps, we clean all soft tissue over the TP and pars. The undersurface of the TP and pars were dissected with a 2-0 upgoing curette. Using the Medtronic high speed 3 mm drill, we drilled 2-3 mm from the junction of the TP with the pars, then the intertransverse ligament is opened and the exiting nerve root is dissected using a ball dissector and nerve hook. Figure 3. Then the nerve root is further dissected caudally and we usually at this step move our tube caudally to expose the caudal TP and facet joint. Figure 4. During this caudal dissection, the facetal artery is frequently injured with brisk bleeding that ca be easily managed with the bipolar cautery. The disc herniation is usually caudal and medial to the exiting nerve root, hence, the nerve root after dissection is retracted laterally and cranially to access the disc fragment. With the high speed drill and Kerrison rongeurs, the foramen can we widened by drilling more of the pars and the facet joint. Then a nerve hook is used to palpate the foramen from lateral to medial to assess for ant residual fragments. After hemostasis is achieved, we irrigated the incision with normal saline and we inject 1 CC of depomedrol around the nerve. The fascia is closed with one figure of 8 stich using the number 1 Vicryl, the skin is closed with 3-0 Monocryl.

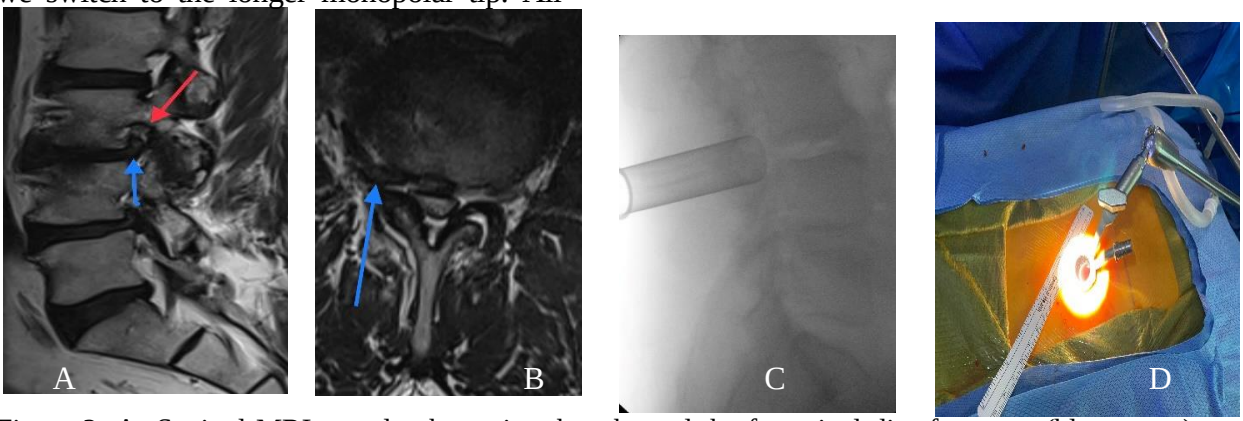

Figure 2: A- Sagittal MRI scan lumbar spine that showed the foraminal disc fragment (blue arrow) compressing the L3 nerve root against the pedicle (red arrow).B- axial cut showing the far lateral disc compressing the right L3 nerve root (blue arrow). C- Intraoperative Fluro image showing the final position of the tube at the L3-4 level. D- Intraoperative picture showing the tube attached to the arm system secured to the operating table.

Figure 3: The black shaded area on the spine model shows the bony work needed to expose the exiting nerve root at the foramen area. We the high speed drill, we drilled the 2-4 mm of the lower TP and lateral aspect of the pars (black shaded area), then we followed the nerve root caudally to the level of the disc.

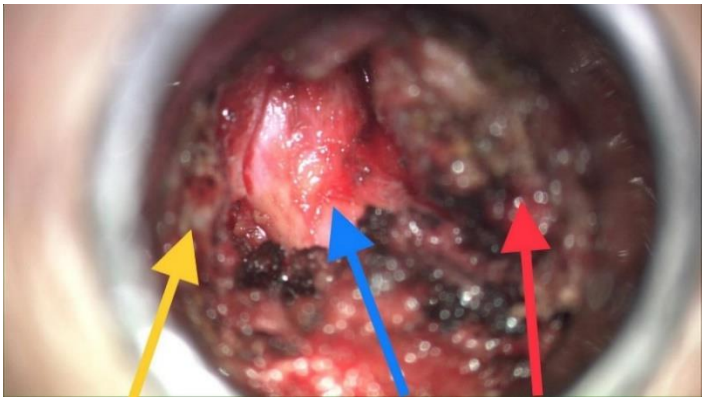

Figure 4: Intraoperative photo that showed the decompressed exiting nerve root after the bony work and resection of the inter-transverse membrane. The blue arrow points to L3 nerve root, the yellow one points to L3 transverse process after we drilled some of it, while the red one points to L3-4 facet joint.

RESULTS:

Foraminal and nerve root decompression were adequately achieved in all cases and there was no need to convert to open approach in any of the cases. The disc fragments were adequately removed, however; it is worth mentioning that in 11 out of the 23 cases the compressing element was calcified disc and endplate in 6 patients and hypertrophied superior articular facet of the caudal vertebra in 5 cases with diminished disc height. There was only one complication that was a CSF leak due to dural tear that was managed with a fat graft and surgical glue on top. The mean follow up time was 12.5 months (4 to 21 months). The average operative time was 67 minutes, The average estimated blood loss was 50 ml and the mean post operative stay was 1 day. Motor weakness improved markedly in 6 out of 8 patients with preoperative muscle weakness and sensory deficits that was in form of hypothesia improved in 5 out of 8 patients with pre operative hyothesia.

VAS evaluation for leg pain: The mean pre op evaluation of leg pain was 8.5 (7-10), whereas the post op mean in the last follow up was 2 (0-4), showing statistically significant improvement ($P<0.001$).

McNab outcome assessment of patients satisfaction: 87% of patients were very satisfied with the results and choose excellent in the questionnaire, while 13 % choose good.

Ethical committee:

The ethics committee at the faculty of medicine, Ain shams university has reviewed the study protocol from the ethical point of

view and approves it. The approval is valid for one year till 23/10/2023.

DISCUSSION:

Many approaches are described in the literature for management of FLDH. Midline approach requires medial or complete facetectomy that causes instability especially with flexion as shown by biomechanical studies [(13)]. Direct exposure of the intertransverse area can be achieved by midline and paramedian skin incision. The Former gives more room to the surgeon to work medial and lateral to the facet joint to access disc fragments in the spinal canal, foramen and extra-foraminal area[(14)]; however, it requires extensive muscles dissection in order to retract them laterally and expose the intertransverse area that results in muscles atrophy and weakness [(15)]. The paramedian approach entails dissection in the plane between the longissimus and the multifidus muscles to expose the transverses processes, pars interarticularis and the facet joint. It was first described by Wiltze and has been modified by many authors [(16,17&18)]. The minimally invasive approach has multiple advantages: the tube works as an efficient retractor, uses a muscle splitting rather than muscle separation technique, hence prevents muscle atrophy and minimizes pain post operatively and lastly, it is better cosmetically since it is done through a 2 cm skin incision or less. The disadvantages are: it requires a learning curve for the surgeon to get familiar with the anatomy and to work through a tube, Dural tear is challenging to repair through the tube, L5-S1 level can be sometimes not suitable for the MIS tubular approach due to patient's sacrum ala and ilium anatomy that sometime obstruct the surgical corridor. Some studies excluded the L5-S1 level FLDH[(19&6)].

Our results are comparable to other reports in the literature in terms of neurological status, pain improvement and functional status. The mean operative time was 55 minutes which is comparable to 43 minutes in Greiner=Perth et al series[(20)] and 44 minutes in Khalil and Lidar series[(3)]. Our patients were discharged few hours after surgery except one patient that had a Dural tear, repaired with fat graft and glue and was kept in hospital for 24 hors and discharged the next day. Khalil and Lidar discharged their patients after 24 hours and they had two dural tears in their series of 31 patients[(3)]. The disc fragment in FLDH is usually caudal and medial to the nerve root, hence, in surgery we used to retract the nerve root cranially and laterally to retrieve the fragment. In order to do so, we used to dock the tube at the cranial transverse process to expose the nerve root where we are expecting to find it at the lateral border of the foramen, then we follow it caudally to the disc space. Murray et al described a modification of the technique where they dock the tube on the caudal transverse process as it is more close to the disc space and they can access the disc fragment without exposing the nerve root to avoid manipulation around the dorsal root ganglia located just lateral to the foramen as they refer post operative parathesia to that dissection [(21)]. We prefer docking at the cranial transverse process as we can check the nerve root foramen for disc fragments as well as the extraforaminal area, however with Murray et al modification, the surgeon will not be able to check the foramen. Also, Michael et al reported a case with FLDH where the fragment was cranial and lateral to the nerve root, which makes it very difficult to retrieve if the surgeon dock the tube on the caudal transverse process[(22)].

Conclusion:

Tubular minimally invasive technique is a safe and effective approach to manage FLDH that prevents muscles atrophy and minimize bone removal in comparison to the traditional open midline approaches that requires extensive muscles dissection and extensive bony removal that destabilize the spine.

Limitation of the study: small sample size, being a retrospective study with no control group.

Conflict of interest:

The authors declare that they have no conflict of interest.

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تقييم التدخل المحدود للغضروف القطنى داخل وخارج مجرى العصب عن طريق الأنبوب الجراحى وتسجيل النتائج الإكلينيكية

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المقدمة: تهدف الدراسة الحالية إلى تقييم التدخل المحدود للغضروف القطنى داخل وخارج مجرى العصب عن طريق الأنبوب الجراحى، ويعرف التدخل المحدود للغضروف القطنى خارج مجرى العصب باسم فتق القرص الجانبي البعيد باستخدام جهاز Medtronic MetRx الأنبوبي جنبًا إلى جنب مع الفحص المجهري الجراحي وتسجيل النتائج الإكلينيكية.

المرضى وطرق البحث: تحليل بأثر رجعي للبيانات التي تم جمعها من سلسلة الحالات الخاصة بنا من المرضى الذين خضعوا لاستئصال القرص الأنبوبي المحدود من أجل فتق القرص الجانبي البعيد في الفترة من ٢٠١٨/٢ إلى ٢٠٢١/٩ وتم تقييم شدة الألم باستخدام مقياس التناظر البصرى قبل وبعد التدخل الجراحى لألم الساق والحالة العصبية والمضاعفات.

النتائج: شملت الدراسة ٢٣ مريضاً. وكان متوسط وقت المتابعة شهورًا. وأظهرت النتائج تحسناً فى ضعف الحركة لدى ٧٥٪ من المرضى الذين يعانون من ضعف الحركة قبل الجراحة. وتحسن العجز الحسي في ٦٢,٥٪ من المرضى. وأظهر متوسط شدة الألم باستخدام مقياس التناظر البصرى لألم الساق تحسنًا ملحوظًا من ٨,٥ قبل الجراحة إلى ٢ بعد الجراحة (عند نقطة دلالة إحصائية < ٠,٠١). وتضمنت المضاعفات مريض واحد يعاني من تسرب السائل الدماغي النخاعي أثناء العملية مع وجود ترقيع بالدهون وغراء جراحي في الأعلى، ولم يكن هناك تسرب للسائل النخاعي خلال فترة ما بعد الجراحة.

الخلاصة: تقترح نتائج الدراسة أن استئصال القرص الأنبوبي عن طريق التدخل المحدود للغضروف القطنى من أجل فتق القرص الجانبي البعيد آمن وفعال وقد يكون بديلاً جيدًا للطرق الجراحية المفتوحة).