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MINIMALLY INVASIVE LUMBAR DECOMPRESSION RADIOLUCENT FORCEPS FOR INTERSPINOUS SPACER INSERTION: AN IRONIC TECHNICAL SYNERGY

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Background: Minimally invasive interspinous spacer insertion is commonly performed with the assistance of radiopaque instrumentation (e.g., ring forceps). Long-handled radiolucent forceps optimize image clarity, anatomy visualization, and reduce radiation dose when using automatic brightness control.

Case Report: A 65-year-old woman with primary lumbar spinal stenosis with neurogenic claudication underwent interspinous spacer placement at L3-L4 and L4-L5 after failed conservative therapy. Radiolucent forceps from the Minimally Invasive Lumber Decompression (mild) (Vertos Medical, Aliso Viejo, CA) procedure kit were used for instrument stabilization.

Conclusion: Repurposing of the radiolucent forceps from the mild procedure kit is an optimized technique for the implantation of interspinous spacer devices. Future studies should be performed to see if this technique results in relevant reductions in radiation dose or operative time.

Key words: Case report, IDS, mild, radiolucent forceps, spinal stenosis

BACKGROUND

In 2018, the minimally invasive spinal treatment (MIST) practice guidelines were published to aid in the appropriate management of symptomatic lumbar spinal stenosis (LSS). Within the spectrum of treatment options, minimally invasive interventions emerged as appropriate options for certain patient populations who fail conservative therapy but do not warrant or wish to undergo invasive surgery (1). These minimally invasive techniques include percutaneous image-guided lumbar decompression (PILD) and indirect lumbar decompression with interspinous spacers.

Minimally Invasive Lumber Decompression (mild) (Vertos Medical, Aliso Viejo, CA) is a PILD procedure used to treat patients with moderate symptomatic LSS secondary to ligamentous flavum hypertrophy. During the mild procedure, a trochar and cannula are used to gain percutaneous access to the lamina and ligamentum flavum adjacent to the spinous process. Debulking of these structures is then achieved with bone and tissue sculptors as contrast media helps evaluate nerve compression via an epidurogram. Given the requirement for instrument stabilization under image guidance (fluoroscopy or computed tomography), long-handled radiolucent forceps are included in the mild procedure kit (2).

The Superion Indirect Decompression System (S-IDS) (Vertiflex, Inc., San Clemente, CA) is a titanium "H-shaped" interspinous spacer implant that is placed between adjacent spinous processes to prevent lumbar

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extension, a movement that is characteristically associated with LSS pain. After access is gained to the desired location for S-IDS placement, the implant is inserted through a cannula using manufacturer-supplied instrumentation under fluoroscopic guidance. Similar to the mild procedure, instrument stabilization throughout the procedure is necessary as instrument and implant placement is confirmed with imaging (3). Unlike the mild procedure kit, radiolucent forceps are not included in the S-IDS kit, requiring the utilization of other available facility instruments such as standard radiopaque ringed forceps.

As general principles for fluoroscopy, optimizing visualization and minimizing radiation exposure for the patient and physician are important considerations during any procedure. This case report demonstrates the technique and success of repurposing previously-disposed-of equipment, specifically the radiolucent forceps that accompany the mild procedure kit, to stabilize instrumentation for interspinous spacer placement in order to limit radiation exposure and improve visualization under fluoroscopy.

CASE

The patient was a 65-year-old woman with a past medical history significant for osteoporosis, left ankle open reduction and internal fixation, and thoracic aortic aneurism without rupture who presented in September of 2017 with sudden onset lower back pain that radiated to her knees bilaterally. Accompanying symptoms included neurogenic claudication. Her pain was exacerbated with prolonged standing and walking. Alleviation occurred with sitting. After initial work-up, the patient was diagnosed with primary LSS with neurogenic claudication and lumbar spondylosis. Initial conservative management with various medications, including acetaminophen with codeine #3, hydrocodone-acetaminophen, and diclofenac sodium 1% topical solution, as well as multiple rounds of physical therapy, failed to provide long-term relief.

During follow-up in December 2018, a lumber spine x-ray showed grade 1 anterolisthesis at L3-4 and L4-5 with mild instability on flexion. Bilateral L3-5 medial branch blocks performed in January and February 2019 provided 80% relief during the local anesthetic phase of the procedure. In March 2019, right and left L3-5 medial branch radiofrequency ablation provided only 10% relief at 8 weeks. L3 transforaminal lumbar epidural steroid injection in July 2019 provided 50% relief for a short time.

Due to failure of conservative management, interspinous spacer implantation was performed after updated magnetic resonance imaging (MRI) noted moderate L3-4 central and bilateral foraminal narrowing and moderate-severe L4-5 multifactorial stenosis. A preoperative dual-energy x-ray absorptiometry (DEXA) scan noted adequate bone density. An interspinous spacer was inserted at L3-4 and L4-5.

The technical conduct of the procedure began with standard weight-based antibiotics, alcohol-based skin prep, and positioning on a Wilson frame. Monitored anesthesia care was used. A 20-mm incision was marked over the L4 spinous process, which was used to access both levels. A mixture of lidocaine 1% with epinephrine 1:100,000 and bupivacaine 0.5% was injected into the incision as well as onto the spinous processes and interspinous spaces with a one-inch needle. Skin incision was performed with a 15-blade, and dissection down to the lumbodorsal fascia was performed with electrocautery. Biplanar fluoroscopy was used to incise the supraspinous ligament with a 10-blade in the midline. Positioning of this blade in the space was facilitated by use of a radiolucent mild surgical clamp, which was then used to guide each step of subsequent instrumentation (Fig. 1). In order to improve visualization, the first dilator was detached from its handle and placed in a typical "bow-tie" appearance in between the spinous processes in the anteroposterior (AP) view. After gaining purchase and accurate trajectory in the AP view, the dilator was held firmly with the radiolucent forceps while the fluoroscope was rotated to a lateral view to gently mallet the dilator to the spinolaminar junction. Next, the second stage dilator-working cannula assembly were advanced over the first, stabilized by the radiolucent forceps to ensure accurate trajectory on AP and lateral views. At this time, the dilators were removed and 3 cc of the local anesthetic mixture was then placed down the working cannula. Reaming was performed under live lateral fluoroscopy to ensure adequate space to deploy the interspinous spacer, which measured to a 12-mm implant with the sizing tool. The spacer was then loaded onto the driver assembly and deployed under fluoroscopic guidance to ensure appropriate capture of the spinous processes in a lateral and then AP view. After satisfactory deployment, the driver was removed and the inserter was tapped down to place the implant at the spinolaminar junction. Then the inserter was released and removed. The above procedure was performed in a similar fashion at L4-5 with a 12-mm spacer

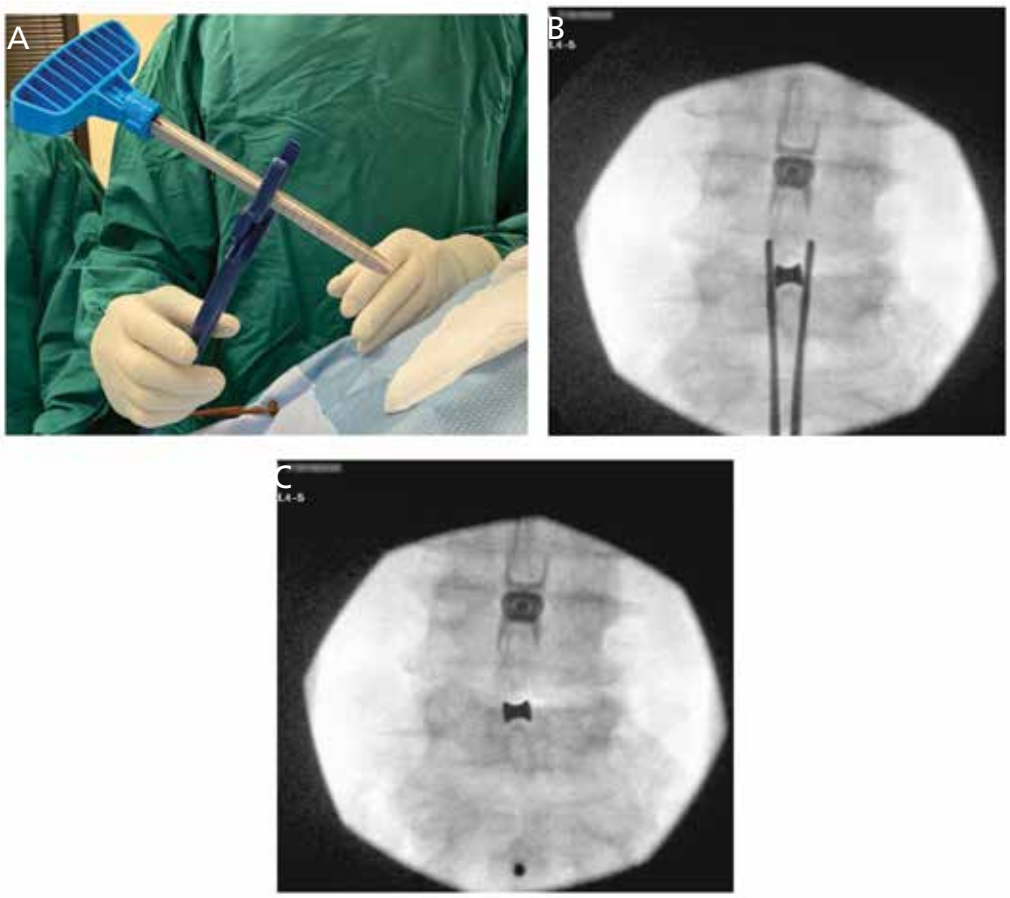

Fig. 1. A) Dilator tool assembly from S-IDS surgical kit held by radiolucent forceps from MILD procedure kit. B) Fluoroscopic image taken during S-IDS placement. S-IDS placed at L3-L4 is seen at the top of the figure. Cannula being stabilized with standard ringed forceps during L4-L5 S-IDS placement is seen at the bottom of the figure. C) Fluoroscopic image taken during S-IDS placement. S-IDS placed at L3-L4 is seen at the top of the figure. Cannula being stabilized with repurposed radiolucent forceps from MILD procedure kit during L4-L5 S-IDS placement is seen in the middle of the figure. Radiopaque lock of radiolucent forceps is seen at the bottom of the image.

followed by a 3-layer closure. The patient tolerated the procedure well with no immediate complications. The patient was discharged home in stable condition.

The patient reported complete resolution of leg pain with mild intermittent low back pain from 2 weeks post procedure to 28 weeks post procedure. At that time, low back pain gradually returned to baseline, likely due to adjacent segment disease, and the patient is currently considering surgery vs dorsal column spinal cord stimulation trial.

DISCUSSION

Both procedures serve as important treatment options in the management for symptomatic LSS (1). Interspinous spacers have been shown to provide long-term improvements in symptom severity, patient function, and patient satisfaction with sustained long-term efficacy in patients with moderate symptomatic LSS (4-6). When compared to surgical intervention with decompressive laminectomy, current literature suggests that the response to the interspinous spacer is non-inferior at 2 years (7). This makes the S-IDS an important intervention to consider prior to laminectomy since it has the added benefits of being a minimally invasive procedure that can be placed under monitored anesthesia care. It can also be explanted with a minimally invasive approach and preserves the option to proceed to laminectomy if required.

Interspinous spacers play an important role in the minimally invasive stenosis paradigm, and so it is important to consider how this procedure can be improved. This case report demonstrates how simple repurposing of the radiolucent mild surgical clamp optimizes the placement of an interspinous spacer device under fluoroscopy to limit radiation and improve visualization.

It is widely accepted that the effects of radiation that result in mutation within a cell can occur at any dose. For this reason, there is no dose of radiation that is

considered safe (8). In fact, it has been estimated that x-rays may account for 1% of all cancers in the United States (9). Since fluoroscopy relies on x-ray imaging, the importance of following the Centers for Disease Control and Prevention's recommendation to keep radiation doses As Low As Reasonably Achievable (ALARA) is essential. This is important for the patient directly exposed to radiation and the medical team exposed to radiation scatter.

One way to limit radiation exposure for both the patient and team is to reduce exposure time with shorter procedures. Because radiolucent materials can improve visualization, it is possible that our technique can translate to more efficient procedures and ultimately less radiation. Future studies measuring procedure time and radiation exposure with radiolucent forceps vs radiopaque instrumentation during device placement would be required to determine if a clinically relevant relationship exists. Additionally, radiation exposure can also be limited by minimizing scatter. Scatter from the patient is one of the main sources of radiation exposure to a medical team during fluoroscopy (10). Metal instrumentation in the field of fluoroscopy further increases scatter radiation exposure (11). Because the disposable radiolucent forceps used in this technique are plastic, it is reasonable to believe that their utilization during interspinous spacer placement decreases radiation exposure and may improve the accuracy of placement.

Improved accuracy from improved visualization has additional potential benefits. Inappropriately shallow placement of the spacer will increase risk of spinous process fracture rate by a factor of 4. Further, difficulty in placement leading to multiple deployments has unknown effects on implant strength, and it is recommended that a new implant be opened after 3 failed attempts at deployment (3). Future studies can be conducted to compare radiolucent forceps vs radiopaque instrumentation with regard to the number of unintended shallow implants and number of failed device deployment attempts to determine if improved visualization is clinically relevant.

CONCLUSION

This case report demonstrates how repurposing of previously-disposed-of radiolucent forceps can be repurposed to successfully aid in the implantation of a minimally invasive interspinous spacer device to improve visualization and limit radiation exposure. Future studies should be performed to evaluate if this technique results in clinically relevant improvements in fluoroscopy time, dose, surgical time, and accuracy of device placement.

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