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Percutaneous Nucleoplasty for the Treatment of a Contained Cervical Disk Herniation

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Abstract: Cervical radiculopathy is characterized by compression of the roots of the nerve. When conservative treatment fails and symptoms persist or increase in severity, surgical treatment is considered. Anterior cervical discectomy with or without fusion is regarded as the standard treatment for cervical disk herniation. Recently, there is an evolving trend in spinal surgery towards less invasive techniques. Nucleoplasty is a minimally invasive technique in which radiofrequency technology is used for percutaneous decompression. During the last years nucleoplasty has been proven to be a safe and effective treatment to alleviate radiculopathy, caused by a contained disk herniation. Nucleoplasty is usually performed on an outpatient basis and is associated with a fast recovery time. This paper will describe the preoperative and postoperative management of cervical nucleoplasty as well as the surgical technique, accompanied by a video.

Key Words: cervical spine, nucleoplasty, minimally invasive, disk herniation

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INDICATIONS

Strict selection criteria of patients are essential for successful treatment. The ideal selection criteria are patients with symptomatic single-level contained cervical disk herniation's (CDH) and minimally degenerated disks. Contraindications are sequestered disk fragments, stenosis of the neural foramen or spinal canal, primary or metastatic malignancy, discitis, calcified disks, osteophytes, severe degenerative disk disease with $>50\%$ loss of disk height, previous operations of the intervertebral disk at the same level, anticoagulant therapy, impaired coagulation and pregnancy. Preoperative screening starts with an x-ray of the cervical spine to exclude osteophytes, possible misalignment of the vertebrae, facet arthropathy, stenosis of the canal, and fracture. Magnetic Resonance imaging (MRi) with T1-and T2-weighting sequences is performed before the PCN procedure to confirm the level of the CDH (See Fig. 1).

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OPERATING ROOM SET-UP

Instruments/Materials Required

- X-ray permeable table
- Intraoperative fluoroscopy (C-arm)
- ArthroCare introducer cannula, 19 G
- ArthroCare Coblator IQ SpineWand, surgical device with integrated cable
- ArthroCare Coablator IQ controller with foot control

Preoperative Preparation

- One hour before the PCN antibiotic therapy is administered with Cefazoline.
- The patient is placed in a supine position on an x-ray permeable table with head slightly hyper extended.
- The neck is sterilized with a Chloorhexidine 0.5% in alcohol 70% solution.
- The draping starts along the patient's neck using a 40×40 cm^2 Steri-Drape with a 10×12.5 cm^2 adhesive aperture and then drapes are placed to create aseptic conditions.
- The patient is treated under local anesthesia and the procedure is performed under a light intravenous sedation with low dose Remifentanil intravenously.
- A facial mask (oxygen 40%, air 60%) is used. This mask also creates a better breathing space for the patients' comfort during the procedure.
- The patient is monitored during the procedure. ECG, blood pressure and oxygen saturation are measured.
- The intraoperative fluoroscopy (C-arm) is positioned on the opposite of the surgeon to obtain anteroposterior (AP), lateral and oblique view.

SURGICAL PROCEDURE

Please see the Supplemental Digital Content for the accompanying video of the procedure (Supplemental Digital Content 1, http://links.lww.com/CLINSPINE/A42).

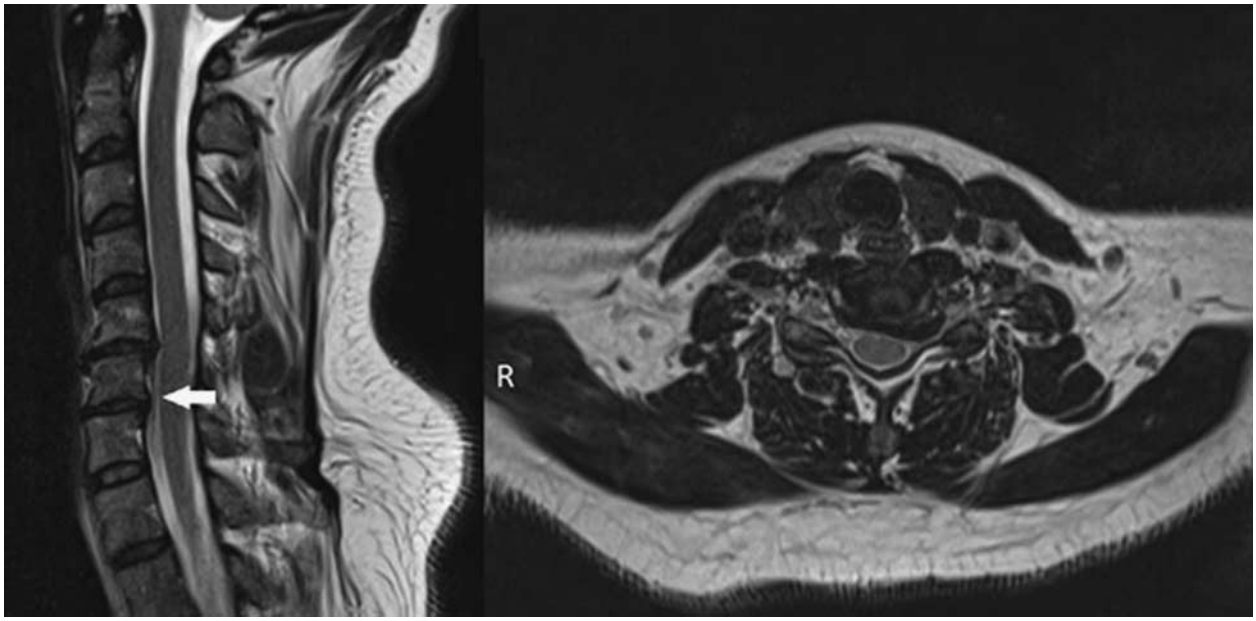

FIGURE 1. Sagital and axial magnetic resonance imaging of the bulging disk at level C6–C7 left.

Step 1: Marking

The intervertebral space of the CDH is detected with a trocar/needle under fluoroscopic view. The procedure is always performed from the right side to prevent puncture of the esophagus. The surgeon keeps the sternocleidomastoid muscle laterally and the trachea medially and the position of the carotid artery is localized. The introducer cannula (19-G, 7.6 cm) is then inserted under a 45-degree angle medially to the sternocleidomastoid muscle and vessels through an anterior lateral approach, and stopped when the annulus/ nucleus junction is reached. The tip of the cannula stylet is aimed for the center of the nucleus in both the coronal and sagittal planes. AP and lateral x-ray monitoring views confirm the precise positioning of the cannula within the nucleus.

Step 2: Insert the Spine Wand

The stylet is withdrawn from the introducer cannula and replaced with the Spine Wand Co-ablation needle (see Fig. 2). This device is advanced until its tip extends approximately 5 mm beyond the tip of the cannula, in order to ensure that the active portion of the wand is deployed in the center or posterior third of the nucleus pulposus.

Step 3: Ablation

A short initial motoric stimulation (0.5 s) is performed upon wand insertion in the most distal position to ensure correct placement; if stimulation or movement is detected, the device will be repositioned. As the device is drawn back out through the disk, 3 ablation cycles of 10 seconds each will be performed, rotating the device tip 360 degrees each time to form 3 consecutive pockets within the disk. The first coablation cycle is performed most posterior in the disk and confirmed by fluoroscopy, the second coablation cycle is performed 3–5 mm more proximal and the third another 3–5 mm more proximal. These 3 ablation cycles lead to a volumetric reduction of the tissue of the nucleus pulposus, resulting in decompression of the herniated disk. The coablation procedure should be painless; if any pain is experienced during coablation the position of the needle is reassessed by fluoroscopy. If the pain persists despite optimal position of the needle the procedure is cancelled.

Step 4: Closure

The 1-mm skin incision is closed with a plaster.

POSTOPERATIVE PROTOCOL

Postoperatively, antibiotic prophylaxis with a cephalosporin is administered to all the patients. To prevent neck edema, patients are treated with a coldpack during 1 hour. Postoperatively, patients are observed during 3 hours bed rest. If necessary, conservative therapies (physical therapy, nonsteroidal anti-inflammatory drugs and analgesics according to the World Health Organisation pain ladder) are prescribed. In our practice, no collars are applied postoperatively. In the absence of complications, patients are discharged on the same day of the procedure. Heavy lifting, forward bending, twisting of the neck, and severe physical activities are not permitted during the first 2 weeks after the procedure. After 2 weeks the patient is allowed to return to sedentary or light work. In our practice, a follow-up phone call is performed by a nurse, trained in Pain Medicine, 48 hours after the procedure. During this consult pain measured by VAS-scores of the affected arm, neck, shoulder and hand, complications (hoarseness and dysphagia), and use pain medication are evaluated. If necessary, pain medication is adjusted. After 6–8 weeks the patient has a control appointment at our clinic to evaluate the final results.

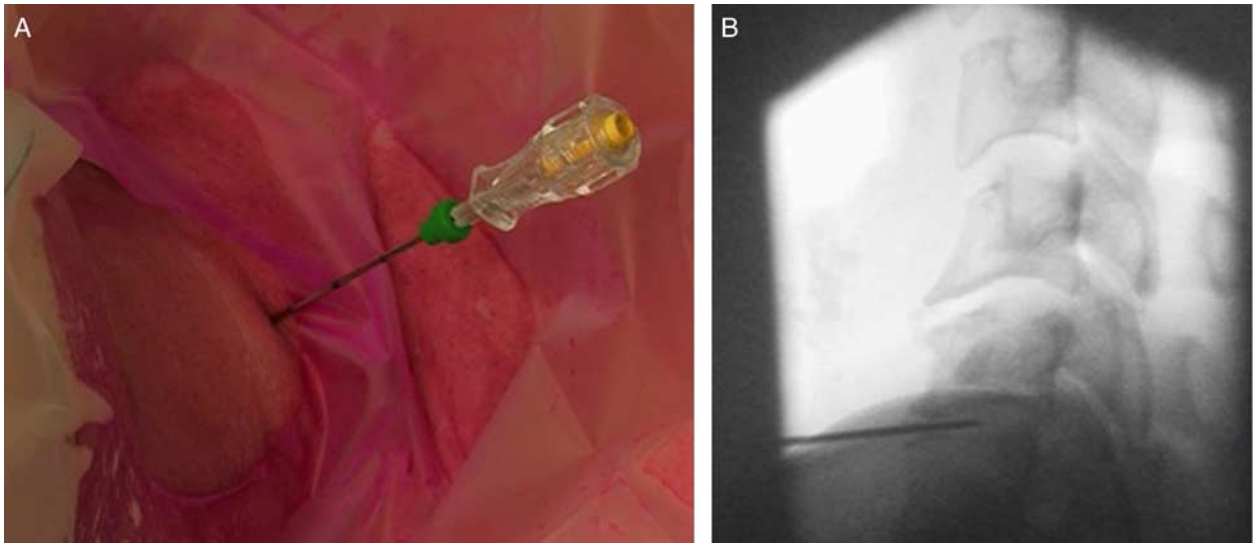

FIGURE 2. A, The position of the needle. B, The fluoroscopy. full color online

COMPLICATIONS

As PCN is performed through needle coablation and no structures are ligated, complications rarely occur and data on these complications are scarce. A recent meta-analysis pooled results of 6 studies compromising 638 patients.[1] Among these patients the complication rate was 0.8% which included one complication because of instrument failure. Spondylodiscitis is another reported complication,[2] which can be dealt with antimicrobial therapy One case of inferior thyroid artery injury is reported.[3]

PEARLS AND PITFALLS

- PCN, compared with surgical treatment, is a less invasive technique which is performed under local anesthetics on an outpatient basis.
- The procedure is proved to be a safe technique when performed in an experienced center with a dedicated team.
- Before placement of the needle the position of the carotid artery and trachea should be marked to avoid complications. For this reason, the procedure is always performed from the right side to avoid perforation of the esophagus.
- Localizing the exact level by fluoroscopy en placement of the needle in tunnel vision is one of the keys of a successful procedure.
- During treatment of the CDH in the lower cervical region, fluoroscopic visualization can be impaired by over projection of the shoulders. Some traction at the arms can resolve this problem.
- Selecting the correct CDHs for PCN is key for a successful outcome.

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