Nucleoplasty for contained lumbar disc herniation

Hany El Zahlawy[1], MD and Tameem Mohamed Elkhateeb[2], MD

1- Assistant professor of Orthopedics, Faculty of Medicine, Ain Shams University
2- Lecturer of Orthopedics, Faculty of Medicine, Ain Shams University

Corresponding author: Tameem Mohamed Elkhateeb, MD
Department of Orthopedics and Spine Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt,
Tel: (+20100)1809052;
Fax: (+20100)1809052;
Email: tameem_77@hotmail.com

The Egyptian Orthopedic Journal; 2019 supplement (1), June, 54: 80-83

Abstract

Background
The purpose of this study was to evaluate the effectiveness of nucleoplasty using coblation technology in treating contained lumbar disc herniation.
Patients & Methods
In a prospective study, 53 patients with contained lumbar disc herniation were treated via coblation using spinal wand under fluoroscopy guidance. There demographic data, operative time, ODI, VAS for back and leg pain and any complications were recorded. Patients were followed up for 12 months.
Results
Their mean age was 28 years. The mean operative time was 28 minutes. The clinical parameters showed highly significant improvement at 1,6 and 12 months after the procedure. A single patient suffered from discitis whereas another suffered from recurrence.
Conclusion
Nucleoplasty appears to be effective when used for contained discs. It requires appropriate fluoroscopy positioning and cooperative patients.

Keywords: Nucleoplasty; Coblation; Lumbar disc herniation

Introduction

There are numerous advantages to the minimally invasive techniques in treatment of lumbar disc herniation including minimal skin incisions, preservation of para-spinal muscles, short hospital stay, prevention of instability and avoiding violation of the partially intact annulus and posterior longitudinal ligaments thus minimizing recurrence. [1,2]

In order for such procedures to succeed, the inclusion criteria for the cases are quite strict: soft contained discs, disc heights preserved >50%, no motor deficits, no discitis, no instability or prior open surgeries. [1,2]

Nucleoplasty was introduced as a minimally invasive alternative for performing percutaneous disc decompression using coblation technology. It relieves pain through the ablation of nucleus pulposus, thus, decreasing intradiscal pressure. Disc protrusion and the associated compression of the nerve root are eliminated as a result. [3-9]

The aim of this study was to evaluate the short and long term efficacy of percutaneous nucleoplasty in patients with painful contained disc herniation.

Patients & Methods

This prospective study was conducted in Ain Shams University Hospitals between June 2012 and December 2015. 53 consecutive patients performed percutaneous disc decompression via nucleoplasty. The study was conducted following approval of the ethic committee. Prior to study inclusion, written consents were obtained from all participants. They were all complaining of low back pain with or without radicular pain, causing disability and not responding to conservative measures (medications and physiotherapy for at least 6 weeks). Images revealed contained posterolateral disc herniation correlating with the clinical findings. Patients were assessed clinically using Oswestry disability index (ODI) and Visual analogue scale (VAS) both before and after the procedures. Plain radiographs, CT and MRI were performed for all cases preoperatively. Their ages, sex, the levels affected and the operative time were noted. Patients were followed up for 12 months. Any complication related to the procedure was also recorded.

Patients presenting with sequestered or extruded disc herniation, contained herniation larger than

one third the sagittal diameter of the spinal canal, severe degenerative disc with greater than 33% loss of disc height, marked spinal stenosis due to extensive osteophytosis, previous spinal surgery in the same level, evidence of infection, spondylolisthesis or spondylolysis, muscle weakness, cauda equina syndrome, segmental instability or possible psychological disorders were all excluded from this study. Statistical analyses were performed using repeated measure ANOVA. P-values <0.05 was considered as being significant, <0.001 as highly significant.

Surgical Technique

Nucleoplasty was performed via local anesthesia and intravenous conscious sedation. A single dose (1gm) of third generation cephalosporin was given intravenously immediately before the procedure and was continued thereafter for 2 days. The patients were placed prone on a frame, while avoiding hyperextension of the operated segments.

Under fluoroscopic guidance, a posterolateral transforaminal approach was used with 45° angle of inclination, a 17-gauge 6-inch-long spinal introducer needle (ArthroCare, Sunnyvale, CA, USA) was inserted through the annulus fibrosus. At L4/L5 disc level, an oblique projection was used to insert the needle a few millimeters inferior and lateral to the superior pedicle and lateral to the superior articular process of L5 thus avoiding the exiting nerve root. At L5/S1, again in the oblique projection, the needle was directed through a triangle bordered by the L5 inferior endplate superiorly, the S1 superior articular process posteromedially, and the iliac crest anterolaterally (Figure 1).

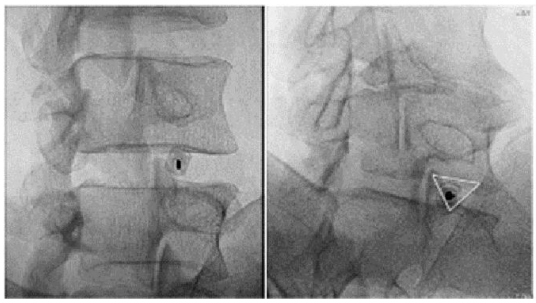

Figure 1: Oblique views showing correct needle placement at L4-5 (Left) and L5/S1 (Right)

Anteroposterior projection was then used to check that the needle had not transgressed the transpedicular line. The introducer needle edge was maintained within the outer annulus during the entire procedure acting as an access cannula for the spinal wand into the nucleus. A Perc-DLR spinal wand (ArthroCare, Sunnyvale, CA, USA) was advanced into the disc via the access cannula placing its tip approximately 5 mm beyond the edge of the cannula. This ensured that the active portion of the wand was beyond the inner layer of the annulus and in the nucleus. The proximal channel limit was marked on the wand (Figure 2).

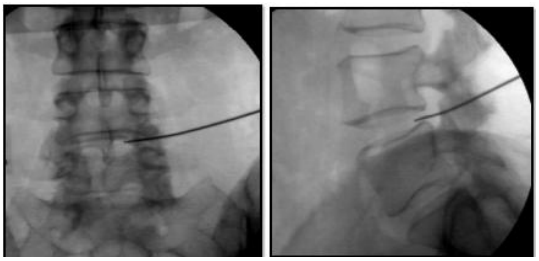

Figure 2: Spinal wand at the proximal channel limit in anteroposterior and lateral views

The wand was then advanced reaching the inner surface of annulus on the other side. The depth stop marker on the shaft of the Perc-DLR wand was advanced close to the needle hub to designate the distal channeling limit. The tip was ensured to be located on the anteroposterior view just medial to the medial border of the contra-lateral pedicle (Figure 3).

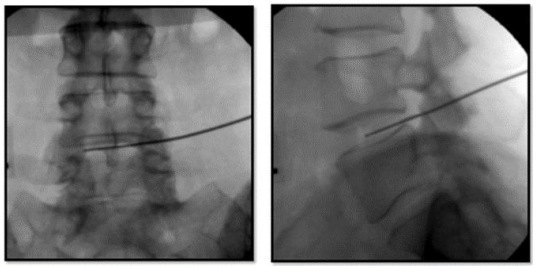

Figure 3: Spinal wand at the distal channel limit in anteroposterior and lateral views

The wand was connected to an ArthroCare System 2000 Controller radiofrequency generator (ArthroCare, Sunnyvale, CA, USA). It allows controlled ablation with minimal risk of heat injury. Ablation was performed at a speed of 0.5 cm/sec which generated approximately 120 volts of energy at the tip of the wand resulting in temperatures of 50–70°C. Advancing the wand in ablation mode created a channel from the posterolateral annulus to the anteromedial annulus. On withdrawal of the wand to the proximal channel limit, the coagulation mode was used at 60 volts of energy and a tip temperature of 70°C.

Results

The mean age of the patients was 27 years (18-53). There were 28 males and 25 females. L4/L5 level was affected in 36 patients whereas

L5/S1 level was affected in 17. 46 patients suffered from both axial and radicular pain while 7 patients suffered only from low back pain. The mean operative time was 28 minutes (16-45). At L4/L5 level, the mean operative time (20 minutes) was significantly shorter than L5/S1 (32 minutes). All patients were discharged from the hospital after 12 hours observation.

VAS scores for back pain, leg pain and ODI before the procedure and at 1, 6 and 12 months after were as in table 1. The improvements in their values were statistically highly significant (p-value <0.001).

Table 1: Clinical assessment of the patients before and after the procedure

	Before	1month	6 months	12 months
Mean VAS back pain	9.1	7.3	3.5	2.8
Mean VAS leg pain	5.9	3.6	2.5	2.5
Mean ODI	64.7	45.3	40.1	28.7

As regard complications a single case suffered from discitis with elevated acute phase reactants and worsening of back pain. It resolved expectantly with antibiotics. The patient was diabetic and morbidly obese. In another case, recurrence of herniation and pain was detected 7 months after the procedure, but the patient refused any surgical intervention and was treated conservatively.

Discussion

Back pain could be caused by contained disc herniation, being referred to as discogenic back pain. Irritation and stretching of pain sensitive annular nerve fibers contribute to the pain process. Nerve roots could also be compressed and inflamed causing radiculopathy. [10,11]

Numerous studies have previously reported on the use of nucleoplasty as a minimally invasive technology in treating contained discs. Reddy et al reported on improvement in VAS for back pain from 8.1 preoperatively to 4.5 at final follow up.[12] Masala et al reported on improvement from 8.2 to 4.1.[13] ODI improved in a study by Mirazi et al from 40.2 to 20.5 while VAS for pain decreased from 7.5 to 2.1. [14] Yakolev et al have also shown that pain and use of analgesics significantly decreased at 1, 6 and 12 months follow up. [15] The results of above studies are comparable to our findings where highly significant improvement could be found clinically.

Nucleoplasty also appears to be advantageous over epidural steroids injection. Reverberi et al compared between percutaneous disc decompression via nucleoplasty and epidural steroids injection. The average VAS was significantly lower after coblation as opposed to steroids injection on long term follow up. [16] In another study by Gerstzen et al, clinical outcomes following plasma disc decompression was shown to be superior to standard fluoroscopy guided transforaminal epidural steroid injection over a course of 2 years. In addition, significantly more patients avoided having to undergo a secondary procedure during that follow up period. [17]

Nucleoplasty is a relatively safe procedure and no complications were reported in several studies. [2, 3, 18, 19] Infectious discitis was reported by some after the procedure. Bhagia et al reported that 4% of cases had fever and increased new areas of back pain. [20] In our study, a single case was diagnosed with discitis. Co-morbidities are thought to have contributed to its occurrence.

Conclusion

Nucleoplasty appears to be an effective minimally invasive approach in treating contained disc herniation. However, its cost is a concern especially in developing countries. It is somewhat technically demanding requiring appropriate fluoroscopy positioning and cooperative patients. Dealing with L5/S1 disc space could show some difficulty especially in obese patients and those with high iliac crests.

References

1. Schäufele M: Interventional and Semi-invasive Procedures for Low Back Pain and Disc Herniation; in Minimally Invasive Spine Surgery. Edited by H.M. Mayer. Second Edition 2006; Springer-Verlag Berlin Heidelberg. Chapter: 28: 249-260
2. Anderson G, Tannoury C: Patient Selection for Minimally Invasive Spinal Surgery; in Minimally Invasive Spine Surgery. Edited by Alexander R. Vaccaro, Christopher M. Bono. First Edition 2007; Informa healthcare USA. Chapter 4: 25-33
3. Singh V, Piryani C, Liao K. Evaluation of percutaneous disc decompression using coblation in chronic back pain with or without leg pain. Pain Physician. 2003 Jul; 6(3):273-80.
4. Singh V, Piryani C, Liao K. Role of percutaneous disc decompression using coblation in managing chronic discogenic low back pain: a prospective, observational study. Pain Physician. 2004 Oct; 7(4):419-25.
5. Chen YC, Lee SH, Chen D. Intradiscal pressure study of percutaneous disc decompression with nucleoplasty in human cadavers. Spine (Phila Pa 1976). 2003 Apr 1; 28(7):661-5.
6. Chen YC, Lee SH, Saenz Y, Lehman NL. Histologic findings of disc, end plate and neural elements after coblation of nucleus pulposus: an experimental nucleoplasty study. Spine J. 2003 Nov-Dec; 3(6):466-70.
7. O'Neill CW, Liu JJ, Leibenberg E, Hu SS, Deviren V, Tay BK, Chin CT, Lotz JC. Percutaneous plasma decompression alters cytokine expression in injured porcine intervertebral discs. Spine J. 2004 Jan-Feb; 4(1):88-98.
8. Sharps LS, Isaac Z. Percutaneous disc decompression using nucleoplasty. Pain Physician. 2002 Apr;5(2):121-6
9. Lee MS, Cooper G, Lutz GE, Doty SB. Histologic characterization of coblation nucleoplasty performed on sheep intervertebral discs. Pain Physician. 2003 Oct;6(4):439-42

10. Atul Sukthankar, Andreas G. Nerlich, Günther Paesold: Age-Related Changes of the Spine; in Spinal Disorders fundamentals of Diagnosis and Treatment. Edited by: Norbert Boos and Max Aebi. First edition 2008; Springer-Verlag Berlin Heidelberg. Chapter 4:91-116
11. Olmarker K, Myers RR, Kikuchi S, Rydevik B: Pathophysiology of nerve root pain in disc herniation and spinal stenosis; in The Lumbar Spine. Edited by Herkowitz HN, Dvorak J, Bell G,Nordin M,Grob D. Third edition 2004; lippincott williams & wilkins philadelphia, pp 11-30
12. Reddy AS, Loh S, Cutts J, Rachlin J, Hirsch JA. New approach to the management of acute disc herniation. Pain Physician. 2005 Oct; 8(4):385-90.
13. Masala S, Massari F, Fabiano S, Ursone A, Fiori R, Pastore F, Simonetti G. Nucleoplasty in the treatment of lumbar diskogenic back pain: one year follow-up. Cardiovasc Intervent Radiol. 2007 May-Jun;30(3):426-32
14. Mirzai H, Tekin I, Yaman O, Bursali A. The results of nucleoplasty in patients with lumbar herniated disc: a prospective clinical study of 52 consecutive patients. Spine J. 2007 Jan-Feb; 7(1):88-92; discussion 92-3. Epub 2006 Nov 20.
15. Yakovlev A, Tamimi MA, Liang H, Eristavi M. Outcomes of percutaneous disc decompression utilizing nucleoplasty for the treatment of chronic discogenic pain. Pain Physician. 2007 Mar; 10(2):319-28.
16. Reverberi C1, Bottoli MG, Pennini M, Gabba E. Disc coablation and epidural injection of steroids: a comparison of strategies in the treatment of mechanical spinal discogenic pain. Acta Neurochir Suppl. 2005; 92:127-8.
17. Gerszten PC, Smuck M, Rathmell JP, Simopoulos TT, Bhagia SM, Mocek CK, Crabtree T, Bloch DA; SPINE Study Group. Plasma disc decompression compared with fluoroscopy-guided transforaminal epidural steroid injections for symptomatic contained lumbar disc herniation: a prospective, randomized, controlled trial. J Neurosurg Spine. 2010 Apr; 12(4):357-71. doi: 10.3171/2009.10.
18. Alexandre A1, Corò L, Azuelos A, Pellone M. Percutaneous nucleoplasty for discoradicular conflict. Acta Neurochir Suppl. 2005; 92:83-6.
19. Gerszten PC, Welch WC, King JT Jr. Quality of life assessment in patients undergoing nucleoplasty-based percutaneous discectomy. J Neurosurg Spine. 2006 Jan; 4(1):36-42.
20. Bhagia SM, Slipman CW, Nirschl M, Isaac Z, El-Abd O, Sharps LS, Garvin C. Side effects and complications after percutaneous disc decompression using coblation technology. Am J Phys Med Rehabil. 2006 Jan; 85(1):6-13.