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Comparison of Percutaneous Nucleoplasty and Open Discectomy in Patients with Lumbar Disc Protrusions

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Rezumat

Comparație între nucleoplastia percutană și discectomia deschisă la pacienții cu protruzii discale lombare

Introducere: Nucleoplastia prin coblație este o metodă minim invazivă situată la mijlocul distanței dintre tratamentul conservator şi cel operator classic al degenerării discului lombar asociat cu protruzie discală. Autorii compară rezultatele obținute prin tratamentul minim invaziv şi cel operator classic al acestei afecțiuni.
Material şi rezultate: Pacienții din două grupe (fiecare grupă având 80 de pacienți) au fost tratați prin cele două metode. Pacienții cu simptomatologie radiculară produsă de protruzii discale cu diametrul antero-posterior < 6 mm, rezistente la tratamentul conservator, au fost operați prin nucleoplastie. În situația în care diametrul antero-posterior al discului herniat a fost > 6 mm, s-a aplicat metoda discectomiei clasice. În grupul tratat prin discectomie deschisă ameliorarea durerii radiculare a fost imediată, dar la 1 an postoperator doar o treime dintre pacienți şi-au reluat munca. În grupul tratat prin nucleoplastie ameliorarea durerii a fost mai lentă dar progresivă. La un an postoperator scorul VAS al pacienților tratați prin cele 2 metode este foarte apropiat. Toți pacienții şi-au reluat munca la 3 zile după nucleoplastie. În acest grup nu au existat complicații intraoperatorii sau postoperatorii. Un pacient a fost ulterior operat prin discectomie clasică.
Concluzie: Nucleoplastia prin coblație este o metodă de tratament eficientă şi sigură a protruziilor discale lombare.

Cuvinte cheie: nucleoplastie, coblație, discectomie

Abstract

Introduction: Coblation nucleoplasty is a minimally invasive method, at middle way between conservative and open surgical treatment of patients with degenerative disc disease and lumbar disc protrusion. Authors compare the outcome of patients treated through the two methods.
Material and results: Two groups of 80 patients each were treated through open discectomy and nucleoplasty. Patients with radicular symptoms caused by disc protrusions, having antero-posterior diameter of herniated disc < 6 mm, resistant to conservative treatment, were operated using nucleoplasty. When antero-posterior diameter of the disc herniation was > 6 mm, classical discectomy method was applied. Classical surgeries (discectomies) were performed by the senior author (D.A.), while the nucleoplasty procedures all three authors equally participated. In the first group improvement of radicular pain was immediate. At 1 year after the procedure only one third of the patients returned to work. In the group treated through nucleoplasty improvement of pain was slow but gradual. After 1 postoperative year the VAS score of patients treated through the two methods were very close. At 3 days post nucleoplasty all patients returned to work. In this group there were not intraoperative or post-operative complications. One patient was afterwards operated through open discectomy.
Conclusion: Coblation nucleoplasty is a safe and efficient method to treat patients with lumbar disc protrusion.

Key words: nucleoplasty, coblation, discectomy

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Introduction

Degenerative disc disease (DDD) is a real socioeconomic problem, with a high prevalence. Compression and shearing forces produce fissuration of the annulus and disc herniation. Symptoms of lumbar disc herniation (LDH) may start as low back pain (LBP), which then develops to radicular pain.

This condition can be treated conservative or surgically through many approaches.

Minimally invasive procedures are increasingly applied for the treatment of LDH.

Nucleoplasty is a novel technique of percutaneous disc decompression approved by the US Food and Drug Administration since 2000.

The aim of this paper is to measure nucleoplasty outcome in comparison with open discectomy in patients with lumbar disc protrusion.

Material and Method

Between September 2009 and September 2010, two cohorts of 80 patients each were operated on through nucleoplasty and open discectomy respectively. Classical surgeries (discectomies) were performed by the senior author (D.A.) at "St. Pantelimon" Clinical Emergency Hospital, while the nucleoplasty procedures, were performed at "Victor Babeş" Clinic where all three authors equally participated.

The patient characteristics regarding sex distribution, age, or level of disease are presented in *Table 1*.

In the coblation group 40% were females and 60% males. In the microdiscectomy group these percentages were 47.5% and 52.5% respectively.

Patients in the 4th and 5th decade of age were the most affected. The majority of procedures were performed at L4-L5 and L5-S1 levels.

The following inclusion criteria were applied for nucleoplasty: radicular pain more intense than back pain and resistant to previous conservative treatment for a period of at least 6 weeks; MRI evidence of contained disc herniation $\leq$ 6 mm in antero-posterior diameter.

For open discectomy, the inclusion criteria were: patients with radicular pain in whom medical treatment failed after 6 weeks, patients with motor deficit and MRI evidence of disc protrusion $>$ 6 mm in antero-posterior diameter.

Common inclusion criteria were: one level protrusion and "virgin" spine at the level of interest.

The exclusion criteria included, for nucleoplasty disc protrusion $>$ 6 mm or sequestration, spondylolistesis and spinal fractures, infections or tumours, and for open discectomy back pain as a chief complaint and disc protrusion $<$ 6 mm.

All procedures were performed by senior experienced neurosurgeons.

Each patient gave informed consent for the operation.

Table 1. *Patient characteristics in the two treatment groups*

Parameters		Nucleoplasty	Open discectomy
Age, median (range) - years		43 (20-81)	47 (20-79)
Sex	male, n (%)	48 (60%)	42 (52.5%)
	female, n (%)	32 (40%)	38 (47.5%)
Preoperative employment status			
	- workers	65	64
	- retired	15	9
	- unemployed	-	7
Level of disease			
	L2-L3	-	4
	L3-L4	8	4
	L4-L5	32	40
	L5-S1	40	32

Open discectomy. Surgical technique

Open discectomy was performed in standard manner.

In all cases a posterior lumbar approach was chosen. All patients received prophylactic antibiotic therapy before incision. Discectomy was performed through the interlaminar space, with small unilateral laminectomy and medial facetectomy. In all cases a 2.5x magnification was used to remove the herniated fragment, followed by subtotal discectomy with intradisc curettage without end-plate lesion.

Patients were discharged in average after 7 days.

Nucleoplasty. Surgical technique

Nucleoplasty is performed in an outpatient setting.

Patients receive intravenous antibiotics before starting the procedure.

The patient is placed in left lateral decubitus in all cases, irrespective of the painful side or the side of the disc herniation. For the L5-S1 level, in cases with high iliac crest or narrowing of the discal space, a pillow is placed under the left lumbar side to open the entrance to the disc. The iliac crest is identified through palpation and marked on the skin. The direction of the disc of interest is checked with the fluoroscopic image and marked on the skin with a line.

The entry point is situated on this line at 10-12 cm from the midline. After local anaesthesia associated with 100 mg Propophol i.v., a guiding wire is introduced under fluoroscopic guidance in the AP and lateral views at the level of the Kambin triangle, through the annulus. Then a 17 gauge Crawford needle is placed into the nucleus pulposus. A bipolar radiofrequency (RF) probe is then inserted through the needle.

Six channels are created in the nucleus by advancing the RF probe (in ablation mode) and withdrawing it (in coagulation mode) using coblation energy.

At the end of the procedure the needle and probe are removed and 80 mg of Depo-Medrol is injected in the epidural lumbar space.

All the patients were examined at 3 month, 6 month and 1 year after the operation.

Results

Clinical data of the 2 groups of patients are presented in *Table 2:* mean VAS scores for the two methods, pre- and post-procedure status at 3, 6 and 12 month.

Table 2. *Clinical data of patients based on outcome and results of Rolland-Morris questionnaire (1)*

Characteristics	Preprocedural		Post-op 3 months		Post-op 6 months		Post-op 1 year	
	NP	OD	NP	OD	NP	OD	NP	OD
VAS score	7.9	8	5.0	2.8	3.7	2.0	2.2	1.8
Improvement of Rolland-Morris questionnaire	-	-	40%	60%	45%	70%	60%	78%

NP = nucleoplasty, OD= open discectomy

Table 3. *One-year outcome according to Odom classification (2)*

Grade	Nucleoplasty No. (%)	Open discectomy No. (%)
Excellent	31 (38.75)	29 (36.25)
Good	27 (33.75)	26 (32.50)
Fair	21 (26.25)	22 (27.50)
Poor	1 (1.25)	3 (3.75)

Visual Analog Scales (VAS) for interpretation of back and leg pain intensity in patients operated for degenerative lumbar spine disorders is a subjective scale in which score "0" means "no distress" and score "10" means "agonizing pain".

General clinical outcome is appreciated after 1 year follow-up by Odom classification (*Table 3*). The first two categories ("excellent" and "good") define the success rate.

In the nucleoplasty group 65 patients were under 65 years old (age of retirement) and all of them were employed before procedure. One patient was operated through open discectomy 3 months after nucleoplasty because of severe pain.

In the open discectomy group arm 71 patients were under 65 years old. Preoperatively, 9 patients were retreated and 7 were unemployed.

The employment status is presented in *Fig. 1*.

All but 1 patient with nucleoplasty returned to work after 3 days. Only a third from open discectomy group returned to work after 1 year from the operation.

Patient's appreciation of the results of nucleoplasty as successful, partial successful or failure and if they recommend it or not, is presented in *Fig. 2*. An improvement of more 75% is defined as successful, between 25% – 75% as partial successful and less than 25 % as failure.

There were no complications in the nucleoplasty group. In open discectomy group were one with CSF fistula, one discitis, 3 superficial infections and 3 recidives. These patients were reoperated.

Discussion

Disc degeneration is a normal evolution process, characterized by dehydration, increase of lactic acid and decrease of glycosaminoglycans. The impossibility to dissipate these toxic products creates an intradiscal medium that is very hostile and a high intradiscal pressure. Because of this intradiscal toxicity

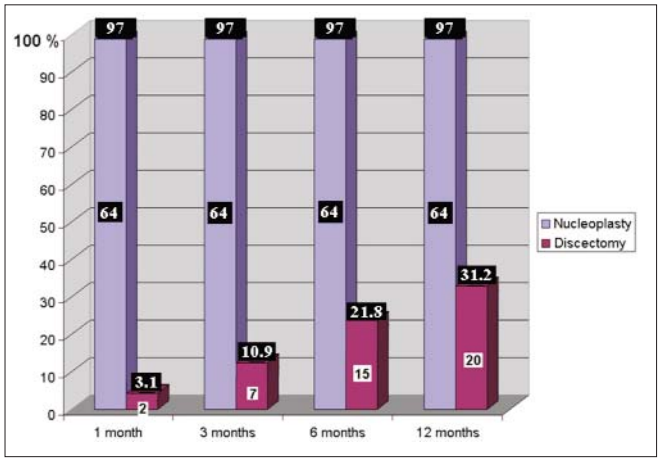

Figure 1. *The employment status of nucleoplasty versus open discectomy*

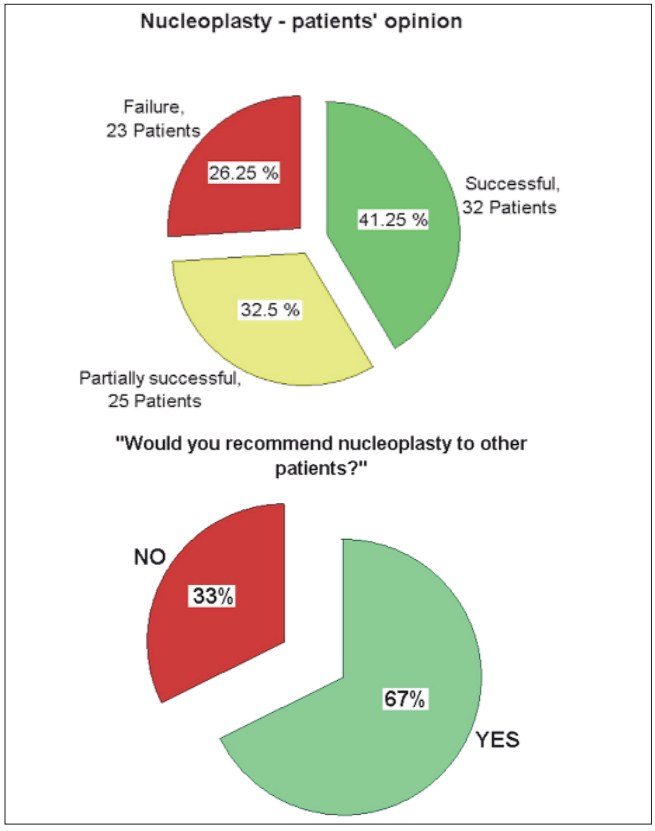

Figure 2. *Nucleoplasty results assessed by patients (Patient's satisfaction)*

the patient presents with pain: low back pain which, if a disc protrusion develops, is associated with radicular pain.

The disc is the pain generator. Back pain is explained by high pressure in the external annulus, with annular fibrosus tears, and invasion of granulation tissue in the disc with new nerve endings (C fibres).

Radicular pain is produced by mechanical compression by the herniated disc and chronic inflammation of the nerve root.

The initial management of disc degeneration and lumbar disc herniation is conservative: AINS, muscle relaxants, physical therapy, epidural steroid injections.

Radicular pain resistant to conservative treatment or progressive motor deficits are indications for open surgery. Lumbar discectomy is the gold standard treatment for large disc herniations or extruded fragments.

Carragee and col. reported that, for patients with contained LDH that measures less than 6 mm in Φ AP, the post discectomy success rate was of only 24%, as compared to 98% in patients with LDH greater than 9 mm Φ AP (3).

In many cases lumbar disc herniations are small and contained, without indications for open surgery. Long term conservative treatment can be inefficient or unacceptable for the patient.

Percutaneous nucleoplasty can be considered a good choice for these selected patients, a method situated half-way between these two extreme ones.

Nucleoplasty radiofrequency energy breaks proteoglycans, and dissolves nuclear material through normothermic molecular dissociation.

Partial removal of the nucleus pulposus decompresses herniated discs, relieves pressure on nerve roots and alleviates pain (4). Reduction of intradiscal pressure is immediate, but retraction of the protruded disc depends on the disc hydration: greater in young people and less in older persons. The water content of the nucleus pulposus varies from 50% to 89% and is age-dependent, decreasing with advancing age.

In our series, improvement of VAS score is greater for discectomy patients than for nucleoplasty patients. However, inclusion criteria are different and discectomy removes the compressive material on the nerve root. Improvement is immediate.

Decrease of VAS score in nucleoplasty patients is due to intradiscal pressure decrease followed after some months, by retraction of protruded disc. Downward trend of VAS score is maintained. At 12 months follow-up VAS score does not differ significantly among the two groups of patients.

VAS scores after nucleoplasty for back pain follow a constant improvement in time. At last follow-up 18.7 % (n=15) had improvement of VAS score between 50-75%, and 57.5 % (n=46) had an improvement of VAS score > 75%.Taken together, 76.2 % of patients had an improvement of VAS score for back pain after nucleoplasty.

The Odom classification presents more objective the results of two surgical interventions. The rate of success between nucleoplasty and open discectomy are near similar: 72.50 % and 68.75 %, respectively.

Employment status is quite different between the two groups: All patients with coblation return to work 3 days after procedure. Most of discectomy patients remain work off for 3 months followed by temporary retirement. Only 10.9 %, 21.8 % and 31.2 %, returned to work after 3, 6 and 12 months respectively. The reduced number of patients who returned to work may have multiple causes: medical and social. The social aspect is out of our goal, but it helped to decrease the number of patients which return to work, although of medical point of view would have been able to do it.

Results of Rolland-Morris questionnaire show an improvement at 12 months of 60% in nucleoplasty group, and 78% in discectomy group.

Patients' satisfaction after nucleoplasty is 73%. This group of patients included successful and partially successful categories. In 67% of cases they recommend nucleoplasty to other patients.

These data taken together are concordant 73% are satisfied, 67% will recommend nucleoplasty, VAS score shows an improvement pain > 50% in 61 patients (76%).

Using nucleoplasty technique, Sharps and Isaac (5) reported an overall 80% success rate, Singh et al 79% at 6 month (6).

In the study of Chen (7) and associates 69% of the patients had total resolution of leg pain and were satisfied with their results after 6 months.

In 2007 Mirzai and col (8) demonstrated a mean decrease in the VAS from 7.5 to 3.1 at 6 months, comparable with our results (decrease from 7.9 to 3.7).

The limitation of the study refers to patients with open discectomy. There are some biases: part of the patients preferred compensation as long as possible and other people refused to be reengaged in a period of economic crisis with many insolvent entreprises; this explains that only a third were reemployed 1 year post-surgery.

Conclusions

Nucleoplasty is a relatively new technique, situated half-way between conservative and open surgical treatment of patients with degenerative disc disease and lumbar disc protrusion. In appropriately selected patients nucleoplasty is effective in relieving pain due to symptomatic contained disc herniation. It is a safe alternative to open disc surgery in the treatment of patients with a small prolapsed/protrusion, who have not responded to conservation treatment. Because we had no complications after nucleoplasty, this procedure is a safe alternative to open disc surgery in the treatment of patients with a small prolapsed/protrusion who have not respondent to conservation treatment.

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