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Case Report

Epidural Fibrosis Following Percutaneous Disc Decompression with Coblation Technology

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Background: Complications reported from percutaneous disc decompression (PDD) include discitis, anaphylaxis (with chemonucleolysis), instability, increased back pain, and reherniation. To the best of our knowledge, there is no report of epidural fibrosis occurring with any of the many types of PDD.

Objective: To document a case of epidural fibrosis following PDD with coblation technology (Nucleoplasty), a previously unreported complication of this procedure.

Design: Case report.

Methods: Details are presented on a 46-year-old man's history, diagnostic test results, treatments, and progression of his symptoms.

Results: Following PDD with coblation technology at L5-S1, the patient noticed improvement in his left lower extremity radicular symptoms and low back pain. He continued to improve over the following week to near complete relief. He resumed his normal activities. Three months post treatment, he experienced a recurrence of his radicular pain with a diminished left Achilles reflex. A subsequent MRI showed improvement of the previous left paracentral protrusion at L5-S1 along with a new contrast enhancing soft tissue mass. This mass, consistent with epidural fibrosis, was located in the left antero-lateral spinal canal and encased the left S1 nerve root. On the patient's next follow-up visit, he reported spontaneous resolution in his symptoms. He had stopped all pain medications and returned to his usual activities.

Conclusion: This case is the first reported occurrence of epidural fibrosis following percutaneous lumbar disc decompression.

Key words: Epidural, fibrosis, nucleoplasty, percutaneous disc decompression.

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The amount of surgical dissection for treatment of lumbar disc herniation has reduced over time with the utilization of the microscope and minimally invasive techniques. Although overall success is very good in well selected patients (1), this treatment has well-known risks. Ivanic et al described the post-discectomy syndrome, of which one known cause is epidural fibrosis (2). In a study of 1,500 patients undergoing unilateral single-level open microdiscectomy, the incidence of epidural fibrosis was reported between 18 and 37%, depending upon the technique (3). Epidural fibrosis is also reported to

contribute in 8–14 % of cases of failed back surgery syndrome (4,5).

The pathophysiology of epidural fibrosis is relatively well understood following surgical discectomy. Fibroblasts from damaged erector spinae muscles overlying the surgery site follow the extension of the postoperative hematoma into the vertebral canal (6). Patients having an extensive epidural scar have been shown to be 3.2 times more likely to experience recurrent radicular pain than those patients with less extensive epidural scarring (7). When symptomatic, epidural fibrosis is difficult to treat and often refractory to conservative measures (8). The primary indication for surgical treatment of epidural fibrosis is failure of conservative treatment. However, it requires time-consuming meticulous dissection, and is potentially dangerous with notoriously unpredictable results (2,9).

Percutaneous treatment of radicular symptoms from disc herniations is possible when the herniation is small and contained. These treatments include chemonucleolysis, automated percutaneous lumbar discectomy (APLD), percutaneous laser discectomy (LASE, Clarus Medical, Minneapolis, MN), percutaneous mechanical discectomy (DEKOMRESSOR, Stryker Instruments, Kalamazoo, MI), and percutaneous plasma discectomy (Nucleoplasty, Arthrocare, Austin, TX). These treatments all have their associated limitations, variable success rates, and complications including increased low back pain, recurrent disc herniation, discitis, hematoma of the iliopsoas muscle, scarring of the annulus, new numbness and tingling, and anaphylactic reaction to chymopapain (10-18). Overall complication rates are much lower than those reported with open surgical discectomy (13). To our knowledge, epidural scarring has not been reported as a complication of any of the many types of percutaneous disc decompression.

Case Report

A 46-year-old man presented with complaints of episodic lower back pain radiating to his left lower extremity for the past 3 years. This pain began insidiously during a time when he was teaching aerobics. He was initially diagnosed with piriformis overuse syndrome secondary to aerobics. He improved with physical therapy. However, over time he experienced relapses with increasing frequency and severity until the symptoms became unremitting. This prompted his evaluation in our clinic.

He described lower back spasms that occurred with prolonged sitting. He also described a burning sensation into his left buttock and posterolateral thigh, radiating to the lateral calf and foot. This was associated with numbness in the lateral toes of the left foot. Symptoms were exacerbated by sitting and lack of sleep. They improved with stretching exercises and ibuprofen. Positive findings on initial exam included tenderness in the left lower lumbar paraspinal muscles and in the sacral sulcus, and tight hamstrings on the left compared to the right. The remainder of his musculoskeletal and neurologic exam was unremarkable. A MRI of the lumbosacral spine was most notable for an L5-S1 left paracentral protrusion. This protrusion measured 5 mm in AP diameter and caused displacement of the left S1 nerve root in the lateral recess (see Fig. 1). There was mild dessication with 45% narrowing of the L5-S1 disc on the T2 sagittal images.

Having failed more conservative treatments in the preceding months, the patient decided to proceed with epidural steroid injections. A mixture of 1 mL of DepoMedrol, 80 mg/mL, and 3 mL 1% lidocaine was equally divided between left L5-S1 and S1-2 transforaminal injections. At his one week follow-up appointment, he noted an 80% improvement in pain. He had minor residual numbness in the left toes and mild in-

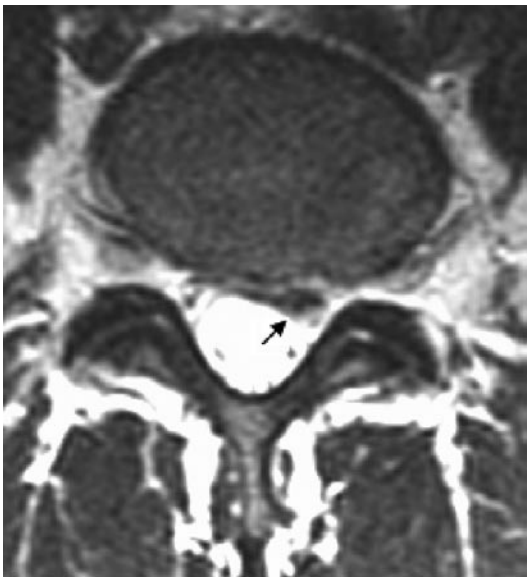

Fig 1. *Pre-treatment T2 weighted axial MRI image at L5-S1 showing left paracentral L5-S1 protrusion with small AP diameter (arrow), displacing the left S1 nerve root in the lateral recess.*

termittent left lower extremity pain. Over the following weeks he gradually resumed his usual activities.

Three months later he experienced a recurrence of his previous symptoms. He elected to repeat the epidural injections. This time he reported no improvement, and he requested more definitive treatment. We considered open surgical microdiscectomy versus percutaneous disc decompression. Given the small size of the protrusion, the likelihood of success with open surgical discectomy was less favorable (19). Given this, along with the lower potential morbidity of percutaneous treatment compared to surgical microdiscectomy, and the lack of objective neurologic impairment related to the L5-S1 protrusion, the risk/benefit profile favored percutaneous treatment. The patient elected to proceed.

Percutaneous disc decompression with coblation technology (Nucleoplasty) was performed under mild conscious sedation. Communication was maintained with him throughout the procedure. The low inclination of the L5-S1 disc and the height of the iliac crest required a needle entry point that was more cephalad than desired, resulting in a needle trajectory slightly off parallel to the L5-S1 disc space. Despite this, the 17-gauge introducer needle was placed into the disc in a single pass by a left posterolateral approach. The needle entered the left posterolateral annulus in the targeted "safe triangle" (20). The treatment wand was placed through the needle and the proximal and distal lesion limits were marked (Fig. 2). As is standard, 6 channels were created in the disc. A lateral fluoroscopic image was obtained between each movement of the wand to prevent accidental migration of the needle position. The entire procedure went as expected. The patient experienced pain only during injection of initial local anesthetic, and during needle puncture of the disc annulus.

Within one hour of treatment he reported improvement in his left lower extremity symptoms and low back pain. The improvements continued over the following days to near complete relief. Two weeks after the procedure, he began gentle stretches and isometric core strengthening exercises under the direction of a physical therapist. Over the following 2 weeks, he progressed to a lumbosacral stabilization program. Within 6 weeks of treatment, he had resumed his usual activities.

Three months later, he returned to clinic with a recurrence of pain in his left lower extremity along with lower back pain. He denied any numbness or tingling associated with these symptoms. He was using a heating pad and taking ibuprofen for his pain.

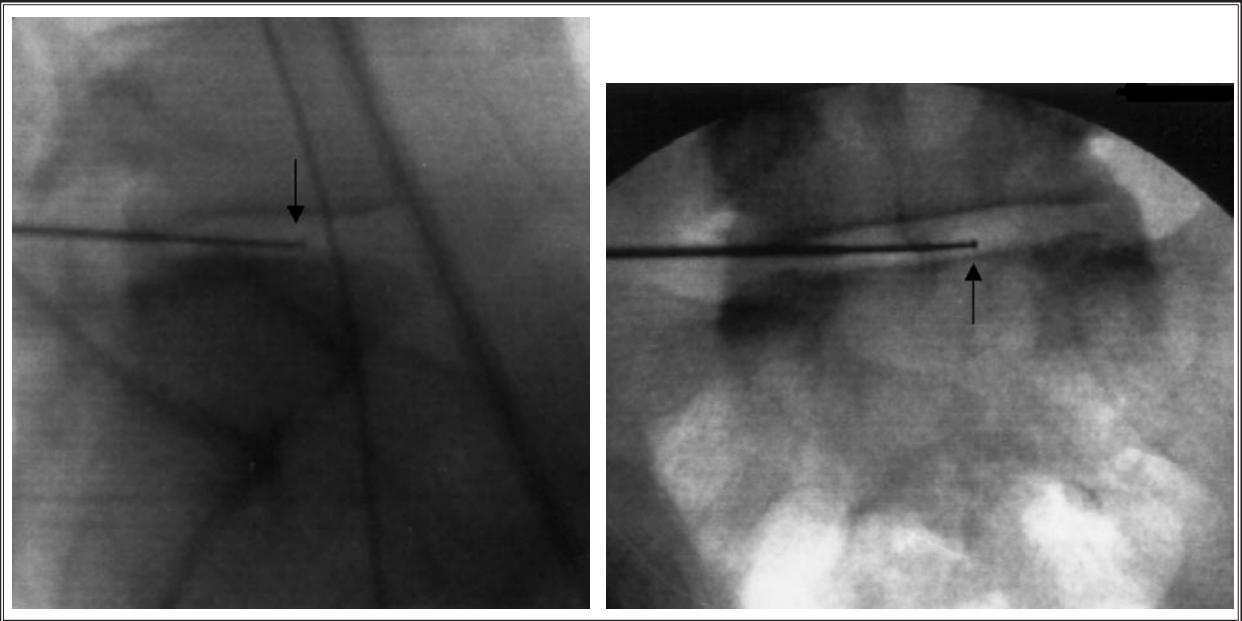

Fig 2. *AP and lateral fluoroscopic images of the Nucleoplasty wand at the distal lesioning limit. Proximal limit was retracted approximately 1 cm.*

Physical exam showed a change in his reflexes from prior examinations with a reduced left ankle muscle stretch reflex, 1/4, compared to 2/4 right ankle and bilateral patellar muscle stretch reflexes. Otherwise his examination was unremarkable. Due to the subtle new neurologic change following a recurrence of radicular pain, along with the known risk of reherniation and other potential complications following discectomy, a gadolinium-enhanced MRI was ordered.

This MRI showed an interval increase in the size of the left paracentral extra-axial mass at L5-S1 (Fig. 3). Adjacent to this was a large new soft tissue mass encasing the left S1 nerve root. On axial T1 and T2 images it was isointense to the adjacent disc. This mass enhanced brightly on post contrast images, consistent with epidural fibrosis (Figs. 4 and 5).

The patient returned 2 weeks later to review his MRI findings. He reported a spontaneous resolution of his symptoms over the days following the MRI. He had no residual back or leg pain. Given the improvement of his symptoms, no further treatment or tests were initiated. He was encouraged to resume his regular activities. At follow-up 3 months later, he remained pain

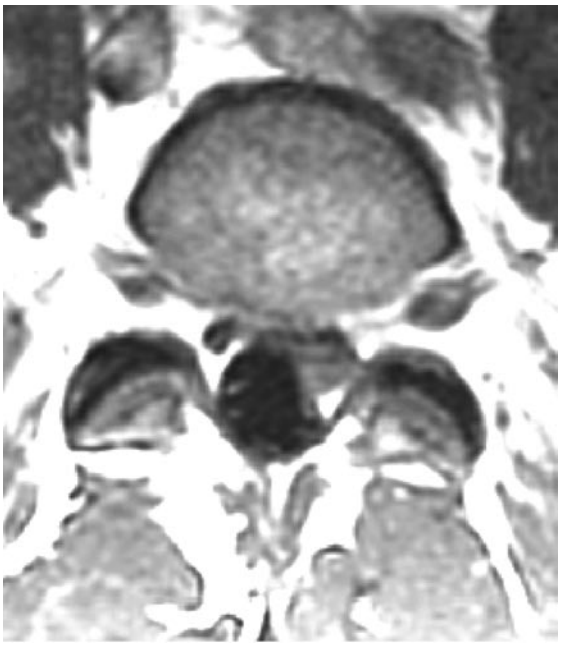

Fig 4. *Post-treatment T1 weighted axial MRI image of the same lesion at L5-S1.*

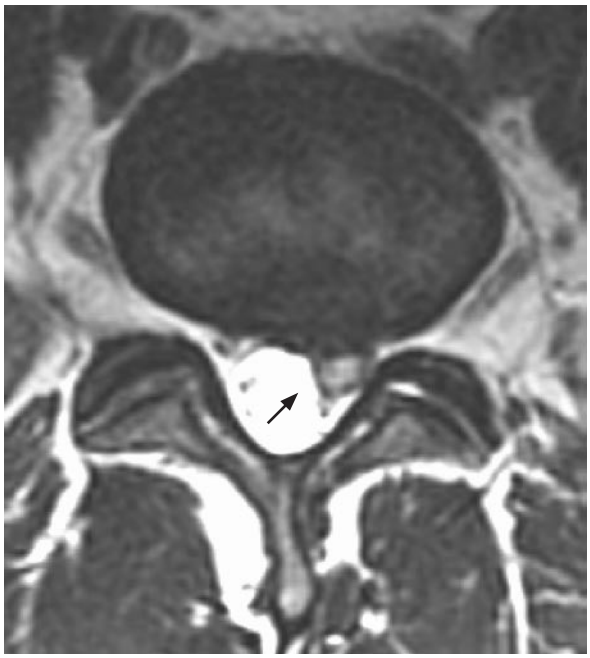

Fig 3. *Post-treatment T2 weighted axial MRI image at L5-S1 showing an interval increase in the size of the left paracentral extra-axial mass (black arrow).*

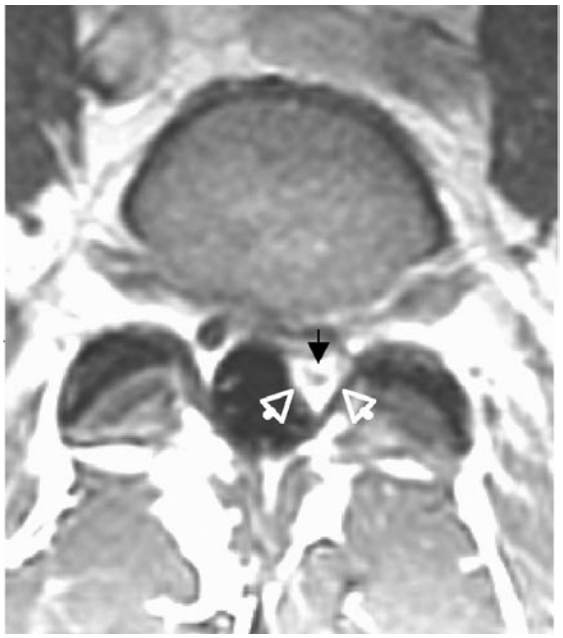

Fig 5. *Post-treatment gadolinium-enhanced axial MRI image at L5-S1 showing significant contrast enhancement of the same lesion (white arrows), consistent with epidural fibrosis. The left S1 nerve root is encased in fibrotic tissue (black arrow).*

free and had returned to his pre-morbid activity level. Currently, more than 2 years since his percutaneous discectomy, he continues without complaints of back pain or leg pain.

Discussion

The incidence of postoperative epidural fibrosis reported with surgical microdiscectomy varies from 18% to 37%, depending on the surgical technique (3). To our knowledge, epidural fibrosis has never been previously reported as a complication of percutaneous disc decompression. There is one report of scarring occurring within the disc itself, without extension into the epidural space, following APLD (14). In this case the author speculates that the fibrosis was beneficial and provided stabilization for the adjoining segments.

Reported complications of percutaneous disc decompression include discitis, hematoma, increased low back pain, anaphylaxis (with chemonucleolysis), instability, new numbness and tingling, and reherniation (10-18). Currently, the most commonly used techniques employ a laser (LASE), an auger suctioning device (DEKOMPRESSOR), and plasma ablation (Nucleoplasty). Of these, Nucleoplasty was the first to be FDA approved and has been studied the most in the lab and in clinical trials.

Nucleoplasty is a relatively new, minimally invasive procedure that utilizes a low-heat radiofrequency process to remove nucleus from the disc. The theoretical advantage is that it avoids thermal damage and tissue necrosis. The radiofrequency is concentrated at the tip of a specialized wand. When applied to a conductive medium, it causes highly ionized particles to form around energized electrodes. These energized particles create a plasma field that destroys organic molecular bonds. The by-products of this process are elementary molecules and low molecular weight inert gases, which are eliminated from the disc via the needle.

Chen et al (21) observed the histologic findings under a light microscope in 2 porcine cadavers after Nucleoplasty. The histologic findings suggested that it achieves volumetric reduction of disc tissue without overt thermal or structural damage to the adjacent tissues. However, because this was not an in vivo study, the effects in a living human remain uncertain.

The Nucleoplasty plasma ablation technology, termed "Coblation," has been used extensively in tonsillectomies, facial resurfacing, and arthroscopic surgeries including chondroplasty, debridement, meniscectomy, lateral release, ligament tightening, synovectomy, and patellar retinacular tightening (22). Even with this extensive use, there is only one report of scarring following Coblation (23). The authors describe the case of a 50-year-old woman who underwent facial resurfacing on the lower eyelids with Coblation therapy. Two days postoperatively she developed a pale white area on the left lower eyelid, consistent with thermal damage. It ulcerated and then healed with scarring.

Lee et al (24) described the incidence of subtotal ionized field ablation of the tonsils and found the main complication to be post-tonsillectomy hemorrhage. Non-hemorrhagic complications included odynophagia, nausea, vomiting, swelling that spontaneously resolved, rash, and a prolonged foreign body sensation. Scarring was not a reported complication. Uribe et al studied 130 patients who received chondroplasty using the Coblation method and reported no complications indicative of treatment failure (25). Bhagia et al (10) recently studied 49 patients who underwent percutaneous disc decompression by Coblation and found that the most common complications were short-term increased pain at the needle insertion site, increased back pain, and paresthesias. We could find no other studies that have reported complications from application of Coblation technology.

It is unclear what caused epidural fibrosis in the patient reported here. His only prior invasive treatments were transforaminal epidural corticosteroid injections one month and 6 months prior to the percutaneous disc decompression. We are unaware of any reported cases of epidural fibrosis from an epidural corticosteroid injection, so this is an unlikely cause. Some have suggested that epidural fibrosis may occur as a result of a chronic disc herniation, however research shows otherwise (26). The 17-gauge introducer needle entered the disc lateral to the area of the observed fibrosis (Fig. 3). There was no direct trauma from the needle or the Nucleoplasty treatment wand in the region of the fibrosis demonstrated on MRI. A recent study showed that Nucleoplasty treatment does alter the inflammatory cytokines in the disc by up-regulating those responsible for tissue healing (27). It is possible that, in select patients, this response is exaggerated causing an overproduction of granulation tissue at the site of injury.

The available data is not adequate to determine if any of these or other factors caused the epidural fibrosis observed in this patient. Epidural fibrosis is a previously unreported complication of percutaneous disc decompression, and should be included in the list of potential complications.

References

1. Carragee EJ, Han MY, Suen PW, Kim D. Clinical outcomes after lumbar discectomy for sciatica: the effects of fragment type and anular competence. *J Bone Joint Surg Am* 2003; 85-A:102-108.
2. Ivanic GM, Pink TP, Homann NC, Scheitza W, Goyal S. The post-discectomy syndrome. Aetiology, diagnosis, treatment, prevention. *Arch Orthop Trauma Surg* 2001; 121:494-500.
3. Aydin Y, Ziyal IM, Duman H, Turkmen CS, Basak M, Sahin Y. Clinical and radiological results of lumbar microdiskectomy technique with preserving of ligamentum flavum comparing to the standard microdiskectomy technique. *Surg Neurol* 2002; 57:5-13; discussion 13-14.
4. Burton CV, Kirkaldy-Willis WH, Yong-Hing K, Heithoff KB. Causes of failure of surgery on the lumbar spine. *Clinical orthopaedics and related research*. 1981:191-199.
5. Long DM, Filtzer DL, BenDebba M, Hendler NH. Clinical features of the failed-back syndrome. *J Neurosurg* 1988; 69:61-71.
6. LaRocca H, Macnab I. The laminectomy membrane. Studies in its evolution, characteristics, effects and prophylaxis in dogs. *J Bone Joint Surg Am* 1974; 56B:545-550.
7. Ross JS, Obuchowski N, Modic MT. MR evaluation of epidural fibrosis: proposed grading system with intra- and inter-observer variability. *Neurological research*. 1999;21 Suppl 1:S23-26.
8. Georges C, Lefaix JL, Delanian S. Case report: resolution of symptomatic epidural fibrosis following treatment with combined pentoxifylline-tocopherol. *Br J Radiol* 2004; 77:885-887.
9. Fandino J, Botana C, Viladrich A, Gomez-Bueno J. Reoperation after lumbar disc surgery: results in 130 cases. *Acta Neuroc* 1993; 122:102-104.
10. 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* 2006; 85:6-13.
11. Bonaldi G. Automated percutaneous lumbar discectomy: technique, indications and clinical follow-up in over 1000 patients. *Neuroradiology* 2003; 45:735-743.
12. Dullerud R, Nakstad PH. Side effects and complications of automated percutaneous lumbar nucleotomy. *Neuroradiology* 1997;39:282-285.
13. Gibson JN, Grant IC, Waddell G. The Cochrane review of surgery for lumbar disc prolapse and degenerative lumbar spondylosis. *Spine* 1999; 24:1820-1832.
14. Gronemeyer DH, Buschkamp H, Braun M, Schirp S, Weinsheimer PA, Gevargez A. Image-guided percutaneous laser disk decompression for herniated lumbar disks: a 4-year follow-up in 200 patients. *J Clinical Laser Medicine & Surgery* 2003; 21:131-138.
15. Krugluger J, Knahr K. Chemonucleolysis and automated percutaneous discectomy--a prospective randomized comparison. *Int Orthop* 2000;2 4:167-169.
16. Matsui H, Aoki M, Kanamori M. Lateral disc herniation following percutaneous lumbar discectomy. A case report. *Int Orthop* 1997; 21:169-171.
17. Mochida J, Toh E, Nomura T, Nishimura K. The risks and benefits of percutaneous nucleotomy for lumbar disc herniation. A 10-year longitudinal study. *J Bone Joint Surg Am* 2001;8 3:501-505.
18. Wittenberg RH, Oppel S, Rubenthaler FA, Steffen R. Five-year results from chemonucleolysis with chymopapain or collagenase: a prospective randomized study. *Spine* 2001;26:1835-1841.
19. Carragee EJ, Kim DH. A prospective analysis of magnetic resonance imaging findings in patients with sciatica and lumbar disc herniation. Correlation of outcomes with disc fragment and canal morphology. *Spine* 1997; 22:1650-1660.
20. Mirkovic SR, Schwartz DG, Glazier KD. Anatomic considerations in lumbar posterolateral percutaneous procedures. *Spine*. 1995; 20:1965-1971.
21. 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; 3:466-470.
22. Kelly BT, Warren RF. Complications of thermal energy in knee surgery—Part I. *Clinics in sports medicine* 2002; 21:737-751.
23. Bellaney GJ. Scarring of the eyelids from Coblation treatment. *Australas J Dermatol* 2004; 45:170-171.
24. Lee KC, Altenau MM, Barnes DR, Bernstein JM, Bikhazi NB, Brettscheider FA, Caplan CH, Ditkowsky WA, Ingber CF, Klausner LM, Moghaddassi MM. Incidence of complications for subtotal ionized field ablation of the tonsils. *Otolaryngol Head Neck Surg*. 2002;127:531-538.
25. Uribe JW, Markarian G, Kaplan L. Use of coblation in articular cartilage surgery. *Research Outcomes in Arthroscopic Surgery* 1998;3:1-4.
26. Saal JA, Saal JS, Herzog RJ. The natural history of lumbar intervertebral disc extrusions treated nonoperatively. *Spine* 1990;15:683-686.
27. 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;4:88-98.