



## Percutaneous treatment of cervical and lumbar herniated disc



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### ABSTRACT

Therapeutic armamentarium for symptomatic intervertebral disc herniation includes conservative therapy, epidural infiltrations (interlaminar or trans-foraminal), percutaneous therapeutic techniques and surgical options. Percutaneous, therapeutic techniques are imaging-guided, minimally invasive treatments for intervertebral disc herniation which can be performed as outpatient procedures. They can be classified in 4 main categories: mechanical, thermal, chemical decompression and biomaterials implantation. Strict sterility measures are a prerequisite and should include extensive local sterility and antibiotic prophylaxis. Indications include the presence of a symptomatic, small to medium sized contained intervertebral disc herniation non-responding to a 4–6 weeks course of conservative therapy. Contraindications include sequestration, infection, segmental instability (spondylolisthesis), uncorrected coagulopathy or a patient unwilling to provide informed consent. Decompression techniques are feasible and reproducible, efficient (75–94% success rate) and safe (>0.5% mean complications rate) therapies for the treatment of symptomatic intervertebral disc herniation. Percutaneous, imaging guided, intervertebral disc therapeutic techniques can be proposed either as an initial treatment or as an attractive alternative prior to surgery for the therapy of symptomatic herniation in both cervical and lumbar spine. This article will describe the mechanism of action for different therapeutic techniques applied to intervertebral discs of cervical and lumbar spine, summarize the data concerning safety and effectiveness of these treatments, and provide a rational approach for the therapy of symptomatic intervertebral disc herniation in cervical and lumbar spine.

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### 1. Introduction

Intervertebral disc herniation is responsible for back pain (neck or low back pain) and neuralgia in 26–39% of the cases [1,2]. Patients are between 30 and 40 years old with the most commonly affected disc levels being C5–C6 and C6–C7 in the cervical spine, L4–L5 and L5–S1 in the lumbar spine [3–5]. Symptomatic disc herniations present with neuralgia (pain radiating to arm or leg at the distribution of a specific nerve root) occasionally combined to neck or back pain; when these two coexist, pain in the extremity should be greater than back or neck pain. Pain could include a lancinating, burning, stabbing, or electrical sensation. The distribution of the symptoms should be consistent with the segmental level where the disc herniation is located (for an L4–5 right foraminal herniation is expected to produce right L4 root neuralgia

1/3–1/2 or a C4–C5 left foraminal herniation is expected to produce left C5 root neuralgia). Nowadays, therapeutic armamentarium for symptomatic intervertebral disc herniation includes conservative therapy, epidural infiltrations (interlaminar or trans-foraminal), percutaneous decompression techniques and surgical options [2,5].

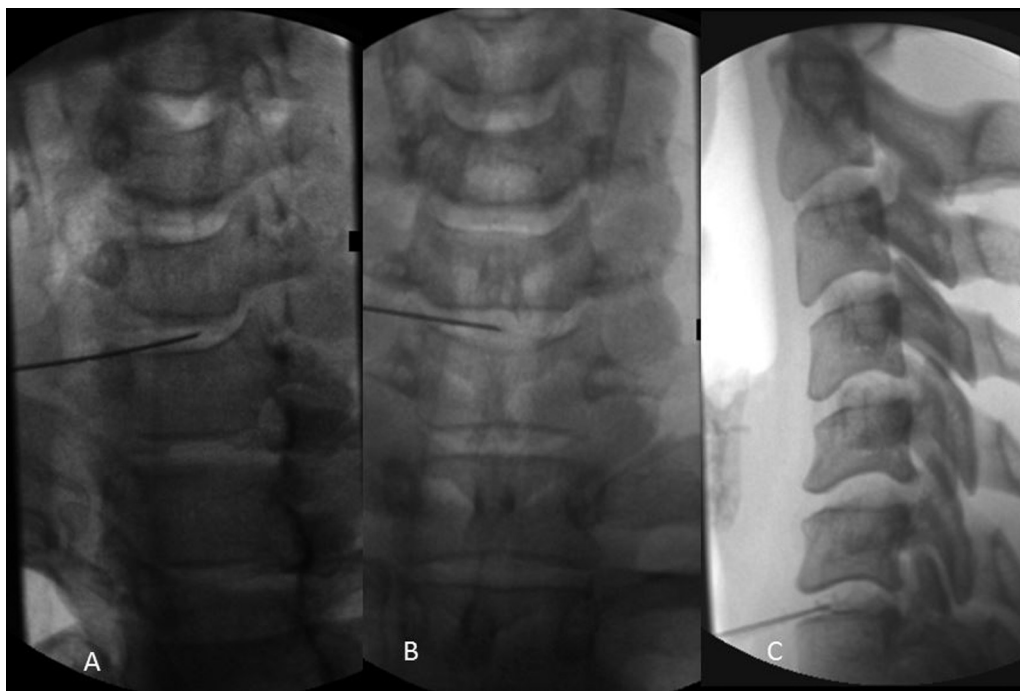
Percutaneous, decompression techniques are imaging-guided, minimally invasive treatments for intervertebral disc herniation which can be performed as outpatient procedures. The substrate for these techniques was provided by the work of Hijikata, Asher, and Choy who had proven that in the intervertebral disc, removal of a small nuclear volume results in significant intradiscal pressure decrease and at the same time creates space for the herniation to implode inwards [2,6]. Indications include the presence of a symptomatic, contained intervertebral disc herniation occupying less than 1/3–1/2 of the spinal canal's diameter non-responding to a 4–6 weeks course of conservative therapy combined to at least 1 infiltration [2]. Contraindications include sequestration, infection, segmental instability (spondylolisthesis), uncorrected coagulopathy or a patient unwilling to provide informed consent [2].

This article will describe the mechanism of action for different therapeutic techniques applied to intervertebral discs of cervical

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**Fig. 1.** Patient with symptomatic C6–C7 intervertebral disc herniation underwent fluoroscopy-guided percutaneous chemical decompression (intradiscal injection of Discogel).

(A) Lateral fluoroscopic view illustrating the trocar placed in the posterior third of the intervertebral disc.

(B) A–P fluoroscopic view illustrating the trocar placed in the midline at midway between the two vertebral end-plates.

(C) Lateral fluoroscopic view during Discogel intradiscal injection.

and lumbar spine, summarize the data concerning safety and effectiveness of these treatments, and provide a rational approach for the therapy of symptomatic intervertebral disc herniation in cervical and lumbar spine.

## 2. Percutaneous intervertebral disc therapeutic techniques

These techniques can be classified in 4 main categories: mechanical, thermal, chemical decompression and biomaterials implantation.

**Mechanical decompression:** aims in removal of a fragment from nucleus pulposus by means of a pneumatically- or water-driven suction-cutting probe, mechanical high rotation per minute devices with spiral tips or metallic laminae [7,8]. Alternatively, mechanical decompression by Herniotome extracts hernia or portion of the hernia in order to decrease pressure upon the nerve root [9].

**Thermal decompression:** includes the use of laser fiber to vaporize a small volume of nucleus pulposus or of radiofrequency energy to cause molecular dissociation and dissolves nuclear material [10,11]. Alternatively, during electrothermal therapy a flexible thermal resistive coil is deployed ut at the annulus fibrosus aiming at nerve endings destruction [2].

**Chemical decompression:** aims in dehydration (by means of gelified ethanol) or in breakdown (by means of ozone's chemical properties and the reaction of hydroxyl radical with carbohydrates and amino acids) of nucleus pulposus [12–14]. Intradiscal injection of Discogel (gelified ethanol) is the only technique up-to-date which can be performed in cases of segmental instability.

**Biomaterial implantation:** intradiscal implantation of Hydrogel, Platelet Rich Plasma (PRP) and Stem cell therapy aim in regeneration of intervertebral disc working in the completely opposite way from the aforementioned decompressor techniques [15,16].

### 2.1. Technique

Strict sterility measures are a prerequisite and should include extensive local sterility and antibiotic prophylaxis [2]. Under local anesthesia (mainly for the skin and subcutaneous tissues) and imaging-guidance (fluoroscopy, computed tomography) a trocar is percutaneously inserted inside the nucleus pulposus of the disc. Through this trocar any of thermal, chemical or mechanical decompression devices is introduced inside the nucleus pulposus, with the least disruption of surrounding tissues. 3D rotational angiographic unit (producing MPR images) provides the advantage of three-dimensional imaging with exact illustration of needle positioning inside the disc limiting risks and complications [17]. In general, the trocar's final position depends on the decompression technique used; almost all techniques require a more or less central trocar placement with the exception of electrothermal therapy during which the coil is circumferentially placed at midway between the two end plates at the level of annulus fibrosus [2].

### 2.2. Cervical spine

Placement of the trocar inside cervical intervertebral discs is performed under antero-lateral approach with the patient in supine position. Whenever fluoroscopy is used as guiding modality, the selected disc should be recognized and aligned. Under subluxation of the larynx the trocar is advanced between larynx and jugular–carotid vessels until the anterior longitudinal ligament. In most cases, right-sided approach is preferred due to the presence of esophagus on the left side. The desired final position of the trocar inside the disc should be towards the posterior third in lateral projection and towards the midline in A–P projection at midway between the two end plates (Figs. 1 and 2). Whenever Computed Tomography is used as guiding modality, the entry point in the skin

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