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Changes on MRI in lumbar disc protrusions in two patients after intradiscal electrothermal therapy

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Abstract
We examined changes to the protruded lumbar disc after intradiscal electrothermal therapy (IDET) using magnetic resonance imaging (MRI) in two patients with chronic discogenic low back pain who underwent IDET. MRI was performed before and 6 months after the treatments. In the follow-up MRI studies, the protrusions were almost abolished and normalized in both patients. We thus confirmed shrinkage of the protruded disc by IDET on MRI images in two patients.

Key words Intradiscal electrothermal therapy (IDET) · Magnetic resonance imaging (MRI) · Shrinkage

Introduction

Intradiscal electrothermal therapy (IDET) is a non-invasive procedure for managing chronic discogenic low back pain in patients failing conservative treatment [1–6]. IDET is thought to decrease discogenic pain by two different mechanisms. First, it may cause thermal destruction of pain-sensitive nerve nociceptors in the outer anulus. Second, the local temperature increase to >60°C affects collagen in the anulus fibrosus, causing it to gradually stiffen, which may diminish the load on the disc and thereby reduce pain [1–6].

However, changes in magnetic resonance imaging (MRI) of disc protrusions after IDET have not been previously studied. Using MRI, we examined changes to the protruded lumbar discs following IDET in two patients.

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Case reports

Two patients (one woman and one man, aged 29 and 36 years respectively) with discogenic low back pain who met the inclusion criteria for the IDET procedure [1,2,5] were selected for IDET. Each patient had an MRI scan prior to the IDET procedure and a second MRI scan following the procedure. Magnetic resonance images before the IDET procedure were compared with those taken 6 months after the procedure in the two patients.

These patients presented to the Department of Anesthesiology of Shiga University of Medical Science Hospital between 2003 and 2005. The patients were informed about the treatment protocol, which was approved by the Hospital's Ethical Committee, and about the possible benefits and side effects of IDET. Informed oral and written consent was obtained before IDET.

Our inclusion criteria for the IDET procedure were comparable to those suggested by Saal and Saal [1,2,5], who developed the procedure.

IDET was performed with the patients lying on a fluoroscopy table in a prone position. A posterior oblique approach allowed visualization of the discs using the technique described by Saal and Saal [1,2,5]. The discs treated were selected on clinical grounds according to the level of positive provocation. Under fluoroscopic guidance, a 17-gauge introducer needle was advanced into the mid-portion of the disc. Proper placement of the introducer needle was confirmed with anteroposterior (AP) and lateral fluoroscopic projections. The spine catheter (SpineCATH, Smith & Nephew, Andover, MA, USA) was navigated through the introducer needle into the posterior anular wall past the midline. Correct placement was confirmed with AP and lateral fluoroscopic projections (Fig. 1). In both patients, a standard high-heating protocol was used, which starts at 65°C and gradually increases to 90°C for 16.5 min. The catheter temperature was gradually raised

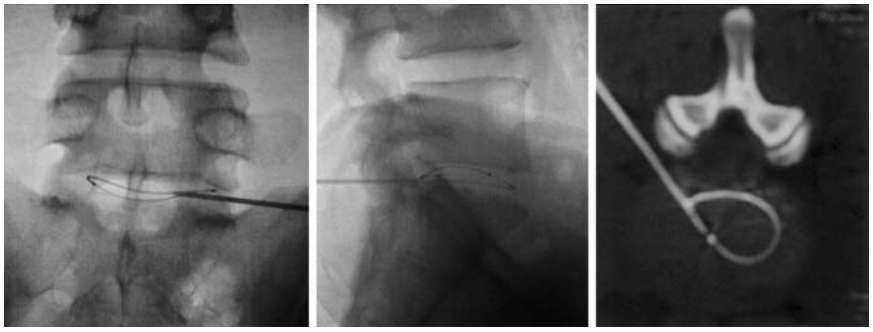

Fig. 1A–C. L5/S1 intradiscal electrothermal therapy (IDET) was performed in the patient. **A** Anteroposterior and **B** lateral fluoroscopic images show proper catheter placement. **C** Computed tomography during IDET in case 1, showing proper catheter placement

Fig. 2. Magnetic resonance images obtained before and after IDET in the same patient (sagittal T2 images). Case 1 (*left two panels*): pre-IDET (*left*), six months post-IDET (*right*). Case 2 (*right two panels*): pre-IDET (*left*), six months post-IDET (*right*)

according to a uniform protocol, starting at 65°C, gradually increasing over 12.5 min to 90°C, and maintaining at 90°C for 4 min in each patient.

In both patients, MRI was performed and sagittal T2-weighted images were evaluated. MRI was performed before and 6 months after the treatment procedures, using a 1.5-T GE Signa system (SIGNA MR System, General Electric, Milwaukee, WI, USA). Follow-up MRI examinations were performed using the same scanning protocol and the same sagittal T2-weighted slice images were evaluated. Magnetic resonance images of the initial and follow-up examinations were analyzed side by side by neuroradiologists. On the same sagittal images, we examined whether the size of the protrusion disc had decreased after IDET, compared with its size on the initial scan.

Case 1

A 35-year-old man, 175 cm tall and weighing 70 kg, underwent L5/S1 IDET (Fig. 1). Visual analog scale (VAS) levels of pre-IDET pain severity were 5–6. There was a progressive lessening of pain after IDET. VAS levels of pain severity 6 months post-IDET were 0–1. The patient reported complete pain relief 12 months after the treatment. He was not working prior to treatment, and was able to return to work 6 months after IDET.

His first MRI scan had revealed a disc protrusion at the L5/S1 level. In the follow-up MRI scan 6 months after IDET, the protrusion was almost abolished and normalized (Fig. 2).

Case 2

A 29-year-old woman, 168 cm tall and weighing 55 kg, underwent L5/S1 IDET. VAS levels of pre-IDET pain severity were 8. There was a progressive lessening of pain after IDET. VAS levels of pain severity 6 months post-IDET were 1–3. The patient reported complete pain relief 12 months after the treatment. She was not working prior to treatment, and was able to return to work 12 months after IDET.

On the first MRI scan, disc protrusions were found at the L5/S1 level. L5/S1 disc protrusion was resolved in the follow-up MRI scan, 6 months after IDET (Fig. 2).

Discussion

It is estimated that in almost 40% of patients' chronic low back pain originates from a painful degenerative intervertebral disk [7]. IDET is a percutaneous procedure that uses a radio frequency (RF) heat source to induce collagen changes within the disc, which, in turn, can decrease disc protrusion, and produce nociceptor denervation of the posterior anulus by the heating effect [1–6].

After the catheter has been placed, controlled electrothermal heat is generated, starting at 65°C and increasing to 90°C over a 16.5-min period. Breakage of the heat-sensitive hydrogen bonds of the collagen fibers causes collagen contraction [1,2,5]. At disc temperatures reaching 65°C, collagen may contract as much as 35% from its original size. Targeted thermal therapy induces collagen fibril shrinkage. Heating the electrode is believed to relieve pain by stiffening the collagen [8]. However, no research has used MRI to demonstrate the changes caused by IDET.

In our two patients, we could confirm shrinkage of the protruded disc by IDET on MRI images. Disc shrinkage of the protrusions was observed 6 months post-IDET on MRI images in both patients. Further studies, including comparison with control patients not receiving the IDET procedure and a larger number of patients, are needed to elucidate the the anatomic changes after IDET.

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