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[Ugur Dogan](#) , Aylin Kurt <sup>\*</sup> , Yasemin Büyükşahin

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*Case Report*

# MRI-Documented Improvement of L4–5 Foraminal Disc Protrusion Following Non-Invasive Audio Neuromodulation: A Case Report

Ugur Dogan <sup>1</sup>, Aylin Kurt <sup>2\*</sup> and Yasemin Büyüksahin <sup>2</sup>

<sup>1</sup> Independent Researcher, The Netherlands

<sup>2</sup> Faculty of Health Sciences, Bartın University, Turkey

\* Correspondence: akurt@bartin.edu.tr

## Abstract

Lumbar foraminal disc protrusions with nerve root compression rarely resolve spontaneously in older adults and often require surgery. A 61-year-old woman with chronic L4–5 radiculopathy initiated Deep Brain Sound Stimulation (DBSS), a non-invasive neuromodulation protocol targeting the subventricular zone. One 21-minute audio session was delivered daily for 44 days. Pain decreased from 100% to 0% within six weeks, and analgesic use was discontinued. Treatment was stopped to monitor durability. Follow-up MRI five weeks later no longer described a left foraminal protrusion or left L4–5 root compression. DBSS may be associated with symptomatic and radiological improvement. Controlled trials are warranted.

**Keywords:** lumbar disc herniation; foraminal stenosis; neuromodulation; deep brain sound stimulation; conservative treatment

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## Introduction

Lumbar disc protrusions are a major cause of back and leg pain in adults and remain a leading indication for spinal surgery. Although symptomatic lumbar disc herniation affects roughly 2–3% of adults, many patients do not achieve sustained clinical improvement with conservative measures alone, and about 15–20% ultimately proceed to surgical intervention [1]. Foraminal herniations, in particular, have a poor natural history due to the narrow anatomic corridor around the exiting nerve root, and older age is associated with reduced rates of spontaneous regression and higher recurrence [2,3]. Surgical decompression is therefore often recommended when foraminal protrusion is accompanied by persistent radiculopathy, progressive neurological deficits, or intolerance to analgesics.

However, surgery carries risk, including dural tears, infection, and adjacent segment degeneration, while prolonged recovery limits work capacity and daily functioning. These concerns have stimulated interest in non-invasive and biologically oriented treatments that may modulate pain or alter tissue behavior. Among emerging approaches, neuromodulation strategies targeting central and peripheral mechanisms of pain processing have gained attention, including spinal cord stimulation, peripheral nerve stimulation, and non-invasive brain stimulation techniques such as repetitive transcranial magnetic stimulation and transcranial direct current stimulation [4].

Deep Brain Sound Stimulation (DBSS) is a non-invasive auditory neuromodulation method that employs precisely tuned monaural and isochronic tones to evoke frequency-following responses within targeted neural circuits. Since 2014, more than 100 DBSS protocols have been developed for exploratory use in psychiatric, neurological, pain, and rehabilitative domains, with observational data indicating consistent symptom reduction and high user satisfaction [5]. Although not yet established as clinical treatment, DBSS applications are based on neurophysiological principles and are iteratively refined through user-reported outcomes. In one published case, DBSS stimulation was

associated with radiological regression of a porencephalic cyst and restoration of motor function [6]. In another, DBSS was associated with complete MRI-verified healing of chronic anterior and posterior cruciate ligament ruptures without surgery [7].

The subventricular zone (SVZ) remains the principal neural stem cell niche in the adult brain, and experimental studies suggest that SVZ-derived progenitor cells and trophic mediators may exert systemic effects beyond the central nervous system. Recent work has demonstrated the presence of multipotent neural stem cells outside the CNS [8], and neurotrophic peptides have been shown to promote tendon healing in vivo [9]. These findings raise the possibility that audio-evoked modulation of SVZ activity could influence reparative signaling with downstream effects on musculoskeletal structures.

We report an MRI-documented case of L4–5 foraminal disc protrusion with nerve root compression in an older adult, with follow-up imaging in which the previously reported left foraminal protrusion and root compression were no longer described after a short neuromodulation protocol.

## Case Presentation

A 61-year-old woman presented with chronic low back pain radiating to the left leg. Pain intensity was consistently rated at 100% on a verbal numeric scale and interfered with walking, bending, and sleep. She relied on gabapentin 600 mg three times daily but remained functionally limited. She had previously been informed that surgical decompression might be necessary.

Pre-treatment MRI (07 July 2025) showed:

- Flattened lumbar lordosis
- L4–5 disc space narrowing
- Diffuse annular bulge with left subarticular–foraminal protrusion
- Compression of the left L4–5 nerve root.

No acute fractures or central canal stenosis were noted, and the radiologist recommended clinical–surgical correlation.

### Intervention:

Deep Brain Sound Stimulation (DBSS), an audio neuromodulation protocol targeting the subventricular zone, was initiated on 02 September 2025. A single 21-minute FLAC audio session was delivered once daily via over-ear headphones. No new medications, injections, or physiotherapy were introduced. As pain began to decline, gabapentin was gradually reduced.

### Clinical course:

Pain improvement began within the first week of DBSS and progressed steadily (Table 1). By 11 October, pain had reached 0%, and all analgesics were discontinued. To evaluate durability, DBSS was voluntarily stopped on 15 October. From 16 to 22 October, pain remained 0%. Mild intermittent pain (10–30%) developed thereafter, differing from her original radicular pattern and later attributed to unrelated degenerative changes affecting other lumbar levels and pelvic structures. No neurological deficits emerged.

Follow-up MRI (14 November 2025) demonstrated:

- The previously described left foraminal disc protrusion was no longer described
- The previously described left L4–5 nerve root compression was no longer described
- Degenerative changes and right foraminal narrowing consistent with a prior laminectomy, unchanged

The patient reported stable mobility, restored sleep quality, and no recurrence of radicular symptoms.

## Discussion

This case documents a clinically and radiologically significant improvement in a 61-year-old woman with MRI-confirmed L4–5 foraminal disc protrusion and nerve root compression. Her pain

had been severe and chronic, requiring high-dose gabapentin, and had impaired daily functioning. Following a short course of Deep Brain Sound Stimulation (DBSS), radicular pain resolved completely, analgesics were discontinued, and the follow-up radiology report no longer described a left foraminal disc protrusion or left L4–5 nerve root compression. Such radiological change is noteworthy, as spontaneous regression of foraminal herniations—particularly in older adults—occurs far less frequently than regression of central or paracentral herniations. Published systematic reviews suggest that while small disc extrusions may regress over months, foraminal lesions compressing the exiting nerve root rarely show complete resolution without intervention [2,3].

The rapid clinical response further adds interest to the case [10]. Pain declined steadily during DBSS use and reached 0% within six weeks, after which treatment was discontinued. Symptom relief persisted for more than a month without ongoing sessions. Importantly, mild pain recurrence later in the follow-up period did not resemble the original radicular pattern and coincided with unrelated degenerative findings on post-treatment MRI. This temporal dissociation strengthens the interpretation that the resolved L4–5 pathology was specifically associated with the period of DBSS use.

The proposed mechanism, although hypothetical, centers on neuromodulatory effects involving the subventricular zone (SVZ). DBSS employs monaural and isochronic auditory frequencies designed to evoke frequency-following responses within defined brain regions. Prior work has shown that SVZ-derived progenitor cells and trophic mediators can influence tissue repair outside the central nervous system, and studies have demonstrated stem-cell-like populations in peripheral tissues as well as neurotrophic peptides capable of enhancing tendon and connective tissue healing [8,9]. It is therefore plausible that DBSS-induced SVZ activity may modify inflammatory signaling, nociceptive processing, or reparative pathways relevant to disc or foraminal structures, in parallel with broader central mechanisms of chronic low back pain and central sensitization [4,11,12]. Distinguishing whether the primary driver of improvement was biomechanical, trophic, anti-inflammatory, or centrally mediated analgesia will require controlled mechanistic studies.

Clinically, DBSS may offer advantages for selected patients. It is non-invasive, inexpensive, and compatible with daily activities. No adverse effects occurred, and the patient was able to taper and discontinue long-term gabapentin—an outcome with meaningful implications for safety and quality of life. These features contrast with the costs, risks, and recovery burdens associated with lumbar decompression surgery, particularly in older patients with multilevel degenerative changes [1,2,13].

This report has limitations. It describes a single case without quantitative measures of lumbar mobility or nerve conduction studies. The auditory parameters remain proprietary, and placebo effects cannot be fully excluded. Assessment of foraminal pathology on MRI can be technically challenging, particularly in the presence of scoliosis and when scans are acquired at different centers. Nevertheless, the previously reported left foraminal protrusion and nerve root compression were no longer described on follow-up imaging. The timeline of symptom resolution also precedes the structural findings, which raises important mechanistic questions. Nonetheless, the absence of the previously reported foraminal compression on follow-up imaging provides objective evidence of a clinically meaningful radiological change not easily explained by placebo alone.

Further research is warranted, including prospective controlled trials that incorporate serial MRI, standardized pain metrics, biomechanical assessments, and biomarker analysis. Such work will be essential to determine whether DBSS can reproducibly influence disc-related pathology and to clarify the pathways underlying the improvements observed here.

## Conclusions

This case documents complete clinical remission following a short course of Deep Brain Sound Stimulation. On follow-up MRI, the previously reported left L4–5 foraminal disc protrusion and nerve root compression were no longer described on formal radiological reporting. Pain improved steadily during treatment, reached 0% by six weeks, and remained absent for more than five weeks after discontinuation. The disappearance of foraminal compression on follow-up MRI suggests that

SVZ-targeted neuromodulation may be associated with clinically meaningful structural and symptomatic improvements, although causation cannot be established from a single case.

Well-designed prospective studies—incorporating serial MRI, quantitative radiculopathy measures, central sensitization metrics, and biochemical markers—are now warranted to determine treatment efficacy, define healing kinetics, and evaluate whether similar neuromodulatory effects may extend to other degenerative spinal pathologies.

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