

# Revision Dorsal Root Entry Zone Lesioning for Intractable Deafferentation Pain After Brachial Plexus Avulsion

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## Abstract

**Background** Neuropathic pain following brachial plexus avulsion (BPA) represents one of the most refractory pain syndromes in neurosurgical practice. Dorsal root entry zone (DREZ) lesioning provides effective relief in most cases; however, pain may recur due to incomplete lesioning or neural plasticity, necessitating revision (redo) surgery. This study evaluates the outcomes of redo DREZotomy in patients with recurrent deafferentation pain following traumatic BPA.

**Methods** A retrospective, single-center review of six patients who underwent microsurgical DREZotomy for BPA-related neuropathic pain followed by revision DREZotomy for recurrence of pain between 2014 and 2025. Pain intensity was assessed using the visual analogue scale preoperatively, postprimary surgery, prerredo, and postredo, along with documentation of the time to recurrence.

**Results** The mean age of redo DREZotomy patients was  $45.17 \pm 15.42$  years (range: 26–64). The preprimary DREZ pain score was  $9.33 \pm 0.82$ , decreasing significantly to  $5.17 \pm 2.32$  postoperatively ( $p = 0.012$ ). The preredo pain score was  $9.17 \pm 0.75$ , which improved markedly to  $3.00 \pm 1.67$  following redo surgery ( $p < 0.001$ ). A significant positive correlation was observed between the degree of pain reduction and time to recurrence ( $r = 0.83$ ,  $p = 0.041$ ), suggesting that greater initial pain relief predicted longer pain-free intervals. At final follow-up, 83.3% of patients achieved good pain relief, and 16.7% had poor outcomes.

**Conclusion** Redo DREZotomy provides a safe and effective salvage option for patients with recurrent neuropathic pain following BPA. The procedure yields significant and durable pain relief, comparable to primary DREZotomy.

## Keywords

- brachial plexus injury
- neuropathic pain
- revision DREZotomy

## Introduction

Pain after a traumatic brachial plexus avulsion (BPA) remains one of the most challenging entities in neurosur-

gery. Brachial plexus injuries affect approximately 1 to 5% of patients presenting at major trauma centers, with a striking male predominance (up to 90%). The majority of adult cases arise from high-velocity trauma, especially motor vehicle

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and motorcycle collisions, with avulsion of nerve roots from the spinal cord seen in approximately 72% of traumatic injuries.<sup>1</sup>

The neuropathic pain from such injuries is often severe, chronic, and refractory to typical medical management. Approximately 70 to 90% of patients experience prolonged pain and disability, which greatly impairs quality of life. DREZotomy lesioning of the dorsal root entry zone (DREZ) is established as the most effective surgical method to disrupt hyperactive nociceptive pathways in the spinal cord and relieve this pain. However, primary DREZotomy sometimes fails to provide lasting benefit, or pain may recur due to incomplete lesioning or ongoing central sensitization, necessitating revision procedures. Revision DREZotomy, therefore, plays a crucial role in comprehensive pain management for these challenging cases, offering renewed hope for meaningful relief. This study presents our institutional experience with revision DREZotomy, supplemented by a focused literature review to clarify patient selection, technical nuances, and outcomes.

## Methods

### Study Design

This retrospective, single-center study where in 77 patients who underwent microsurgical DREZotomy for neuropathic pain following BPA between 2014 and 2025. Among these six patients who underwent revision (redo) DREZotomy between 2014 and 2025, they were identified and analyzed separately.

All the patients who underwent primary DREZotomy with recurring postoperative pain on follow-up were provided with adequate analgesia to avoid the need for revision surgery; however, with the pain not responding to the medical management, these patients were evaluated and planned for a revision surgery accordingly. The study was conducted in accordance with institutional ethical standards. Data regarding pain distribution, pre- and postoperative pain scale, prerredo DREZotomy pain, postredo DREZotomy pain scale, time to recurrence of pain, and follow-up time were noted and documented.

Patient confidentiality was maintained by anonymizing all personal identifiers. As this was a retrospective review, formal informed consent was not required; however, follow-up information was obtained through outpatient visits or telephonic interviews to ensure comprehensive data collection.

### Outcome Evaluation

Pain intensity was assessed using the visual analogue scale (VAS), ranging from 0 (no pain) to 10 (worst possible pain). Each patient's pain was documented at three points: preoperatively, immediately postoperatively, prerredo DREZotomy pain scale and postredo DREZotomy pain scale and at the latest follow-up.

Pain relief was graded as follows: good relief with VAS less than 6 and poor relief with VAS if the score was 6 or above.

### Redo/Revision DREZotomy Technique

In patients undergoing revision DREZotomy, the previous surgical site was re-explored through the same incision. Dissection proceeded through subcutaneous and paraspinal tissues to the bony spinous processes. Instead of re-entering the prior exposure, the paraspinal muscles were reflected from the contralateral lamina up to the medial facet margin. A contralateral laminectomy was performed to reach a virgin dural plane.

From this side, the fibrotic adhesions overlying the dura were carefully released using a Penfield no. 4 dissector. Dense scar tissue adherent to the prior operative field was removed with up-cut rongeurs under magnification until the old incision site was visualized. The dura was then exposed completely, and adhesions were freed from overlying muscle.

The dura was opened sharply in layers until the thecal sac was fully visualized. The incision was extended cranially and caudally with microscissors. In most cases, the spinal cord appeared rotated toward the ipsilateral side. Adjacent nerve roots above and below the prior lesion were identified to re-establish anatomical orientation. The previous DREZotomy tract was recognized as a shiny yellow line running craniocaudally, just lateral to the dorsal root insertions. Using microscissors, the old tract was gently cut and exposed, and the posterolateral sulcus was opened "like a book" with bipolar tips to re-establish the lesion plane.

Following completion of the redo lesioning, hemostasis was secured, and the dura was closed in a watertight manner using 6-0 Prolene sutures.

## Results

The mean age of the six patients who underwent redo DREZotomy was  $45.17 \pm 15.42$  years, ranging from 26 to 64 years, indicating that the cohort represented a middle-aged population with a wide age distribution. All the patients were male. At the time of the most recent follow-up after redo DREZotomy, the mean current pain score had significantly decreased to  $2.50 \pm 1.64$  (range: 1–5), reflecting a substantial and clinically meaningful improvement in pain levels across the cohort.

The mean preoperative pain score prior to the initial DREZotomy was  $9.33 \pm 0.82$ , which decreased significantly to  $5.17 \pm 2.32$  postoperatively ( $t = 3.87$ ,  $df = 5$ ,  $p = 0.012$ ). The mean difference of  $4.17 \pm 2.64$  (95% CI: 1.40–6.94) demonstrates a clinically meaningful reduction in pain intensity. The correlation between pre- and postoperative pain scores was weak and nonsignificant ( $r = -0.25$ ,  $p = 0.64$ ), confirming that DREZotomy achieved significant pain reduction irrespective of preoperative pain severity. Among six patients who underwent revision (redo) DREZotomy, the mean prerredo pain score was  $9.17 \pm 0.75$ , which decreased markedly to  $3.00 \pm 1.67$  after surgery ( $t = 10.26$ ,  $df = 5$ ,  $p < 0.001$ ). The mean difference of  $6.17 \pm 1.47$  (95% CI: 4.62–7.71) indicates robust postoperative improvement, with a moderate but nonsignificant correlation between pre- and postoperative scores ( $r = 0.48$ ,  $p = 0.34$ ). Overall, the magnitude of pain relief following redo DREZotomy was

greater than that of the initial procedure, underscoring its efficacy in treating recurrent or residual neuropathic pain.

Pearson correlation analysis demonstrated a significant positive association between the degree of pain reduction ( $\Delta$ VAS) and the time to recurrence ( $r=0.83$ ,  $p=0.041$ ), suggesting that patients who experienced greater initial pain relief tended to remain pain-free for longer durations. The correlation between pre-DREZ pain scores and recurrence time was positive but nonsignificant ( $r=0.62$ ,  $p=0.19$ ), while  $\Delta$ VAS also showed a positive though weaker relationship with initial pain scores ( $r=0.61$ ,  $p=0.20$ ). The mean duration to recurrence was approximately  $29 \pm 29$  months, indicating that sustained pain relief is achievable, particularly when the initial lesioning achieves a greater reduction in pain intensity.

At the final follow-up, 83.3% ( $n=5$ ) of patients achieved good pain relief, while 16.7% ( $n=1$ ) had poor relief. Both primary and redo DREZotomy procedures resulted in statistically and clinically significant pain reduction. The redo procedure yielded greater absolute relief ( $\Delta$ VAS =  $6.17 \pm 1.47$ ) compared with the initial surgery ( $\Delta$ VAS =  $4.17 \pm 2.64$ ), and the significant correlation between pain relief and time to recurrence highlights that a more complete initial lesioning may translate into prolonged analgesia. These results affirm that redo DREZotomy is a durable and effective salvage strategy for patients with recurrent neuropathic pain following BPA, achieving outcomes comparable or superior to the first procedure.

## Discussion

The DREZotomy procedure remains among the most effective surgical interventions for deafferentation pain after BPA. Multiple studies have reported long-term analgesia, with approximately 80% of patients achieving substantial pain reduction.<sup>2-5</sup> Despite this, a minority of patients continue to experience inadequate or recurrent pain due to incomplete lesioning, scarring, or altered spinal anatomy. Revision or redo DREZotomy has therefore emerged as a viable salvage option, with encouraging outcomes. Weipeng et al<sup>6</sup> demonstrated that two patients with inadequate primary results achieved complete and sustained pain relief after revision surgery, highlighting the importance of surgical precision.

The mechanism underlying sustained pain relief involves irreversible ablation of hyperexcitable interneurons within the dorsal horn, which are responsible for maintaining deafferentation pain. Bertelli and Ghizoni<sup>7</sup> described that even nonavulsed roots may contribute to pain via interneuronal cross-activation, emphasizing the need for complete lesion coverage. Although earlier studies proposed diminishing relief over time due to neural plasticity or rewiring, recent evidence shows that most patients maintain stable analgesia long-term. Recurrent pain likely reflects incomplete lesioning or maladaptive plasticity of neighboring dorsal horn

neurons. Our findings reinforce the role of accurate identification of the posterolateral sulcus and adequate lesion depth in preventing such recurrence.

Revision DREZotomy carries unique technical challenges, including adhesions, scarring, and distorted anatomy. Adequate exposure via full or multilevel laminectomy, sharp arachnoid dissection, and intraoperative neurophysiological monitoring are critical for achieving optimal outcomes. Meena et al<sup>2</sup> recommend lesioning one to two levels above the highest avulsed root for completeness. Doddamani et al<sup>5</sup> advocate the microscissor technique to minimize thermal injury in scarred tissue. Intraoperative monitoring with motor and sensory evoked potentials assists in re-identifying distorted anatomical landmarks.

## Conclusion

While primary DREZ provides durable pain relief in most cases, revision surgery remains a rational and effective salvage option, capable of achieving meaningful relief in selected individuals. Prospective, multicenter studies are needed to define predictors of success, refine timing, and standardize operative approaches for revision DREZ.

### Note

No person who had contributed substantially to the production of this manuscript has been excluded from authorship.

### Conflict of Interest

None declared.

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