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Original Article

Efficacy of Microscissors DREZotomy in Patients with Posttraumatic Brachial Plexus Injury: A Single-Center Study

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Abstract

Introduction Brachial plexus injury (BPI) is often associated with a neuropathic pain that usually is managed with analgesics; however, in up to 10% of the patients, it may be associated with a severely disabling chronic pain that does not respond to even maximal medical therapy.

Materials and Methods This retrospective analysis included all the patients undergoing microscissors DREZotomy (MDZ) by a single surgeon (D.A.) for post-BPI brachialgia over 4 years (excluding 1.5 years of the COVID-19 pandemic) between 2018 and 2024 at our institution. Pain was quantified using the visual analog scale (VAS) between 0 and 10.

Results A total of 32 patients underwent MDZ, of whom 3 patients had a redo DREZotomy. There were no complications and 65.7% patients showed an excellent response to pain with a VAS score of less than 3/10, which was statistically significant ($p < 0.001$). About 25.1% patients showed a good improvement in the VAS score of between 3 and 5.

Conclusion MDZ is a very safe and highly effective technique to relieve the chronic refractory neuralgia in BPI. This technique can be performed with ease even in resource-limited conditions.

Keywords
- brachial plexus injury
- dorsolateral sulcus
- microscissors DREZotomy
- pain
- visual analog scale

Introduction

The primary goal of any treatment is to retain maximum functional output and diminish any pain from the disease to improve the quality of life. Unfortunately, patients who sustain brachial plexus injury have a substantial loss of function of their injured limb and, to add to their misery, the development of a neurogenic pain in that limb itself is an unbearable and unimaginable consequence that can have a very detrimental psychological impact on the patient's mental well-being as well.

Utilizing the concept of "gate theory of pain" by Melzack and Wall[1] in 1965, the dorsal root entry zone (DREZ) was identified as a site for anatomical manipulation. Based on this, Sindou[2] in 1972 performed lesioning at the DREZ site using a bipolar cautery at low settings in a patient with neuropathic pain due to brachial plexus infiltration by a Pancoast tumor. Multiple studies followed, which involved utilizing various methods of lesioning at DREZ site to achieve a painless outcome.[3,4] Soon, other methods using radiofrequency ablation, ultrasonic ablation, and laser-based ablation using CO_2 and argon laser for performing DREZotomy gained significance worldwide.[3,4] However, over the last few decades, DREZotomy fell in favor of newer neuromodulation techniques like spinal cord stimulation, which were very expensive as well as industry driven.

In our institute, this technique of DREZotomy has been revived and further innovated by the senior author (D.A.) by

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using a mechanical technique using microscissors.[5] This method has a major advantage of being atraumatic and does not need any special equipment that would increase the cost of surgery, thereby giving patients with brachial neuralgia an easy and inexpensive access to this technique of pain relief.

Materials and Methods

This retrospective study included all patients who underwent microscissors DREZotomy (MDZ) procedures for neuropathic pain following brachial plexus avulsion (BPA; 3 patients underwent resurgery) between 2018 and 2024 at our trauma center. Initially, antineuralgic pain medications like: anticonvulsants and antidepressants were tried in combinations. Patients who failed to respond to the combination of medical therapy for a minimum period of 6 months were considered for DREZotomy. The distribution of pain and severity of the pain pre- and postsurgery were noted.

Outcome Assessment

The characterization of pain was estimated based on linear grade assessment of the visual analog scale, with 0 being no pain and 10 being maximum possible pain. The patient was asked regarding the pain preoperatively, postoperative day 1, and at the time of discharge from the hospital. The scope of improvement was graded as follows: scores less than 3 was categorized as excellent, 4 to 5 as good, 6 to 7 as fair, and 8 to 10 as poor pain relief. More than 50% reduction would be considered a mark of adequacy of surgery.

MDZ Technique

The patient is placed in the prone position after induction under general anesthesia.[6] A midline skin incision extending till the spinous processes is made, and unilateral muscles are detached so as to expose the hemi-laminae on the side of the neuropathic pain. An ipsilateral C3–C7 hemilaminectomy is performed and extension of the bone removal caudally is considered in case of nonvisualization of the lowermost normal dorsal root. The dorsolateral sulcus is opened up beginning two spinal segments above until the lowermost normal dorsal root. The cord is entered at an angle of 45 degrees in the DRZ (between the dorsal and corticospinal tracts) and sharply dissected till the depth of 2 to 3 mm, using only microscissors (►**Fig. 1**). Vertical small vessels seen subpially ensure the integrity of both tracts. The scissors are marked at 3 mm from the tip, which serves as a guide for the depth of the lesion created. This dissection is continuous all along the length of the posterolateral sulcus between the cranial and caudal-most intact nerve roots. Coagulation is used for achieving hemostasis, in case of bleeding using a fine-tip bipolar cautery under low settings. However, maintaining a proper angulation and plane of dissection opens up the avascular posterolateral sulcus (PLS) without troublesome bleeding, which often stops spontaneously or with gentle pressure. After hemostasis, watertight dural closure is achieved using 5–0 Prolene suture.

Statistical Analysis

The Wilcoxon signed-rank test was performed to test the null hypothesis, comparing the pre- and postoperative pain scores. A statistical analysis was performed by using STATA/MP software. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 32 patients underwent DREZotomy during the study period. About 96.2% were males and 3.8% were females. The majority of the patients presented with refractory neuralgia of 9/10 on VAS (54.8%), followed by those with a pain score of 10/10 (22.6%). Around 65.7% patients showed an excellent response to pain with a VAS score of less than 3/10, which was statistically significant ($p < 0.001$). Another 25.1% patients showed a good improvement in VAS score of between 3 and 5. Three cases (9.7%) underwent a redo DREZotomy in view of inadequate pain relief from the DREZotomy done either outside or within our institute. After the redo DREZotomy, all three patients achieved an excellent VAS score of 3/10.

Discussion

BPA by itself is an unforgiving injury, but when accompanied by neuropathic pain that is not controlled even with maximal medical therapy using analgesics, it becomes a nightmare for those who have to go through with it. The MDZ technique devised by us is an atraumatic lesioning technique to alleviate the refractory pain caused by brachial plexus injury. Neuropathic pain is the most common sequelae accompanying the avulsion injury, seen in approximately 70% patients with BPA. In at least 25 to 30% of these individuals, the pain is refractory to medications and hence the role of neuromodulation and ablation procedures.[7–12]

Sindou studied the topographic anatomy of the spinal cord and defined the arrangement of nociceptive fibers at the root entry zone in human cadavers.[13] They found that the small fibers carrying pain, both myelinated Aδ and unmyelinated C, are positioned ventrally and laterally compared with a median and dorsally and medially placed large myelinated Aβ fibers.

Our technique of DREZotomy is an evolution of the previously described technique by Nashold and Bullitt that aimed at destroying cells in the substantia gelatinosa in the Rexed laminae I and II.[13] Takai and Taniguchi proposed a modification of the existing procedure of DREZ lesioning by including the deeper layers of the posterior horn of spinal gray matter including the Rexed lamina V.[14] This was based on the hypothesis that deeper layers of the posterior horn in spinal gray matter are also concerned with conduction of pain.

The pain-free status following DREZotomy using different techniques reported in the literature varies ranging from 50 to 100%. Sindou[2] and Nashold and Bullitt[13] reported more than 50% reduction in the pain in 69 and 72.3% of patients,

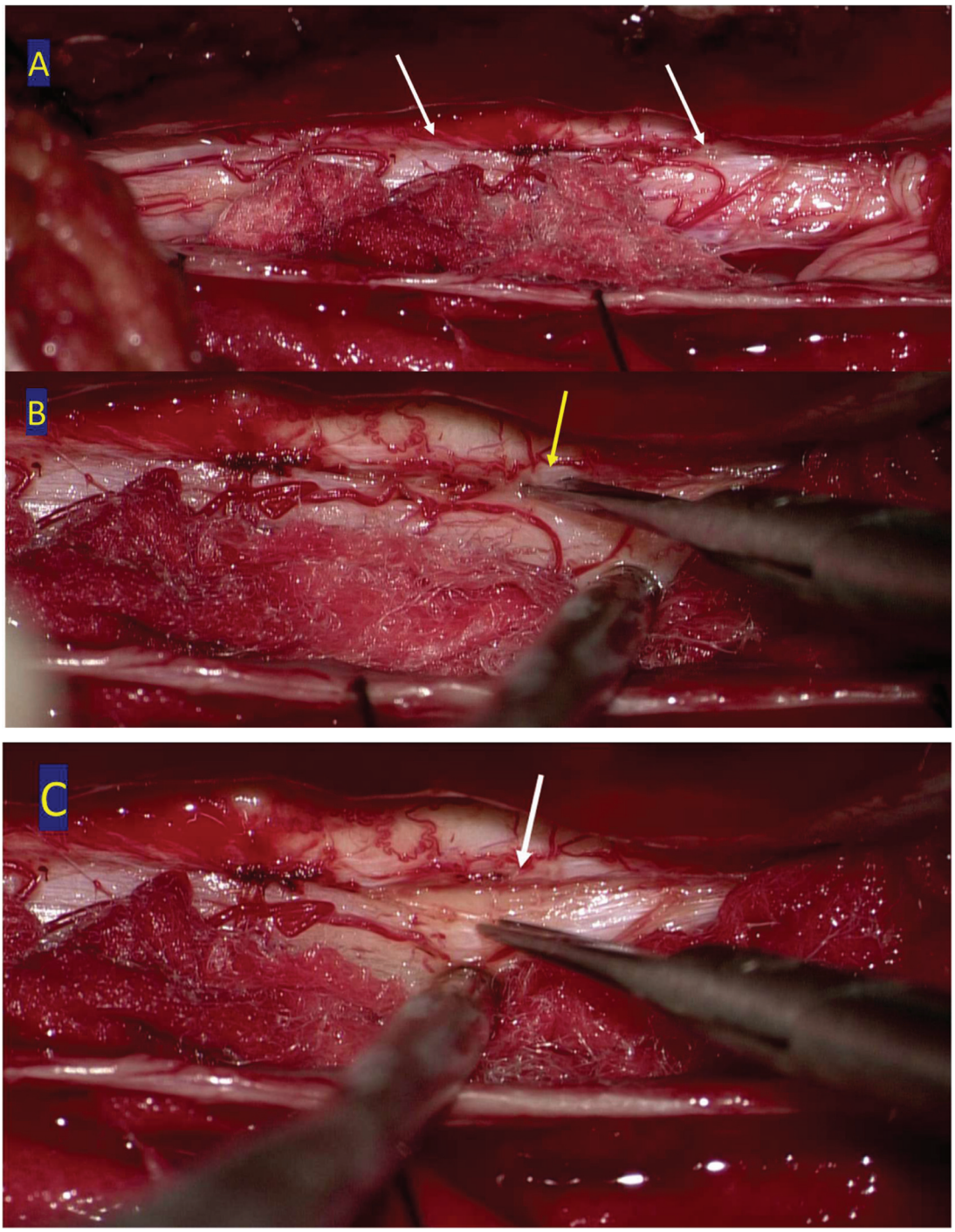
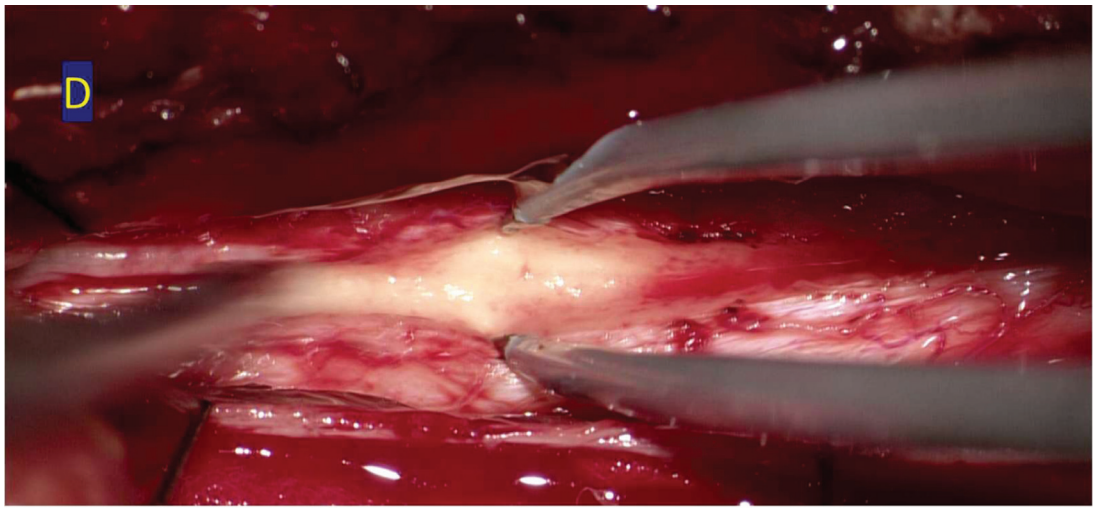


Fig. 1 Intraoperative pictures following right C3–C7 hemilaminectomy and dural opening. (**A**) Dorsolateral sulcus (*white arrows*). (**B**) The dorsal root entry zone opened with micro-scissors with the lesion created lateral to the roots (*yellow arrow*) with an angle of 35 to 45 degrees. (**C**) The dorsolateral sulcus is opened (*white arrow*) for a depth of 3 mm, which is (**D**) opened up like a book using the bipolar cautery forceps and (**E**) depth is validated using the markings on the plastic ruler.

respectively. Dreval published the largest series of DREZotomy to date utilizing ultrasonic lesioning and achieved more than 50% pain-free outcomes in 87% patients.[4] In a previous series by us,[6] 81% patients benefited significantly from DREZotomy, achieving more than 50% reduction in pain at a mean follow-up of 32 months. Surgical failure was noted in 14% of patients.

In this study, approximately 90% achieved significant pain reduction from the surgery. Follow-up of cases operated 6 years ago revealed a more or less similar pain scale that was achieved postoperatively, suggesting the consistency of results from this procedure. Three patients had to undergo a repeat DREZotomy, one of whom underwent primary surgery at our institute and two were treated elsewhere.



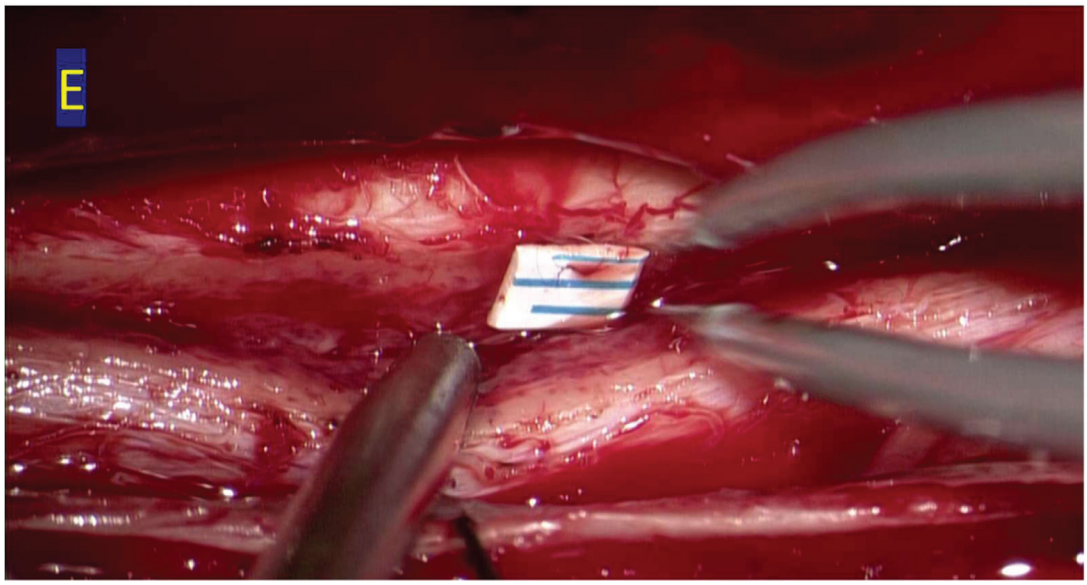


Fig. 1 *(Continued).*

These results improve upon our previously published work in which 81% patients had benefited from the surgery, achieving more than 50% reduction in pain at a mean follow-up of 32 months.

Conclusion

Our study clearly shows that MDZ is a very safe and highly effective technique to relieve chronic refractory neuralgia in brachial plexus injuries. This technique can be performed with ease even in resource-limited conditions.

Funding
None.

Conflict of Interest
None declared.

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