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Website: www.neurologyindia.com

DOI: 10.4103/neurol-india.Neurol-India-D-24-00763

Awake Sciatic Nerve Neurolysis after Injection Injury – An Innovative Technique and Our Experience

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Abstract:

Background and Introduction: Sciatic nerve injection injury is the most common type of injection nerve injury. Injection injury to nerve causes severe, intractable radicular pain in affected limb. Owing to chemical damage, nerve is damaged both mechanically and chemically. As a result, adhesions and nerve fibers damage is more than expected. Surgical neurolysis is recommended for pain relief. However it is done in general anesthesia and effect of neurolysis is checked only after reversal.

Objective: There are chances that incomplete neurolysis can cause persistence of pain. To overcome this limitation, we evaluated "awake sciatic neurolysis technique."

Methods: This was a prospective, nonrandomized study which evaluated awake sciatic neurolysis in sciatic nerve injection injury patients. A total of 11 patients underwent this procedure after evaluating clinical profile. During this procedure, patients were asked about pain relief on rest and leg movement. When VAS score decreased to 3 or less, procedure was stopped.

Results: The average VAS score was 9.5 (10 in 7 cases). During surgery, VAS score decreased to 3 and below in all except in 2 cases. In long-term follow-up, one patient had VAS more than 3.

Conclusion: Our study is about a novel technique "awake sciatic neurolysis." The results were satisfactory, but it has some technical difficulties. It has advantage of checking impact of neurolysis during surgery and modify technique according to relief.

Key Words:

Awake, injection injury, sciatic nerve, sciatic neurolysis

Key Message:

Awake sciatic neurolysis is a good option to assess pain relief during surgery of sciatic nerve and thus modify procedure accordingly.

Sciatic nerve injury is the most common type of injection nerve injury.[1-4] It is more common in children.[2-4] Various studies have recommended and suggested expectant management with physiotherapy and painkillers, steroid block, exploration, neurolysis, and/or excision of injury area and nerve repair.[1-6] The decision about the type of approach, such as external neurolysis, internal neurolysis, and/or excision-repair, is taken based on clinical symptoms, duration, and nerve action potential findings.[1-6] In injection injury, the main symptom is intractable neuropathic pain, arising from the buttock and radiating to the leg, which increases on bending forward.[2,3,5-10] When exploration surgery is planned, the primary aim is pain relief and the secondary aim is recovery of functional loss. Various studies have reported that significant pain relief could be achieved by releasing the nerve. However, it was assessed in the postoperative period when the patient became awake.[2-4] Only steroid block confirms pain relief during the procedure, and based on symptomatic relief, the clinician changes strategy.[6,7] Surgery is considered the main treatment, if there is no pain relief with medical management 3 months after injury.[5,10,11] The advantage of sacral block over surgical exploration is pain assessment during procedure. To overcome this disadvantage of surgery, we hypothesized that pain relief could be confirmed intraoperatively like during sacral block, so that the procedure can be modified based on the clinical response. In this study, we

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How to cite this article: Bishnoi I, Feletti A, Singh A, Lal B, Kumar D. Awake Sciatic Nerve Neurolysis after Injection Injury – An Innovative Technique and Our Experience. Neurol India 2025;73:546-50.

Submitted: 18-Oct-2024 **Revised:** 02-Feb-2025
Accepted: 15-Feb-2025 **Published:** 23-May-2025

included sciatic nerve injection injury patients, who underwent surgical exploration with awake sciatic nerve exploration, and we evaluated the clinical results.

Methodology

This was a prospective study, conducted at our institute from 2020 until 2023. The procedure was performed in compliance with relevant laws and institutional guidelines and have been approved by the appropriate institutional committee (No-E-24/2020, dated 5/2/2020). Patients over 18 years of age, who had a history of sciatic nerve injection injury or were found to have sciatic nerve injection injury, having neuropathic pain and/or motor deficit, were enrolled in the study after informed consent. All patients were given the choice of conservative and surgical management. Those patients who opted for medical management were excluded from the study.

In the period 2017–2020, we managed 4 patients with sciatic nerve injury (injection or stab) under general anesthesia, who were operated for complaints of neuropathic pain and/or foot drop. The pain relief was up to 50% (average VAS score was 4-6), and 3 of 4 needed painkillers. This below-average outcome was one factor prompting us to start performing this surgery in awake state. The other cause was to reduce the need for unnecessary neurolysis if pain relief occurs early. On the contrary, if no pain relief, continue surgery until there is significant pain relief.

Diagnosis of injection injury was confirmed by history and examination, followed by nerve conduction studies. Particular stress was given on the exact point of injection (if the patient remembered it vividly).

In 3 years, we encountered 24 cases of sciatic nerve injection injury. Of these 24 cases, 11 cases were enrolled in study. Thirteen patients were rejected due to following reasons: 7 patients had more than 12 months old injury, 4 patients had pain relief on medication and main complaint was foot drop, and 2 cases refused any kind of surgery despite severe neuropathic pain. The chief neurosurgeon appropriately counseled enrolled patients about procedure steps. Then, a senior psychiatrist evaluated every case for mental fitness regarding awake surgery. The patients were explained about the projected surgery time to be 120–150 minutes. Patients were asked to lie prone for at least 2 hours to bear the discomfort of the position. That is why every case was operated after at least 5 days post admission. Table 1 summarizes the details of the study patients.

Every patient was instructed about the procedure and awake status during surgery also. The surgery began after establishing the patient's mental status to perform awake exploration. The aim was to best assess pain relief status intraoperatively and proceed till significant pain relief (VAS < 4).

Example case

A young adult, early 20s presented with severe current like pain sensations in left buttock, radiating lateral-posterior thigh, calf, foot, and 5th toe. The patient had a history left buttock injection, given by quack, 2 months before. After injection, the patient experienced severe pain at puncture site, which was going until left foot. Although getting up and trying to walk, the patient fell and noticed foot drop. Despite physiotherapy, pain killers and steroids, there was no relief. On examination, there was left foot drop, complete sensory loss in L5, S1 region

Diagnosis of injection injury of sciatic nerve was made on the basis of history, examination, NCV study, and MRI neurography [Figure 1]. The patient had severe pain and was not allowing anybody to touch his left leg and thigh, as it caused agonizing pain.

On examination, there was atrophy of hamstrings, calf muscles and foot drop. Left lower limb straight leg raise (SLR) test was positive at 10–15 degree angle. There was sensory loss over calf and lateral aspect of foot.

After complete evaluation, we decided to explore sciatic nerve at injection site. It was conducted under local anesthesia with mild sedation. Written informed consent was obtained for both the surgical procedure and the academic usage of the photographs.

Procedure

The patient was placed in a prone position with a 20-cm diameter bolster below the lower abdomen [Figure 2a]. The operative side hip joint was flexed 30 degrees to make ischial tuberosity prominent. After surface marking of the sciatic nerve [Figure 2b], local anesthesia (lignocaine + bupivacaine + normal saline) was given at the operative site. The anesthetist administered a 1000 mg intravenous infusion of paracetamol. No sedation was used to obtain the best response from the patient. Skin and subcutaneous fat were raised in a single flap [Figure 2c]. The Gluteus maximus muscle was bluntly dissected over the sciatic nerve marking to reach the piriformis muscle. If pain, 3-5 ml local anesthesia was given in the muscle. The Gluteus medius muscle was encountered below the maximus, which was dissected bluntly to reach the Piriformis muscle. It was either cut or simply retracted (in this case) to expose sciatic nerve [Figure 2d]. At this stage, the microscope was used to examine the nerve and complete the procedure. The nerve was traced cranially to the "greater sciatic foramen" and caudally to the normal sciatic

Figure 1: MR neurography, sagittal section showing sciatic nerve course in gluteal region, with central hypointensities (red arrow and circle) near femur head

Table 1: Clinical profile of study patients

Age/Sex	Duration	Sensory symptoms	Motor symptoms
24y/M	2 months	Radicular pain buttock to foot (VAS – 10)	Foot drop (2/5)
26y/M	5 months	Same (VAS – 10)	Foot drop (2/5)
67y/F	12 months	Same with sensory loss of 5th toe and lateral foot (VAS – 9)	Foot drop (0/5)
31y/M	1 month	Pain (VAS -10)	No
20y/M	4 months	Pain and allodynia (VAS – 10)	Foot drop (1/5)
61y/M	2 months	Pain and sensory loss (VAS – 8)	Foot drop (1/5)
38y/F	7 months	Pain and allodynia (VAS -10)	Foot drop (0/5)
52y/M	10 months	Pain (VAS – 9)	No
48y/M	18 months	Pain (VAS – 9)	No
29y/M	4 months	Pain and sensory loss (VAS – 10)	Foot drop (1/5)
46y/M	3 months	Pain and sensory loss (VAS – 10)	Foot drop (2/5)

VAS=Visual Analogue Scale

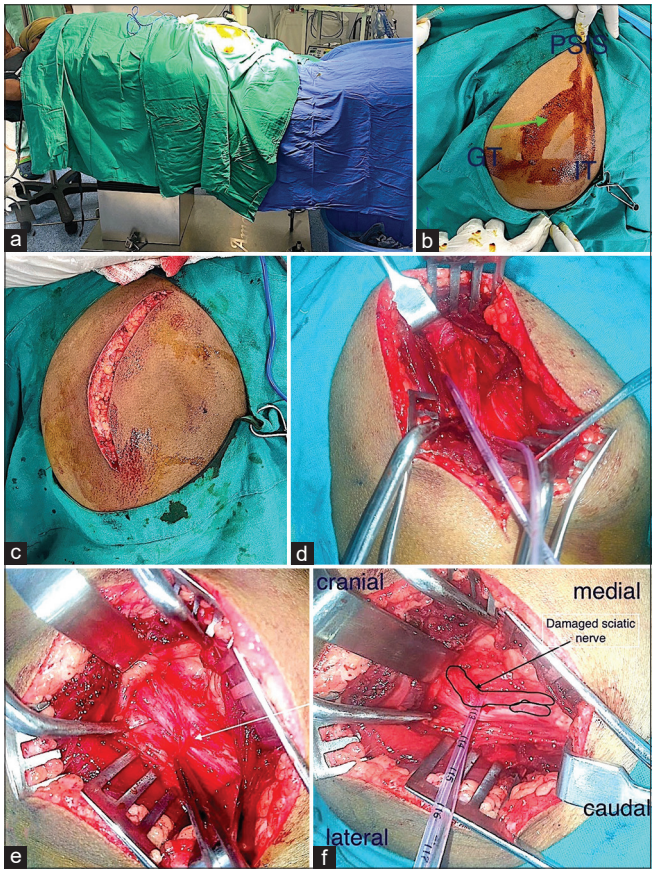


Figure 2: (a) Showing prone position, with hip flexion, (b) Showing surface marking sciatic nerve, curved line (green arrow) starting midpoint of PSIS (posterior superior iliac spine) to IT (Ischial tuberosity) reaching till midpoint of IT to GT (greater trochanter), (c) intraoperative picture depicting skin incision, (d) exposure of sciatic nerve (held by loop),(e) gliosed medial half of sciatic nerve (white arrow), (f) sciatic nerve after external neurolysis, showing gliosed area (marked)

nerve, which appeared glistening white and gliding easily. At the injection injury site, the nerve was yellow colored on the medial side, with few dark-colored pigmented spots and densely adhered to surrounding muscles [Figure 2e and f]. We did sharp external neurolysis to dissect free nerve from muscle. The external neurolysis was considered complete if the nerve could be mobilized and the instrument could be passed and mobilized below it. We did not use neuromonitoring. The patient was asked to describe pain aggravation and relief. As per the patient, external neurolysis caused intermittent current sensation to the foot, bearable, and immediate partial relief after completion. Internal neurolysis was the second stage, which involved cutting the normal nerve's epineurium close to the injection site and moving toward the injured area. Perineurium and endoneurium were then dissected to release internal adhesions. The damaged area was dissected and freed from normal nerve fibers where the sheath demarcation had been lost. Internal neurolysis was done sharply with microscissor. The patient was again asked to describe pain aggravation and relief by moving the affected foot's dorsi- or plantar flex state. The patient had about 90% pain relief on the table, i.e., VAS score below 4. In between surgery, the anesthetist was comforting and repeatedly asked the patient about surgical site pain and position.

After completion of the procedure, the patient was turned supine. SLR was repeated and there was no pain until 60 degrees, after which there was pain at the operative site.

The patient was discharged next day, advised pain killers, antibiotics, avoiding prolonged pressure on surgery site and physiotherapy of affected limb. At 10th day, the patient had VAS score of 2 and foot drop and satisfied with outcome. At the 6-month follow-up, there was almost complete relief (VAS – 1) and power gain 3/5 in foot.

Results

Out of 11 patients, 9 were male and 2 were female. The average age was 40.2 years (range: 24–67 years). Six patients were below 40 years. The average duration of symptoms was 6.2 months (range, 1–18 months). Seven patients had a pain duration of less than 6 months. The average VAS score was 9.5; 7 patients had score 10. Out of 11, 8 patients had foot drop.

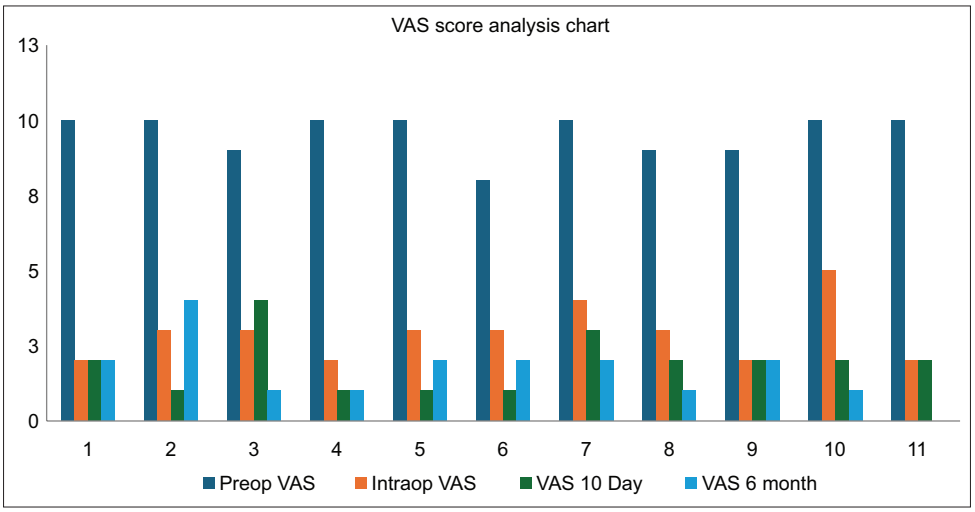
Ten patients (91%) were from village, and one was from town. The nature of the injected drug could not be assessed as 9 patients (82%) received injection from quack or untrained persons. In 3 (28%) cases, the injection was given without removing the cloth. However, 7 out of 11 patients said it was a painkiller, and in the other 4, there was no information. We suspected it was either paracetamol or diclofenac.

The results after surgery are summarized in Table 2. No patient required sedation or general anesthesia. Out of 11, 5 patients underwent external neurolysis, 5 patients underwent both

Table 2: Operative result analysis

Procedure	Duration (minutes)	VAS score operative	VAS score 10 days	VAS 6 months	Motor symptoms 10 days	Motor symptoms 6 months
E N	60	2	2	1	Foot drop	MRC 3/5
E N+I N	100	3	1	2	Foot drop	MRC 3/5
E N+I N	110	3	4	4	Foot drop	Foot drop
E N	70	2	1	1	N A	N A
E N+I N	105	3	1	1	Foot drop	MRC 3/5
E N	90	3	1	2	Foot drop	MRC 3/5
E N+I N	100	4	3	2	Foot drop	Foot drop
E N	55	3	2	2	N A	N A
E N	60	2	2	1	N A	N A
E N+I N+Repair	120	5	2	2	Foot drop	MRC 3/5
E N+I N	110	2	2	1	Foot drop	MRC 4/5

E N=External Neurolysis, I N=Internal Neurolysis, N A=not applicable, VAS=Visual Analogue Scale, MRC=Medical Research Council



Graph 1: VAS score analysis

external and internal neurolysis, and one underwent neurolysis with scar excision and repair. The intraoperative VAS score did not improve in two cases. In one case, the score was 4 after both external and internal neurolysis. There was no scar, so excision and repair were not done. In another case, the score remained 5 even after repair. Graph 1 shows VAS score assessment in follow-up. There was a significant improvement in pain score (relief) after neurolysis, except in one patient, whose score remained 4 (Case – 3, 67-year-old lady, duration 12 months). There was motor loss in 8 patients (73%). Motor power or foot drop improved in 6 patients (6/8, 75%) after the 6-month follow-up. In the postoperative period, no nerve conduction studies were conducted.

The surgical results were extremely satisfactory.

Discussion

In developing countries, due to the fewer professionals, injections are commonly given by untrained professionals, especially at the periphery.[1,2,5,9,12] Buttock is one of the most common sites of the intramuscular region. Untrained professionals prefer intramuscular (I.M.) sites as they do not need localization of veins and precision. For this reason the sciatic nerve is commonly injured due to gluteal muscular injection.

There have been various studies on the management of sciatic nerve injection injuries. Conservative treatment is indicated in case of partial injury or Sunderland NII grade 1 (reversible conduction block). In grades II and III, studies advocate either sciatic neurolysis or repair. Surgical exploration is indicated within 3-6 months of injection injury.[2,11,13] In various reported series, neurolysis is done either under general anesthesia or not specified about anesthesia.[2,10-13] The assessment was performed after recovering from sedation.

To the best of our knowledge, there are no studies about neurolysis in awake patients after searching the literature on Google/PubMed using the words "awake sciatic exploration/neurolysis." Conversely, the assessment of our patient was similar to other studies.[2,10-13]

As sciatic neurolysis is a major procedure that requires time and a prone position, it is performed under general anesthesia. However, we could perform it in an awake state based on 1) the availability of long-acting anesthetic agents such as bupivacaine (effect duration 2–4 hours), 2) buttock muscle disuse atrophy due to neuropathic pain causing restriction of movement, 3) proper counselling of patient by the chief surgeon about surgery, aim, and timing, and 4) availability of anesthetist if the procedure could not be completed.

The aim was to decide intraoperatively how much exploration is needed to achieve pain relief (VAS < 4, criteria set to objectively measure pain relief). In our series, 5 patients reported intraoperative relief (VAS < 4) after external neurolysis, and 4 got relief after external-internal neurolysis. Two patients did not get intraoperative relief, one underwent EN-IN, and one underwent excision and repair.

Awake patient sciatic neurolysis was attempted to assess pain (mainly) and power status during surgery. During surgery, exploration was divided into external neurolysis only, external-internal neurolysis only, and neurolysis with scar excision and repair. If intraoperatively patient got pain relief (VAS below 4) with external neurolysis, further adhesiolysis was not done. If intraoperatively patient was not satisfied with pain relief (VAS score 4 or more) after external neurolysis, exploration was continued to internal neurolysis and reassessment. If still VAS 4 or more and scarring was present, excision of the scar and repair of the nerve was planned. In one patient (S. No. – 7), the intraoperative VAS score remained at 4 after internal neurolysis, and it was stopped at this stage as there was no scarring. This patient showed improvement at the 10th day VAS and 6 months VAS. The operative discomfort, nerve irritation, and/or central modulation of pain perception could be the causes of a high intraoperative VAS score.

In one patient (S. No. – 3), the intraoperative VAS score decreased to 3, but the follow-up score was 4 on the 10th day and 6 months. The probable cause could be nerve irritation/recurrent adhesions/improper adhesiolysis, and/or central modulation of pain perception. This patient had 12-month old nerve injury. Such a long time may cause central modulation of pain perception, as seen in brachial plexus injury.[14] For pain relief, she was given gabapentin 800mg and nortriptyline 20 mg combination and gabapentin-based gel. She refused further intervention as she was better than preoperative status. Pain relief (decrease in VAS score) at 6 months could be due to good physiotherapy, healing of nerve after neurolysis and mobilization.

The scarce number of patients is a limitation for this study. However, it highlights the importance of awake sciatic nerve exploration. Based on our findings, it may be stated that awake exploration is a suitable method to assess immediate pain relief, and the procedure can be modified based on intraoperative relief. We believe significant pain relief can be achieved by an awake state as it is relief-dependent. Before starting awake sciatic nerve surgery, a neurosurgeon must be well-versed in nerve approaches and cadaver dissection, to reduce surgery time till nerve exposure. Yeremeyeva *et al*.[15] published results of 196 cases of sciatic nerve injury, operated from 1968-99, in which neurolysis or complete repair of the nerve was decided based on the presence of action potential (neurolysis only) and absent potential (repair). They concluded good results in positive potential cases. However, they could not assess how much neurolysis is needed for a satisfactory pain relief.

Our approach has some limitations: Non-cooperative patients are not eligible; there is a limited time for surgery due to local anesthesia t-half life; a false sense of relief may cause improper/under exposure; no intraoperative neurophysiological monitoring was done; injury older than 12 months was selectively omitted except one; there was no comparative trial with general anesthesia sciatic neurolysis cases and repeated intraoperative muscle contractions can impair dissection around the nerve. A large-scale comparative study (LA vs GA) is needed to confirm our results, along with data to correlate neurophysiology before and after surgery.

Conclusion

Sciatic nerve injection injury is very debilitating and still common, due to untrained professionals. Radicular pain is the main and most devastating symptom. Awake sciatic neurolysis technique is a good method to treat and assess pain relief and modify the procedure, based on real-time results.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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