

More than just sciatica. Clinical presentation, surgical treatment and functional outcomes of sciatic nerve schwannomas

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Abstract

Introduction: Peripheral nerve schwannomas are rare benign tumors. The onset of a schwannoma in the sciatic nerve is uncommon and can impair the nerve's functionality. To this date, the literature on this topic is mainly composed of case reports, lacking large case series.

Aim: To overcome the limitations of previous literature, we performed a retrospective study on surgical enucleation of sciatic nerve schwannomas, evaluating surgical treatment's clinical and functional effectiveness.

Materials and methods: We examined retrospectively all cases of sciatic nerve schwannomas that underwent surgical enucleation between 2016 and 2022. For each one, we analyzed lesion size and localization. Motor and sensory deficits, Tinel sign, and lower limb functionality (assessed using MSTS and LEFS score) were evaluated before surgery and at the patients' latest follow-up.

Results: Eight cases were included in our study. All patients had pre-operative sensory deficits. The mean MRC score was 3.9 before surgery, while MSTS and LEFS scores were 21.1 and 59.5, respectively. No local recurrence or major complication were recorded. After surgery, the mean MRC score rose to 5, and both MSTS scores (29.5) and LEFS scores (78.1) significantly increased compared to pre-operative records.

Conclusions: In our cohort, good functional performances and symptomatic relief were seen after the removal of sciatic nerve schwannomas. Early diagnosis and prompt surgical treatment should represent the therapeutic approach for sciatic neurinomas, considering the good postoperative outcomes.

Keywords

diagnosis, enucleation, functional outcome, sciatic nerve schwannomas, symptoms

Introduction

Schwannomas are benign soft tissue tumors arising from well-differentiated Schwann cells of the peripheral nerves.^[1-4] Malignant degeneration is a possible but un-

common occurrence, affecting less than 1% of all cases.^[5] Schwannomas typically appear as solitary masses with a round or oval shape, often in continuity with the nerve from which they originate. They exhibit slow growth and can remain silent for an extended period. However, as time

passes, those tumors tend to increase in size, and their local mass effect may cause symptoms including pain, dysesthesia, and muscle weakness.^[3-8]

Surgical eradication, performed with enucleation, represents the consensus treatment for schwannomas. Tumor excision with enucleation aims to remove the disease and decompress the involved nerve to relieve symptoms and aid functional recovery.^[9,10]

The sciatic nerve is the longest in the human body. It is critical for lower limb mobility and sensitivity because it innervates the muscles in the thigh's posterior compartment, as well as those in the leg and foot. Its fibers also contribute to skin sensitivity in the foot and leg, with the exception of the latter's anteromedial surface. Due to its anatomical position and pivotal role in the lower limb's functionality, lesions of the sciatic nerve may compromise patients' overall health and limit many of their daily activities.^[11] Because of the importance of the nerve and the threatening effects damage could cause, tumor resection represents a delicate intervention even for the most experienced surgeons.^[3-11]

Aim

Sciatic nerve schwannomas are rare, and to this date, only case reports and a few case series with a limited number of patients have been described in the literature.^[12-17] This study reports our experience in treating sciatic nerve schwannomas. We evaluated the symptoms and possible prognostic factors of the cases, as well as assessed lower limb functionality, to understand the effects of the disease and its treatment on patients' daily lives.

Materials and methods

This single-center retrospective study was conducted in accordance with the ethical standards outlined in the 1964 Declaration of Helsinki and its subsequent amendments. According to our country's laws, the review by the ethics committee was not considered necessary, as the study only involved standard surgical and clinical procedures, without experimental treatments or supplementary evaluations. All patients gave their written informed consent.

Our study reviews all schwannomas arising from the sciatic nerve treated with surgery in our institution between January 2016 and December 2022. We included only those cases in which the tumor arose directly from the body of the nerve in the segment between the greater ischiatic foramen and the sciatic bifurcation.

We collected data regarding each patient's general information, symptoms, and the date of diagnosis of schwannoma. The time between the onset of the first symptom and the final diagnosis (diagnostic interval) was documented for each case.

Our patients' functional status was assessed using the Musculoskeletal Tumor Society (MSTS) and the Lower

Extremity Functional Scale (LEFS) scoring systems before surgery. At the same time, the muscular strength of muscles innervated by the sciatic nerve was evaluated according to the Medical Research Council (MRC) scale. Deep and cutaneous sensitivity were assessed in the sciatic nerve territory, and a Tinel-Hoffmann test was performed on the neoplastic masses.

All patients had pre-operative MRIs, used to orient the diagnosis, guide the surgical planning, and estimate the size of the tumor (Figs 1, 2).

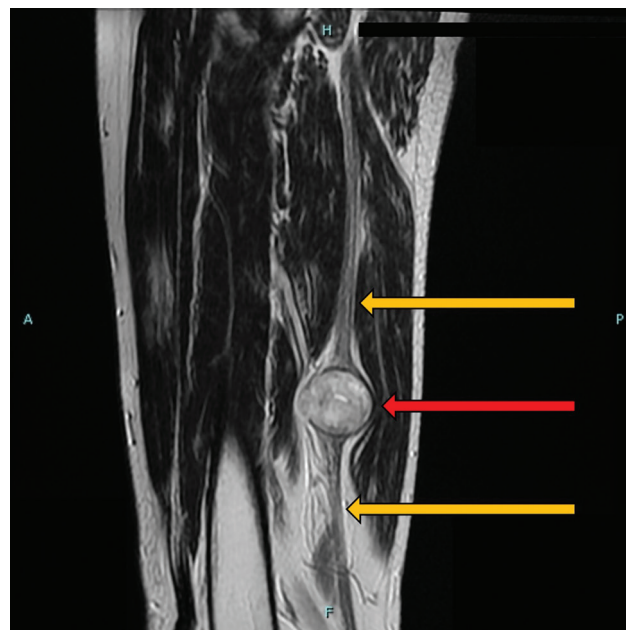


Figure 1. MRI T1-weighted sagittal scans that display a schwannoma (red arrow) and the sciatic nerve (yellow arrows) from which the tumor originates.

Intraoperative neurophysiological monitoring was not performed in our cohort. Before the incision, lesions were localized under ultrasound guidance to orient the surgical approach intraoperatively. During the surgical procedure, the sciatic nerve was identified and isolated. While preserving the continuity of the involved nerves, the schwannomas were carefully enucleated and removed. Our pathologists examined surgical specimens, confirming the diagnosis of schwannoma.

All our patients had oral integration of lipoic acid, citicoline, and vitamins B for 30 days after surgery, aiming for an antioxidant and neurotrophic effect after surgery.

Our patients' follow-up was made of clinical evaluations and postoperative MRIs, performed within 6 and 12 months after surgery, and later depending on the necessities of everyone.

Major complications (Clavien-Dindo Classification grade II or higher), as well as local recurrences, were reported.

At each patient's latest follow-up, we re-evaluated sensory deficits, performed once again the Tinel test, and assessed muscular strength with the MRC score. We also re-calculated the MSTS and the LEFS scores.

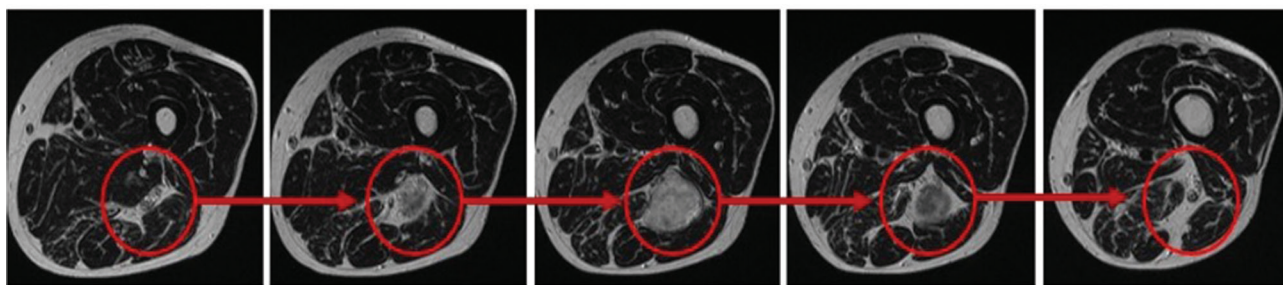


Figure 2. A series of transverse axial MRI T1-weighted scans (from proximal on the left to distal on the right) shows a sciatic nerve in the middle third of a thigh with an intraneuronal schwannoma (particularly visible in the middle scan).

Statistical analysis was performed using Stata SE 13 (StataCorp LLC, College Station, TX). Statistical significance was set to 0.05 for all the endpoints.

Results

Eight cases with schwannomas of the sciatic nerve received surgical enucleation in our center between January 2016 and December 2022. Five males and three females were included, with a mean age at surgery of 52.2 years (42–65). Everyone came to our attention because of at least one symptom attributable to the disease; none had an accidental diagnosis. The first symptom was pain in 5 cases (62.5%), paresthesia in 1 case (12.5%), and swelling in the remaining 2 cases (25.0%). The mean diagnostic interval was 11 months (1–26).

Before surgery, each patient developed paresthesia. The symptom was severe in 4 cases (50%) and moderate in the other 4 cases (50%). While 2 cases (25%) did not exhibit objective weakness, the remaining 6 (75%) showed at least a slight reduction in muscular strength, with their MRC value being four or lower. The mean pre-operative MRC score was 3.9 (3–5). The Hoffman-Tinel sign was slightly positive in 1 case (12.5%), whereas it was strongly positive in the other 7 cases (87.5%).

On average, the mean pre-operative MSTS score was 22.1 (19–26). The mean pre-operative LEFS score was 59.5 (46–77). According to the MRI images acquired before surgery, the mean tumor size was 52.7 mm (31–81). In 3 of our 8 cases, the schwannoma affected the gluteal region or the upper third of the thigh; in 3 other cases, it affected the middle third, and in the remaining 2 cases, it involved the distal third of the thigh. The pre-operative clinical picture of our patients is reported in detail in **Table 1**. A Pearson correlation test revealed a statistically significant positive correlation between diagnostic delay and tumor size at the time of procedure ($r=0.867$; $p=0.005$). The same test also assessed that the size of schwannomas had a strong negative correlation with the pre-operative MSTS score ($r=-0.941$; $p<0.001$) and LEFS score ($r=0.924$; $p=0.001$). The time between the onset of the first symptom and diagnosis also showed a direct correlation with preoperative

functionality, as measured by the MSTS score ($r=-0.804$; $p=0.016$).

The three patients with a lesion in the gluteal region or proximal thigh were treated with a transgluteal or infragluteal approach (**Fig. 3**).

For the other 5 cases, we chose the posterior approach to the thigh (**Fig. 4**).

A complete excision of the neoplasm by enucleation could be achieved in all cases. No major complications occurred during or after surgery.

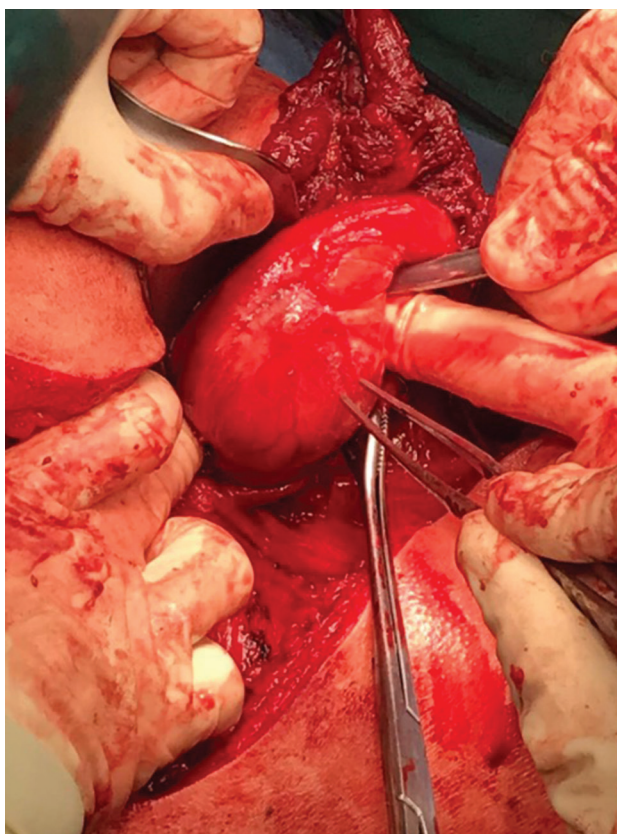


Figure 3. Intra-operative exposition of a sciatic nerve schwannoma in the right gluteal region, exposed with a transgluteal approach. The tumor emerges as an ovoid mass in direct contact with the sciatic nerve. Gluteal fibers can be seen in the upper section of the picture, above the neurinoma.



Figure 4. Intra-operative image of a sciatic nerve schwannoma arising from the mid third of the thigh, exposed with a posterior approach. The tumor, isolated from the surrounding tissues, lies in the middle of the operative field.

The mean follow-up was 25.37 (6–54) months. No local recurrence was observed in any of our patients after surgery.

Five of our eight patients had no post-operative paresthesia. The other three cases had transient episodes of paresthesia in the weeks that followed surgery. For one of the latter, these episodic symptoms resolved spontaneous-

ly within five weeks, while the remaining two cases still report episodes of mild paresthesia at their latest clinical evaluation. No case had a positive Hoffman-Tinel sign after the treatment. Compared to their preoperative conditions, each patient experienced a reduction in sensory symptoms after surgery.

Each patient achieved complete restoration of postoperative muscular strength. Hence, the MRC score was 5 out of 5 in all cases (100%). This value was improved by 1.1 compared to the mean value recorded before surgery.

The mean post-operative MSTS score of our population was 29.5 (27–30), 5.3 (4–10) higher than the one reported pre-operatively. The mean postoperative LEFS score was 78.1 (74–80), representing a mean increment of 13.9 (3–33) compared to the average preoperative score. Both scores testified to at least a slight increase in each patient’s lower limb functionality. According to Mann-Whitney U tests, postoperative values were significantly higher than preoperative ones in both MSTS and LEFS ($p < 0.001$), indicating the effectiveness of surgical enucleation on patients’ clinical status. We found a positive correlation between tumor size and postoperative functional recovery, as calculated by the differential MSTS score ($r = 0.769$; $p = 0.026$) and the differential LEFS score ($r = 0.805$; $p = 0.016$) between preoperative and postoperative values. Cases with larger lesions generally had better functional recoveries in our cohort.

Clinical outcomes of surgical treatment and functional performances in our cohort are summarized in **Table 1**.

Discussion

Sciatica is a pain that radiates in the sciatic nerve territory and is typically felt from the buttocks down to the back of the thigh, the leg, and possibly the foot. Nervous damage can also cause paresthesia and, in some cases, lead to reductions in muscular strength. This combination of symptoms may lead to severe functional impairment and consequently threaten the overall quality of life. Sciatica, as well

Table 1. Preoperative and postoperative picture of our case series

No	Age (yrs)	Diagnostic delay (mos)	Site (thigh third)	Size (mm)	First symptom	Preoperative					Postoperative					FU (mos)
						Tinel	Sensitivity	MRC	MSTS	LEFS	Tinel	Sensitivity	MRC	MSTS	LEFS	
1	52	18	Proximal	59	Pain	+	Severe	4	21	58	-	Mild	5	29	78	41
2	65	18	Proximal	81	Pain	+	Severe	3	19	46	-	None	5	27	70	23
3	64	1	Proximal	32	Swelling	+/-	Moderate	5	26	77	-	None	5	30	80	10
4	50	3	Mid	35	Swelling	+	Moderate	5	25	72	-	None	5	30	80	6
5	51	26	Mid	70	Paresthesia	+	Severe	3	20	50	-	None	5	30	78	54
6	42	8	Mid	55	Pain	+	Moderate	3	20	52	-	Mild	5	30	80	21
7	46	15	Distal	53	Pain	+	Severe	4	22	52	-	None	5	30	79	24
8	48	6	Distal	37	Pain	+	Moderate	4	24	69	-	None	5	30	80	24

FU: follow-up

as other signs of sciatic nerve injury, can be attributable to several pathologies. Most cases are attributable to lumbar disc herniations, which cause a compression of the nearby nerve roots.^[11] Differential diagnoses include other spinal disorders, such as spinal stenosis or spondylolisthesis, piriformis syndrome, coxarthrosis, pelvic or lumbar bone tumors, and sciatic neuritis.^[18] Peripheral nerve schwannomas arising from the sciatic nerve are sporadic and, therefore, are often overlooked in a differential diagnosis.^[19] However, despite their extremely low incidence, sciatic schwannomas are frequently associated with sciatica. In a 2020 literature review by Telera et al.^[3], 21 out of 23 (91.3%) cases of sciatic neurinomas examined complained of pain in the sciatic territory. These data are consistent with those in our population since each of our eight patients had sciatic pain at the moment of their hospitalization.

Furthermore, pain was the most common symptom of the outbreak, the first sign of disease in 5 of our 8 cases (62.5%). In light of our data, despite their rarity, sciatic schwannomas should be considered in the differential diagnosis for patients presenting with sciatica. In particular, the chances of facing a peripheral schwannoma are higher when pain in the sciatic territory is associated with the recognition of a palpable swelling through the course of the ischiatic nerve, especially if it is painful under pressure. In the same review by Telera et al.^[3], 14 cases had a palpable lesion once the diagnosis was made, twice the number (7) of those who did not report any localized swelling. In the same review, the Hoffmann-Tinel sign was positive in 16 cases, whereas only six did not feel pain during deep palpation of the mass. In our case series, all our patients had a palpable mass in their ischiatic region or thigh. Tinel sign was strongly positive in 7 cases (87.5%) and slightly positive in the remaining cases (12.5%). Our findings corroborate the importance of a palpable mass and a positive Hoffmann-Tinel sign in orienting the diagnosis toward a peripheral schwannoma. Therefore, in light of our experience and recent literature, cases that do not suffer from a lumbar disk herniation and develop symptoms attributable to an injury of the sciatic nerve should be subjected to a careful clinical examination, including deep palpation through the course of the sciatic nerve.^[3,7,11-17] In particular, if a solid mass is found during the process, the Tinel test should be undertaken to support the clinical suspicion of sciatic nerve schwannoma.^[20]

An early diagnosis is mandatory to reduce the tumor's volumetric increase and thereby limit its clinical presentation.^[21,22] Ultrasound is often the initial imaging modality for these patients. The examination can detect schwannomas as homogeneous hypoechogenic round masses in direct contact with the sciatic nerve. An MRI should be performed later to confirm the appearance. Schwannomas are supposed to present as well-defined, fusiform, or round masses, intense in T2 sequences, attached to the nerve.^[23,24]

In our population, the diagnostic interval was strictly correlated with tumor size ($p=0.005$). The greater diameter of the mass was also associated with patients' preoperative

functionality, as assessed by both MSTS and LEFS scores ($p<0.001$). Our data support the idea that the bigger the tumor gets, the more pressure it exerts on the sciatic nerve itself and the nearby soft tissues, causing progressive functional impairment of the affected lower limb, as had already been reported in the literature for schwannomas arising distally to the sciatic fork.^[21,22]

Our outcomes suggest the existence of a common thread connecting the diagnostic interval, tumor size, and preoperative functionality of cases. This link is supported not only by statistical analysis but also by a direct correlation between the start and end of the thread: diagnostic delay and functional status ($p=0.016$).

Once diagnosis has been established, surgery represents the only reliable approach for symptomatic sciatic schwannomas.

The identification of the mass under ultrasound guidance before skin incision increases surgeons' precision, limits surgical exposure, prevents damage to healthy tissues, and shortens surgical time.^[21,22,24] Intraoperatively, palpation is crucial to locate the schwannoma, a mobile, solid, elastic, round mass. Surgeons should identify, isolate, and protect the nerve in its continuity. Electrophysiological monitoring has also been proposed as a tool to assess the conditions and the performance of the treated nerve.^[25] Although it was not investigated in our cohort of sciatic schwannomas, the introduction of such a technique could improve treatment quality and increase surgeons' awareness of potential nerve damage during and after surgery.

The absence of major postoperative complications supports the reliability and safety of surgical enucleation of sciatic nerve schwannomas, particularly when performed by expert surgeons in a highly specialized center. Muscular strength and sensitivity status improved in each case with preoperative defects, and postoperative functionality increased significantly after surgery in our population ($p<0.001$). All our cases underwent a total or subtotal restoration of their lower limb functionality, allowing them to return to their activities of daily living.

We are aware that our study is not free of limitations. The rarity of these tumors impeded our ability to operate in a broader population, partially limiting the statistical significance of some of our data. The retrospective nature of our study represents another limitation, as it hindered the complete standardization of postoperative follow-up procedures.

Beyond these limits, our experience may help expand the knowledge on topics like schwannomas of the sciatic nerve, which have been poorly described in previous literature due to the absence of larger cohorts.

Conclusion

Sciatic neurinomas can present with various combinations of localized swelling, neurological deficits, and primarily pain, which can result in significant functional impairment

of the affected lower limb. An early diagnosis is mandatory to allow for a fast intervention before the tumor enlarges and patients' clinical conditions worsen. Surgical excision performed with enucleation can be a viable therapeutic option to reduce neurological motor and sensory deficits.

Ethical Approval

Not applicable. This present study was conducted in full compliance with the ethical standards outlined in the 1964 Declaration of Helsinki and its subsequent amendments.

Ethical statements

The authors declared that no clinical trials were used in the present study.

The authors declared that no experiments on humans or human tissues were performed for the present study.

The authors declared that all patients gave their written informed consent before being included in the study.

The authors declared that no experiments on animals were performed for the present study.

The authors declared that no commercially available immortalized human and animal cell lines were used in the present study.

Conflict of interest

The authors have declared that no competing interests exist.

Use of AI

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Author contributions

All authors have contributed equally.

Data availability

All data used are referenced or included in the article.

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