ORIGINAL ARTICLE

Acta Orthop Traumatol Turc 2015;49(2):139-143
doi: 10.3944/AOTT.2015.14.0119

Surgical excision of peripheral nerve schwannomas: analysis of 11 patients

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Objective: Benign schwannomas are the most common tumour of the peripheral nerves. Symptomatic schwannomas are treated by surgical excision, but new neurological deficits may develop. We performed a retrospective review of cases of schwannomas in the extremities and reviewed the relevant literature.

Methods: We retrospectively reviewed the demographic characteristics of 11 patients with schwannomas treated at our institution. We also reviewed the clinical characteristics and postoperative results of these cases, determined the possible risk factors influencing the development of complications and compared the risk factors with those reported in the literature.

Results: There were five males and six females with a mean age of 37.6 (range: 17–62) years. The mean postoperative follow-up was 54.6 (range: 26–88) months. Three tumours were located in the forearm and the rest were localized in the lower extremity. No recurrences were observed during the follow-up period. New motor and sensory deficits were observed in only one patient.

Conclusion: Schwannomas in the extremities can be excised with acceptable risk of neurological deficits. Meticulous dissection is required during surgery.

Keywords: Neurilemmoma; neuroma; perineural fibroblastoma; peripheral nerve; schwannoma.

Peripheral neural sheath tumours are very rare, and schwannomas, which are also known as neurilemmomas, neuromas and perineural fibroblastomas, are the most common type. In 1910, Verocay named such tumours 'neuromas' and postulated they should be histologically distinguished from neurofibromas.[1] Verocay was also the first to state the widely acknowledged theory that neuromas arise from Schwann cells.[1] Most of these tumours are incidentally diagnosed as slow-growing solitary tumours in middle-aged patients, and there is no sex predilection. Malignant transformation of schwannomas is rare.[2,3] These tumors most commonly occur in the head and neck and involve the brachial plexus and spinal nerves; the extremities are affected less often.[4] Most peripheral schwannomas can be resected with minimal or no postoperative neurological deficits. However, the surgeon must anticipate and discuss with the patient the possibility that new neurological deficits could develop.

The aim of the present study was to establish the clinical characteristics of schwannoma cases, including the incidence of preoperative symptoms, incidence of postoperative neurological deficits, tumour size, dura-

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Submitted: March 24, 2014 **Accepted:** October 08, 2014

Available online at
www.aott.org.tr
doi: 10.3944/AOTT.2015.14.0119
QR (Quick Response) Code

tion of symptoms, histopathological classification and location of the tumour.

Patients and methods

We retrospectively reviewed the data of 11 patients who underwent surgical excisions of peripheral nerve schwannomas at our institution between 1998 and 2008. We included only histopathologically confirmed schwannomas of the major peripheral and cutaneous nerves of the extremities. Intramuscular, plexiform, brachial plexus and spinal nerve schwannomas were excluded from the study. The schwannomas were diagnosed clinically as a tumour in the line of a nerve, accompanied by a positive Tinel's sign or by sensory disturbance in the distribution of the nerve.

Magnetic resonance imaging (MRI) was performed preoperatively in all patients to determine the size, limits and anatomical location of the tumours. In most cases, MRI showed a well-defined tumour with contrast enhancement. We did not routinely perform biopsy because of the risk of iatrogenic neurological injury.

All tumours were excised by using microsurgical techniques under microscopic magnification. We carefully made a longitudinal incision in the epineurium until the shiny surface of the tumour was exposed. Then, we performed extra-capsular dissection after retracting the nerve fibres that surrounded the tumour. Clinical follow-up was performed at the following time points: the first postoperative day; 1, 3, 6 and 12 months after the surgery; and every subsequent year after surgery.

The study conformed to the Turkish national recommendations of the ethics committees for human clinical research and complied with the 1975 Declaration of Helsinki as revised in 2000. The protocol for this retrospective study was approved by the Ethics Committee of Erciyes University Medical Faculty, Kayseri/Turkey (2014/130), and informed consent was obtained from all patients.

Results

The study population included five males and six females with a mean age of 37.6 (range: 17–62) years. The mean postoperative follow-up duration was 54.6 (range: 26–88) months. The shortest and longest durations of symptoms were 8 and 60 months, respectively (mean, 18 months) (Table 1).

Three tumours were located in the forearm

Table 1. Patient demographic data and clinical results of 11 patients surgically treated for peripheral nerve schwannomas.

Case (n)	Age	Sex	History of Symptoms (Months)	Preoperative symptoms		Site (Nerve)	Size (cm)	Histopathological type (Antoni pattern)	Postoperative symptoms		Follow-up (Months)
				Pain	Neurological symptoms				Pain	Neurological symptoms	
1	34	Male	12	x	Sensory	N. radialis ramus profundus	12×8×4	A	Pain Free	Full Recovery	38
2	29	Female	15	x	Sensory	N. ischiadicus	14×8×5	A	Increased	Full Recovery	60
3	30	Female	9	x		N. ischiadicus	9×5×3	A+B	Pain Free		42
4	62	Female	8	x		N. ulnaris	9×3×2	A+B	Pain Free		26
5	46	Female	54		Sensory	N. radialis ramus superficialis	6×5×4	A		Full Recovery	68
6	56	Male	8	x		N. tibialis	5×3×2	B	Pain Free		75
7	28	Male	18	x	Sensory	N. peroneus communis	6×5×4	A	Pain Free	Full Recovery	29
8	17	Female	9	x		N. peroneus fibularis	5×2×2	A	Increased	New Deficit	35
9	22	Male	21	x		N. tibialis	6×5×2	A	Pain Free		66
10	29	Female	28	x	Sensory	N. tibialis	10×8×4	B	Pain Free	Full Recovery	74
11	31	Male	32		Sensory	N. tibialis	8×6×4	B		Increased	88

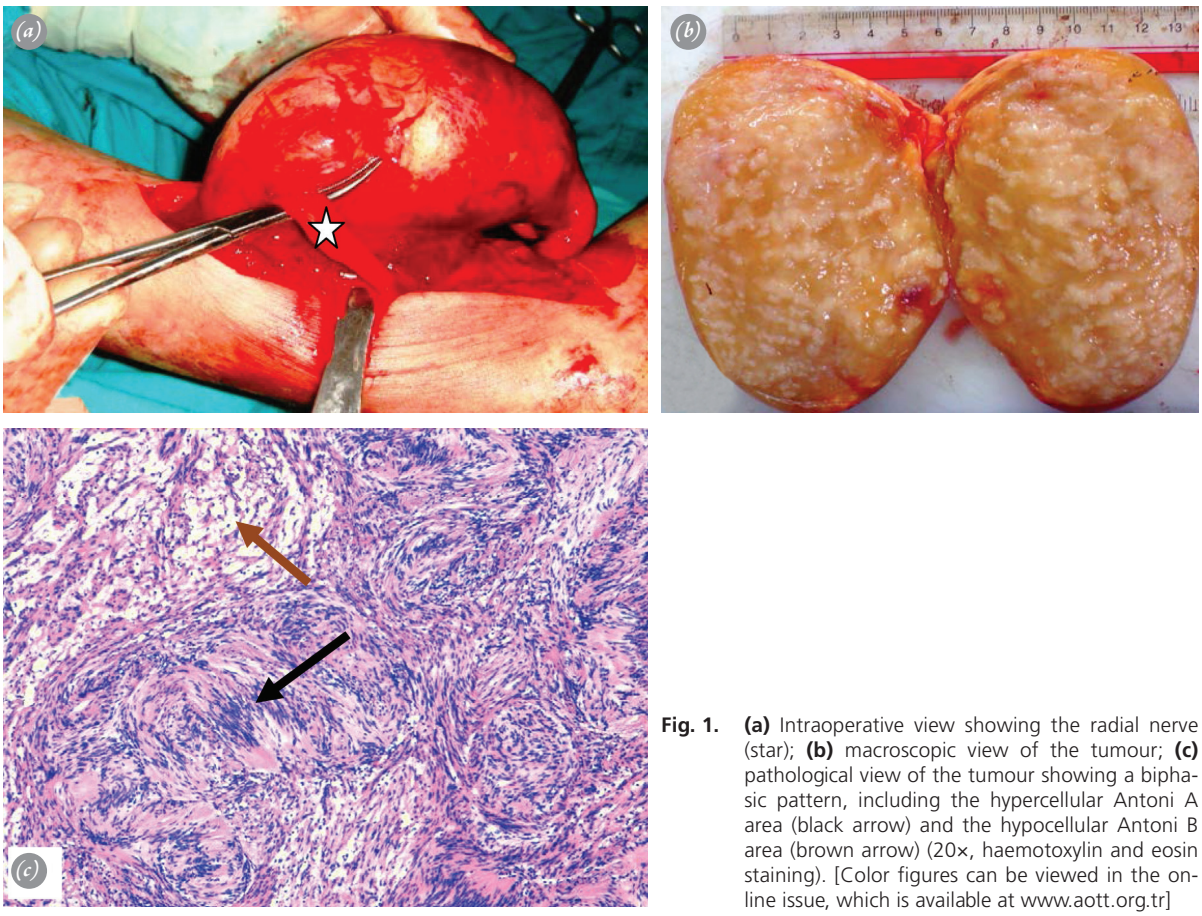

Fig. 1. **(a)** Intraoperative view showing the radial nerve (star); **(b)** macroscopic view of the tumour; **(c)** pathological view of the tumour showing a biphasic pattern, including the hypercellular Antoni A area (black arrow) and the hypocellular Antoni B area (brown arrow) (20×, haemotoxylin and eosin staining). [Color figures can be viewed in the online issue, which is available at www.aott.org.tr]

(Fig. 1) and the rest were localized in the lower extremity (Fig. 2). The smallest tumour was 5 × 2 × 2 cm and the largest was 14 × 8 × 5 cm. The largest tumours were found in the proximal segments of the sciatic nerve. All patients had recognized a growing tumour before presentation (Table 1).

In all patients, the diagnosis of benign schwannoma was histopathologically confirmed by excisional biopsies. The most frequent schwannoma type was Antoni Ain six patients, followed by Antoni B in three patients. In two patients, a mixed type (Antoni A & B) tumours were observed (Fig. 1) (Table 1).

Preoperatively, pain was present in nine (82%) of the 11 patients. Seven (78%) patients became pain free after surgery; in contrast, pain increased postoperatively in the other two (22%) patients. Six (55%) of the 11 patients were detected to have sensory deficits. Postoperatively, the sensory deficits of five (83%) patients showed full recovery, and the deficits worsened in only one (17%) patient. New and persistent motor and sensory deficit developed in only one (9%) patient after surgery. No recurrences were observed during the follow-up period (Table 1).

Discussion

Peripheral nerve schwannomas are usually encountered in early or middle adulthood, and there is no apparent sex predilection.[5] Persistent postoperative neurological deficits have been reported in some patients who have undergone schwannoma excision.[6] However, the clinical course of excision and risk factors associated with postoperative neurological deficits are not well known. Complete excision of the tumour can lead to some damage to the parent nerve because the fascicles are embedded in the tumour. Even if schwannomas are meticulously dissected from the involved nerve under magnification, neurological deficits may occur. In our study, six patients were detected to have sensory deficits at the preoperative examination. Postoperatively, sensory deficits disappeared in five patients and improved in one patient. New sensory and motor deficit developed in one (9%) patient. If meticulous dissection is not performed, multiple neurological deficits can occur postoperatively. Oberle et al.[7] reported immediate postoperative sensory deficits in six (50%) of 12 patients. Donner et al.[5] also reported that 13% of the 85 patients with schwannomas in their

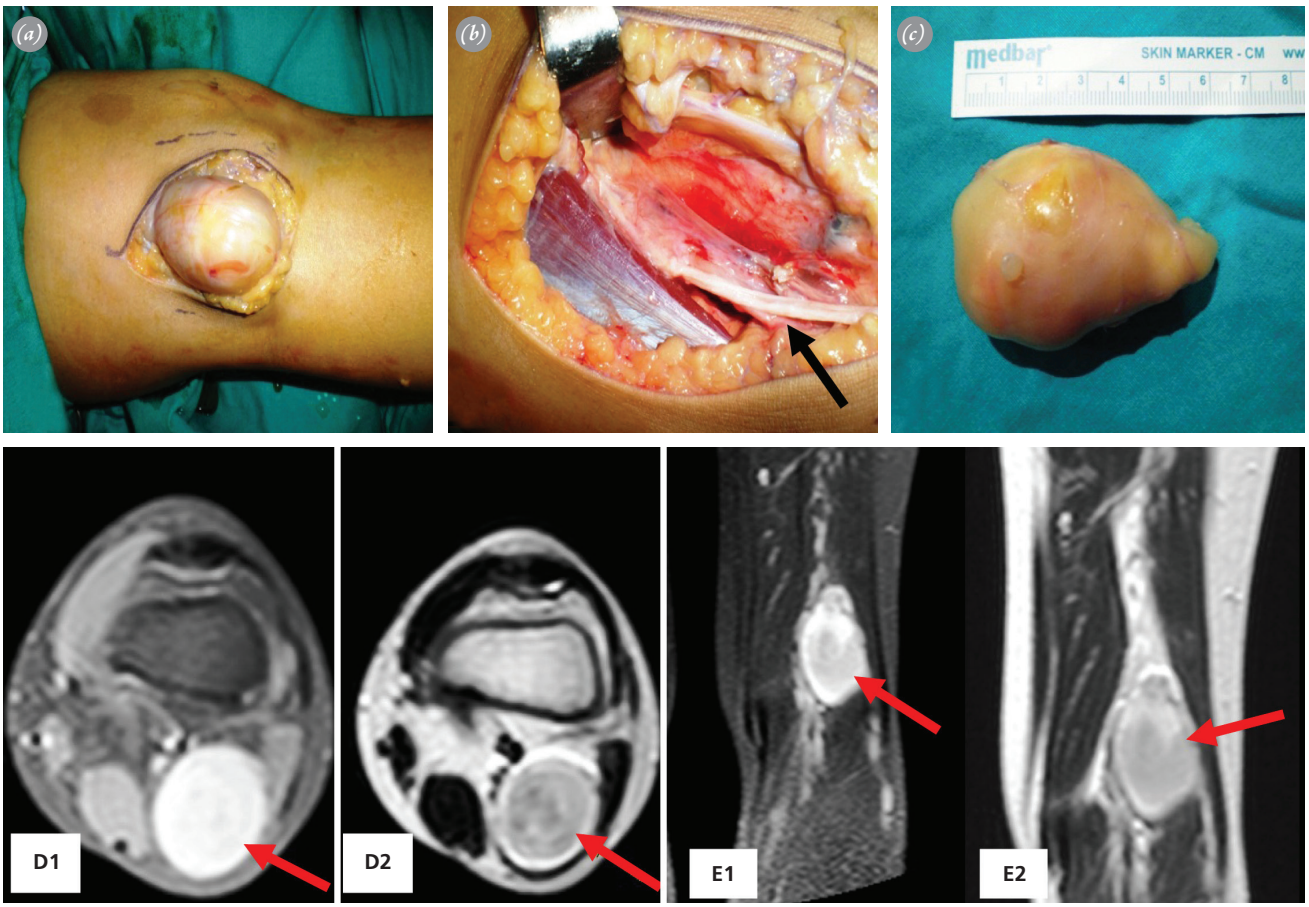

Fig. 2. **(a, b)** Intraoperative view of case 7; **(b)** the common peroneal nerve is shown by the arrow; **(c)** postoperative view of the tumour; MRI showing axial T1-weighted (D1) and T2-weighted (D2) views with the lesion marked via the arrow; sagittal T1-weighted (E1) and T2-weighted (E2) views, with the lesion marked via the arrow. [Color figures can be viewed in the online issue, which is available at www.aott.org.tr]

study developed muscle weakness after surgery. Kang et al.[2] reported that neurological deficits were observed in two of 13 patients with schwannomas in the major nerves of the upper extremity, but the deficits had improved by the last follow-up. These authors concluded that symptoms of iatrogenic neurological deficit persist. In our study, preoperative neurological deficits were easily rectified surgically, but iatrogenic neurological deficits did not disappear as readily as a new deficit. The single patient (out of 11) who developed a postoperative surgery-related neurological deficit showed improvement of the deficit to mild hypoaesthesia; however, the symptoms persisted until the last follow-up and adversely affected the patient's activities of daily living. Oberle et al.[7] and Kim et al.[8] suggested that disease duration and tumour diameter are associated with the occurrence of symptoms. However, in our study, there was no relationship between disease duration or tumour diameter and the occurrence of neurological deficits.

Percutaneous fine-needle biopsy sampling should not be part of the workup of a suspected schwannoma because of the risk of neurological deficits. Levi et al.[9] reported that neurological deficits were significantly more frequently observed in patients who had undergone a preoperative biopsy (12 of 29 patients) than in those who had not (10 of 58), and they suggested that preoperative fine-needle biopsy causes neurological deficits. For this reason, percutaneous biopsy was not performed preoperatively in our study. In most cases, peripheral nerve schwannomas can easily be detected by palpation alone. The tumour can easily be mobilized from side to side but not along the axis of the located extremity.[10] In our study, all patients had recognized a growing tumour before presentation. In addition, the Tinel's sign is characteristically positive over the tumour and shows a significant correlation with neurological complications.[11] In addition, in our study the Tinel's sign was positive in all patients. MRI is the preferred imaging technique for confirming the clinical diagnosis of schwannomas except in cases of very distally located tumours in which the di-

agnosis is quite obvious.[12,13] MRI is capable of revealing the details of these tumours, their capsules and the nerve from which the tumours arise. Contrast enhancement is usually strong at the centre of the lesion (Fig. 2). This central enhancement seems to represent the presence of hypercellular Antoni A type cells in the central part of the tumour and a hypocellular Antoni B type cells in the periphery.[14,15] In our study, histopathological analysis identified Antoni A type in six patients, Antoni B type in three patients and a mixture of Antoni A and B cells in two patients.

In the literature, there is debate about the incidence of spontaneous pain with schwannomas. Reported incidences range from 0%–100%.[5,10,14,16,17] In our study, pain was present in nine (82%) of 11 patients preoperatively. Seven (78%) patients became pain free after surgery; the other two (22%) had worsened pain postoperatively. In the series of Donner et al.,[5] only 24 (32%) of 76 patients suffered from pain, and 88% had partial or complete resolution of pain syndromes. Recurrences of schwannomas after complete resection is extremely rare (1%).[18] In the present study, recurrences were not observed in the follow-up period.

There were some limitations in our study. This was a retrospective study of peripheral nerve schwannoma excisions performed at different times by two different surgeons. The fact that there were two surgeons may have affected the complication rate. In addition, the number of patients was small because peripheral nerve schwannomas occur very rarely and this was a single-institution study.

This retrospective study should alert surgeons to the possibility of new neurological deficits after surgical treatment of peripheral nerve schwannomas. Patients with this condition should be preoperatively informed of potential neurological problems. Meticulous attention to detail is required to avoid a higher risk of fascicular injury during dissection.

Conflics of Interest: No conflicts declared.

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