

Sciatic Notch Dumbbell Tumor Resection: A Surgical Technique and Report of Two Cases

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ABSTRACT

Intrapelvic and extrapelvic sciatic notch dumbbell tumors (SNDTs) are rare soft-tissue tumors that are difficult to remove. This study aimed to report the surgical technique and evaluate the clinical findings of SNDTs. We performed a retrospective review of the clinical outcomes and primary features of two consecutive cases of SNDTs. Both patients with SNDTs had different clinical presentations and prognoses and underwent surgeries with the same technique. We performed complete surgical resection of the tumor in one patient with greater trochanteric osteotomy and pelvic osteotomy in both patients. We achieved satisfactory results in both cases by implementing the utilitarian approach and pelvic osteotomy through the greater sciatic notch to surgically resect the tumors. This technique was chosen to provide a maximum benefit to the patients.

Keywords: Dumbbell tumors, pelvic osteotomy, sarcoma, sciatic notch, surgical technique

INTRODUCTION

Intrapelvic and extrapelvic sciatic notch dumbbell-shaped tumors (SNDTs) are rare soft-tissue tumors and may trigger classic sciatica through invasion of the sciatic nerve, sacral plexus, and/or the sacrum. SNDTs pass through the sciatic notch and form a dumbbell shape, resulting in symptoms linked to the compression of nearby structures. SNDTs can be malignant or benign,^[1] and they clinically present as space-occupying lesions characterized by sciatica, radiculopathy, progressive indolent weakness and sensory loss, pain at the tumor site, or general back pain.^[2,3]

Because SNDTs are rare tumors, and due to scarce of reported clinical information in the studies, the SNDT incidence remains unknown.^[1,4-6] Hence, many orthopedic and spinal surgeons have inadequate experience with sciatica caused by misdiagnosed SNDTs.^[7] However, very few studies on SNDTs have been performed to date.^[6] It is important to consider the serious differential diagnosis in patients who present with unilateral sciatica with suspicion of pelvic pathology; magnetic resonance imaging (MRI) or computed tomography (CT) should be used to confirm the diagnosis of SNDT.^[2] This study

aimed to report the surgical technique and evaluate the clinical findings of two cases who presented with SNDTs.

CASE REPORTS

Case 1

A 56-year-old woman not known to have medical conditions before presented to us with pain in the right hip and a tingling sensation in the right lower limb; she used a walking aid. A part of her imaging, pelvic MRI, showed a lesion in the right gluteal region, which was described as a dumbbell-shaped mass measuring 16 cm × 13 cm × 12 cm. Her MRI revealed cystic and solid components extending to the pelvis through the right sciatic notch. Therefore, a core-needle biopsy was performed

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by a musculoskeletal interventional radiologist, which was done using an anterior ilioinguinal approach through the inner wall of the pelvis direct to the tumor after the discussion with the orthopedic oncologist. The biopsy results revealed a high-grade undifferentiated spindle cell sarcoma.

Following diagnosis, the patient's functional status rapidly declined. She was confined to a chair and experienced progressive unilateral lower-limb muscle atrophy and foot drop secondary to sciatic nerve palsy. The plan was to start neoadjuvant radiation therapy and then to be followed with surgical resection as per the discussion during a tumor board meeting, which determined the best course of action for treating her from the tumor, as she was not having a metastatic disease.

On completion of the 25 fractionated of 50 Gy, re-evaluation of the mass by MRI shows a regression of the mass to 9.5 cm × 5.5 cm [Figure 1a]. Hence, the patient was prepared for surgery in the form of wide margin resection after 6 weeks postradiation.

Surgical technique

The patient was placed in a right lateral position; the bony prominences of her right hip were well padded and protected. An incision was made using the utilitarian approach (or extensive ilioinguinal approach), extending from the pubic tubercle along the inguinal ligament to the anterior superior iliac spine, and along the iliac crest to the posterior superior iliac spine.

Due to the tumor position, we performed a greater trochanteric osteotomy to mobilize and prevent damage to the abductor muscles. After that, we exposed the iliac crest by performing a greater sciatic notch osteotomy, which allowed an *en bloc* tumor excision in the gluteal area and the pelvis. This technique facilitates tumor release and prevents further spreading of the tumor. We performed a subtle dissection of the sciatic nerve, which was heavily compressed against the tumor. The tumor was excised with a wide margin over a fixed structure (sciatic nerve) [Figure 1b and c]. Finally, we fixed the iliac bone osteotomy using a compression plate with two cannulated screws and fixed the greater trochanteric osteotomy using tension bands. The pathological analysis confirmed the diagnosis of a high-grade undifferentiated spindle cell sarcoma with free margins of the intrapelvic mass.

Two weeks postoperation, the patient had small dehiscence at the edge of the incision, which was expected after radiation and a T-incision. The wound healed completely after wet-to-dry, and incisional vacuum-assisted closure wound dressing protocols were administered.

Upon discharge, the patient was informed about nonweight-bearing for at least 6 weeks [Figure 1d]. She was fitted with an ankle-foot orthosis for her foot drop and was mobilized using walking aids. The patient was managed later with physiotherapy and occupational therapy. Four weeks postoperatively, the patient began to improve and experience weak dorsiflexion, 2/5 in muscle power scale, and after

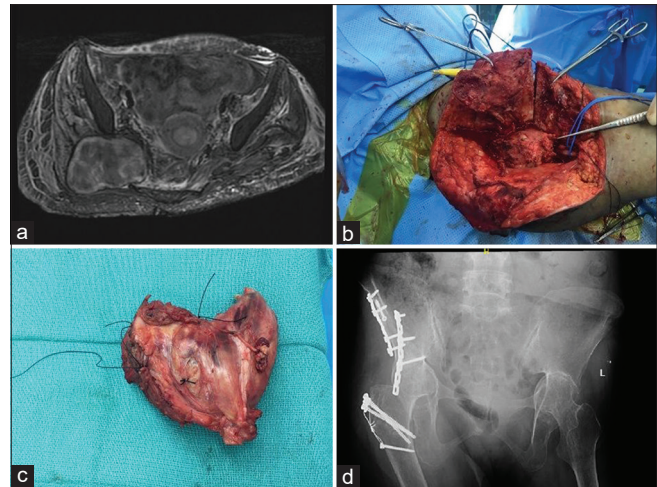


Figure 1: (a) Axial magnetic resonance imaging of the pelvis showed a lesion in the right gluteal region extending to the sciatic foramen, pushing the internal organs into the left side. (b) The utilitarian approach and pelvic osteotomy expose the tumor; the arrow shows the dissected sciatic nerve. (c) The resected tumor, the long suture shows the lateral border, and the short shows the superior border. (d) Postoperative anteroposterior pelvic radiograph of the pelvis shows the two osteotomies

8 weeks, she got better muscle power and better recovery (3/5). Apart from her routine follow-up after 3 months, then in 6 months, her surveillance for recurrence and metastasis was evaluated and was negative.

Case 2

Five years ago, a 49-year-old female presented with a vaginal cervix mass to the gynecology clinic, and she received chemotherapy and radiation at that time.

After 2 years, she was referred to the orthopedic oncology clinic by her gynecologist after she presented with a new pelvic mass within the greater sciatic notch and was complaining of sciatica symptoms, right lower-limb weakness, foot drop, and radiculopathy in her right lower limb.

Staging by abdominal and pelvic CT scans was performed and revealed small lung nodules and a stable right gluteal mass lesion. The patient was evaluated after MRI, which revealed a dumbbell-shaped soft-tissue lesion in the right gluteal region. The tumor extended from the intrapelvic ring, through the sciatic notch, and into the buttock (gluteus medius and minimus) [Figure 2a]. In this case, the core-needle biopsy approached laterally through the gluteus medius and minimus due to extension of the tumor to these muscles, as these muscles were planned to be resected. The biopsy was also performed by a musculoskeletal interventional radiologist after a discussion with the orthopedic oncologist. It revealed a high-grade radiation-induced rhabdomyosarcoma with extraskeletal osteosarcomatous differentiation after radiation treatment to her cervix cancer.

The tumor board decided that mass resection should be performed after completing three cycles of chemotherapy because the lung nodule was small (<5 mm) and considered

nonspecific for metastasis. Treating the patient was chosen over palliative care to improve her quality of life. In this case and with proper evaluation of the tumor by MRI, the tumor was attached by the neurovascular bundle but not encased by the tumor. A marginal margin resection was planned due to the extended mass and its attachment to the neurovascular structure (sciatic nerve and gluteal vessel). In such a tumor, a resection that includes epineurium is considered a wide margin.

As Clarkson *et al.* assert, the local and systematic recurrence rates are similar when epineural dissection is performed for soft-tissue sarcoma to preserve the sciatic nerve. They also stated that the epineural dissection of the sciatic nerve will not affect the disease recurrence if combined with adjuvant radiation therapy.

They find that this combination will result in satisfactory functional outcomes, equivalent to results in those patients who did not require epineural dissection, and it has even superior impairment scores compared with patients who require complete nerve resection. They reached a conclusion that “resection of the sciatic nerve should be reserved for patients in whom the nerve is entirely encased within the macroscopic mass of the tumor.”^[8]

A preoperative assessment showed muscle atrophy, a severe weakening of the right lower limb, and loss of sensation. The tumor involved the entire gluteus medius and minimus.

Surgical technique

The patient was placed in a lazy lateral position, which allowed access to the posterior and anterior anatomy of the patient. Applying the same utilitarian approach as used in Case 1, we identified the sciatic nerve and observed that the

tumor involved both the gluteus medius and the minimus, as the preoperative MRI template indicated, which is why these muscles were resected.

Pelvic osteotomy (through the sciatic notch from posterior to anterior) was performed to relieve pressure on the sciatic nerve and vessels and move the tumor away from the notch. We then began subtle dissection, marking the tumor borders with surrounding structures. The tumor was completely resected and measured 12 cm × 11 cm × 6 cm, with a portion of the gluteal medius and minimus covering the tumor; it was then sent for pathological testing [Figure 2b and c].

Two reconstruct locking plates were used for the fixation of the pelvic osteotomy and reconstruction, which included inserting the resected muscle portions (gluteal medius and minimus) using a Trevira attachment tube. The Trevira attachment tube was secured to the iliac crest and the gluteus medius and minimus, restoring the stability of the right hip. The patient remained hospitalized for 2 weeks postoperation for proper rehabilitation, during which time she experienced gradual recovery of the sciatic nerve [Figure 2d].

The postradiation pathological report revealed a radiation-induced sarcoma, with 60% of the tumor being necrotic. After 4 months, her chest CT showed new nodules and was transferred to the palliative care center.

DISCUSSION

SDNTs are rare, which makes it challenging as no standardized treatment approach has been established. Instead, the surgical technique depends on the tumor type, malignancy, extent of surrounding tissue invasion, and the surgeons' experience and

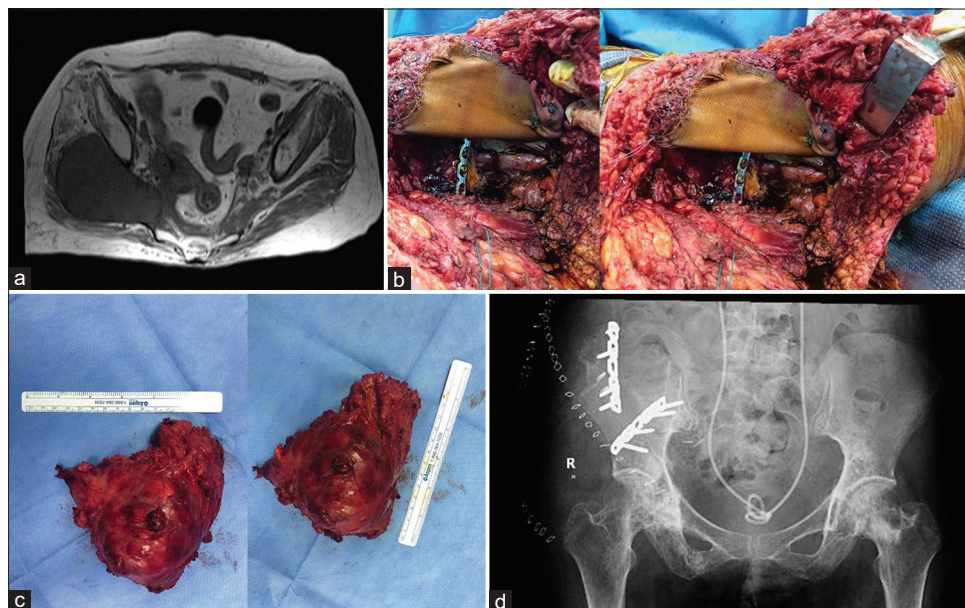


Figure 2: (a) Axial magnetic resonance imaging of the pelvis showed a lesion in the right sciatic notch extending to the gluteal area. (b) Utilitarian pelvic approach for SNDT after resecting the gluteal medius and minimus muscles; the arrow shows the Trevira attachment tube attached to the iliac crest and greater trochanter. (c) The resected tumor. (d) Postoperative anteroposterior pelvic radiograph shows surgical clips at the right gluteal region. Postfixation of the right iliac bone by plate and screws with bilateral double-J ureteral catheters

preference. Consequently, multiple treatment approaches have been described in the literature.

Resecting dumbbell-shaped tumors is challenging, particularly when the sciatic notch is penetrated, given their anatomical nature and proximity to vital structures such as the femoral neurovascular bundle, sciatic nerve, gluteal artery, and abdominal viscera. The utilitarian approach was first mentioned by Enneking and Dunham^[9] and is a novel approach in pelvic tumor resection. This extended ilioinguinal approach extends from the pubic tubercle along the inguinal ligament to the anterior superior iliac spine and along the iliac crest to the posterior superior iliac spine.

In both cases we described, the tumor location mandated us to perform the resection utilizing the anterior approach.^[9] The first case showed satisfactory results with negative margins, but the second case had controlled positive margins at the site of the sciatic nerve course against a fixed structure, which was not surprising due to the large tumor size.

From the literature review, the biology of each tumor behaves differently and that would change the ultimate oncology outcome for the patient. O'Donnel showed that resection of sarcoma around or abutting neurovascular bundle is relatively equal to the wide margin in terms of local recurrence. However, it carries worse cause-specific survival in terms of neurovascular injury and functional outcome.^[10]

Another surgical approach is the transabdominal approach, in which an assistant surgeon pushes the tumor into the pelvic area to easily visualize and resect it. This method is adequate in benign tumors, such as lipomas, but would not be appropriate for malignant tumors due to the risk of seeding or contaminating the abdominal contents.^[4]

Li *et al.* proposed using a combined anteroposterior approach after studying several techniques in a cohort of 50 patients.^[11] In this approach, the patient is placed in a lateral position, and the anterior lower abdomen lateral oblique approach is used to open the retroperitoneal space and identify the vital structures and anterior tumors. This is followed by a posterior lateral approach to fully reveal the tumor and expose the greater sciatic foramen and sciatic nerve.^[12]

Inadequate margins are an adverse and independent prognostic factor in the local pelvic recurrence of sarcomas.^[11] Tumor location is a very important factor in tumor resectability; *en bloc* SNT resections are not feasible due to the anatomical complexity of the surrounding organs. To achieve a wide surgical margin in the pelvis is difficult and remains controversial about achieving the proper definition of wide margins. As there are multiple classifications for the margin, the most utilized classification is the R classification by the Toronto group. They stated that patients with <1 mm of normal tissue microscopically from margin to tumor did not have an increased risk of local recurrence.^[13]

A recent report has suggested a safe resection technique involving the combination of a one-stage transabdominal and transluteal approach.^[3]

This study was limited because navigation-aided technology for pelvic tumor resection was not available in our hospital at that time. Morris *et al.* show that navigation systems are more beneficial in achieving more accurate resection, limb reconstruction, and limb salvage. They reached the conclusion that the system can help in optimal surgical margins and improve recurrence rate, decrease in usable time, beneficial in complex pelvic, and more exact tumor resection and allograft implantation.

On the other hand, the hindrances of navigation framework are the cost of hardware, increase of arrangement time, and learning curve.^[14]

CONCLUSION

In the two cases, we reported that the results were satisfactory and were achieved by implementing the utilitarian approach and pelvic osteotomy through the greater sciatic notch, which helps in achieving healing of the osteotomy postoperation and in tumor resection in such anatomical area even after local radiation.

Recommendations

We recommend the use of the utilitarian approach and pelvic osteotomy through the greater sciatic notch, which helps in achieving healing of the osteotomy postoperation and in tumor resection in SNTs. We also recommend performing a nerve conduction study pre- and postoperation to monitor for all space-occupying lesions in cases such as SNTs for medicolegal documentation and assessment of outcome.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that names and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

Authors' contributions

WSA, AAA, and AHB conceived and designed the study, conducted research, provided research materials, and collected and organized data. WSA and AHB analyzed and interpreted data. AAA and AHB wrote the initial and final draft of the article and provided logistic support. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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