A Posttraumatic, Joint-connected Sural Intraneural Ganglion Cyst—With a New Mechanism of Intraneural Recurrence: A Case Report

Neal M. Blitz, DPM, FACFAS,1 James Prestridge, DPM,2 Kimberly K. Amrami, MD,3 and Robert J. Spinner, MD4

Intraneural ganglion cysts are rare in occurrence and most commonly involve the peroneal nerve at the fibular neck. We present a case of a traumatically induced intraneural ganglion cyst of the sural nerve that developed after a nondisplaced posterior malleolus ankle fracture. The intraneural ganglion cyst was connected to the subtalar joint by its articular branch and ascended several centimeters into the distal fourth of the leg. It was resected from the sural nerve proper and the posterior branch of the lateral calcaneal nerve, and the articular trunk was ligated. The patient developed subclinical intraneural recurrence, which was detected on a postoperative magnetic resonance imaging (MRI). Retrospective reinterpretation of the preoperative and postoperative MRIs revealed that ligation of the articular trunk proximal to a major branch (ie, the anterior branch of the lateral calcaneal nerve) led to increased intraneural cyst propagation distally: within the blind stump of the articular trunk and within several anterior branches of the lateral calcaneal nerve but not within the parent sural nerve or its continuation, the lateral dorsal cutaneous nerve. This mode of intraneural, but extraparental nerve recurrence can be easily understood by considering the altered fluid dynamics, particularly the increased resistance. This case report provides further evidence not only supporting the articular theory of intraneural ganglion formation but also highlighting the importance of searching for, identifying, and treating the pathologic articular branch connection near its joint connection in all cases. Level of Clinical Evidence: 4. (The Journal of Foot & Ankle Surgery 47(3):199–205, 2008)

Key words: ankle fracture, intraneural ganglion, sural nerve

Ganglion cysts occurring within the epineurium of a peripheral nerve are described as intraneural ganglia. They may result in pain, motor dysfunction, and sensory loss. Approximately 300 cases of intraneural ganglion cysts have been reported in a multitude of locations. The common peroneal nerve at the
Case Report

A 38-year-old man presented to the primary author (N.M.B.) complaining of an enlarging soft tissue mass that developed 3 weeks following a right ankle inversion injury. His symptoms included shocking sensations, numbness, and pain to the lateral aspect of the right foot. On physical examination, a 2.5 × 1.5-cm soft tissue mass was palpable posterior to the lateral malleolus at the level of the ankle joint. Numbness and allodynia were present in the lateral foot and percussion tenderness over the distal aspect of the sural nerve at the level of the ankle and just proximal to it produced radiating dysesthesias into the lateral portion of foot. The ankle was without effusion and pain free through range of motion.

Weightbearing radiographs of the right ankle demonstrated a small, nondisplaced posterior malleolar fracture involving less than 10% of the tibial plafond (Figure 1). The mortise was anatomic and without medial clear space widening and proximal leg films did not demonstrate a fibular shaft or Maisonneuve fracture. A soft tissue mass was evident that projected posterior to the distal fibula and anterior to the Achilles tendon just inferior to the ankle joint.

A magnetic resonance image (MRI) scan demonstrated an increased T2 signal intensity mass in the posterolateral aspect of the ankle intimately associated with the sural nerve—an intraneural ganglion. The intraneural ganglion extended in a tubular fashion within an articular branch from the posterior aspect of the subtalar joint (Figure 2, A). The intraneural ganglion cyst extended proximally above the subtalar joint to the distal fourth of the leg. Its maximal dimension was 1.2 × 1.4 cm at a point 1.5 cm above the subtalar joint (Figure 2, B). The appearance of the tapered joint connection with proximal expansion of the cyst was consistent with a “balloon sign” (14). The top of the balloon was 2.8 cm above the articular branch but a linear streak extended an additional 2.5 cm above that (total = 5.3 cm above the subtalar joint). A “signet ring” sign was present with eccentric displacement of the nerve fascicles at this level (Figure 2, C). Distinct intraneural cyst could be seen within the sural and the lateral calcaneal branches (Figure 2, D). Subtle evidence of descent within the anterior and posterior branches of the lateral calcaneal nerve and the sural nerve distal to the level of the articular branch (ie, the lateral dorsal cutaneous branch) (approximately 1.5 cm) was present (Figure 2, A and B). Capsular vessels between the intraneural ganglion and the ankle and subtalar joints were identified (Figure 2, E). In addition, the posterior talofibular ligament was disrupted and there was grade 2–3 chondromalacia of the tibiotalar joint.

Treatment of the posterior malleolus fracture involved weightbearing as tolerated in a removable cam walker. Surgery of the mass was performed 7 weeks after the injury (Figure 3, A). A curvilinear incision was made over the mass. The lesser saphenous vein was reflected anteriorly. A sural intraneural ganglion cyst was evident and the nerve fascicles of the sural nerve were displaced anteriorly (Figure 3, B). Using standard microsurgical techniques, cyst was resected from the sural nerve proper and the posterior branch of the lateral calcaneal branch (Figure 3, C). The articular trunk was identified and was deeply ligated with 3–0 absorbable suture and then transected. However, the articular branch was not resected from its joint of origin at the subtalar joint. The histological and immunohistochemical features of the intraneural ganglion cyst were confirmed (Figure 4, A and B).

The patient was kept non-weightbearing postoperatively until the first follow-up appointment at 2 weeks. At the initial postoperative visit, the patient reported the return of sensation to the distal lateral aspect of the foot. Examination revealed a deficit in light touch remained in the distribution of the lateral calcaneal nerve in addition to region of the incision. Over the postoperative course, some sensation was restored along the dorsolateral aspect of the foot and in the vicinity of the incision. Plain films and MRI documented incomplete union of the posterior malleolar fracture. At 2-year follow-up examination the patient was asymptomatic.

Postoperative MRI at that time demonstrated intraneural, but extraparental nerve, cyst recurrence. The subtalar...
joint connection persisted, increasing in prominence compared to the preoperative images (Figure 5, A–C). Cyst extended now only 1.1 cm above the subtalar joint, being truncated at the level of the ankle joint (Figure 5, A). The proximally directed balloon sign was not present on the postoperative MRI. Instead, the recurrent cyst extended from the subtalar joint along the articular branch, slightly superiorly into the articular trunk blind stump and then inferiorly 2.7 cm below the subtalar joint, reaching its maximal size (1.8 × 1.1 cm) at a point 1 cm below the subtalar joint. In contrast to the preoperative MRI, there was no cyst apparent proximal to the truncation point, either within the sural nerve proper or the posterior branch of the lateral calcaneal nerve. Distal cyst enlarged and became more prominent. The intraneural cysts were seen within the articular trunk blind stump (approximately 1 cm) as well as 3 anterior branches of the lateral calcaneal nerve resulting in 4 adjacent, distally directed inverted balloon signs (Figure 5, B). A signet ring sign could also be seen within the anterior branches
of the lateral calcaneal nerve demonstrating eccentric displacement of the individual nerves by the cysts (Figure 5, D).

Discussion

This case strengthens the argument for the articular theory. First, it provides clear evidence of a joint connection in an unusual location. Of the 4 previous cases of sural intraneural ganglia (6, 26–28), this is the second case in which a joint connection between the intraneural ganglion and a joint was identified. Pringle et al (26) also found a connection to the calcaneocuboid joint. As the sural nerve partially innervates both the subtalar and calcaneocuboid joints (as well as several other joints in the foot and ankle region) (29), it is logical that intraneural ganglia can originate from these joints.

Second, as has been shown previously, intraneural recurrence occurred because a neural pathway (ie, a patent articular branch–joint connection) persisted after surgery (1). In previously reported cases where decompression by itself was performed without articular branch disconnection, intraneural recurrence occurred predominantly in a proximal direction with more limited dissection distally. In this case, since ligation was performed within the proximal portion of the articular trunk (proximal to the take-off of the anterior branch of the lateral calcaneal nerve), cyst was present in the articular trunk blind stump and the posterior branches of the lateral calcaneal nerve, but not within the sural nerve itself (Figure 6). According to the unifying articular theory, intraneural cyst in the sural nerve would not be anticipated, and in fact would be prevented by such ligation (this absence of intraneural cyst in this location would provide additional evidence against de novo formation). Instead, a new pattern of intraneural recurrence was observed, one that could be easily understood based on the altered fluid dynamics. Because the joint connection to the subtalar joint is maintained (and the intraarticular pressures are presumably elevated), cyst propagation continues along the articular branch and articular trunk to the point of ligation; because of the increased resistance, the intraneural cyst then descends down the anterior branches of the lateral calcaneal nerve. The typical balloon-shaped proximal propagation pattern seen preoperatively is reversed postoperatively leading to an inverted balloon sign, where cyst becomes bigger distally because of the increased forces (“back pressures”) experienced due to the pathologic block proximally.

While it is possible that the ankle fracture and the subtalar joint-related intraneural cyst were detected coincidentally in this patient, we believe that trauma was a causative factor.
by 2 potential explanations: (1) there was concurrent
injury to the 2 neighboring joints; and (2) a communication
between the 2 joints, which is known to occur normally and
pathologically as seen on arthrography (30, 31), facilitated
the passage of fluid under increased intraarticular pressures
to pass from the ankle joint to the subtalar joint and prop-
agate through the latter’s articular branch.

This case report emphasizes the importance of knowing
about, searching for, identifying, and treating the pathologic
articular branch near its joint connection in all cases of
intraneural ganglia. While resection of the sural nerve can
be performed with acceptable morbidity, we currently
would recommend decompression of the intraneural cyst
through a small longitudinal epineurotomy (away from
nerve fascicles) combined with disconnection (transsection
and ligation) of the articular branch at the level of the joint.

FIGURE 5 Postoperative right ankle MRIs. (A) Sagittal T2-weighted image with fat suppression shows recurrent intraneural cyst (asterisk) now extending from the subtalar joint (large arrow) along the articular branch (small arrowhead) to its blind stump (+) in the articular trunk and then distally. When compared to the preoperative imaging there is a distinct truncation point (large arrowhead) with increased extent and prominence of cyst descent. The lesser saphenous vein (thin arrow) is seen due to flow-related enhancement on this sequence. (B) Sagittal T2-weighted image with fat suppression immediately lateral to Figure 5, A, shows ballooning cyst within the blind stump of the articular trunk (+) and the anterior branches of the lateral calcaneal nerve (asterisks) creating an “inverted balloon” sign due to increased proximal resistance related to the ligation of the nerve at initial surgery (arrow, lesser saphenous vein). (C) 3D MIP of a T2-weighted fast recovery FSE acquisition with fat suppression showing the truncation point proximal to the take-off of the articular branch (arrowhead) and anterior branch of the lateral calcaneal nerve (asterisk). The cyst within the blind stump of the articular trunk (+) and the individual anterior branches (asterisks) of the lateral calcaneal nerve is better demonstrated in Figure 4, B. The saphenous vein (arrow) is also seen. (D) Axial T1-weighted image showing intraneural cyst (signet ring sign) within the anterior branches of the lateral calcaneal branches with eccentric displacement of the individual nerve fascicles (arrows).
of origin. Based on this unified theory, we contend that disconnection of the articular branch near the joint of origin can eliminate intraneural recurrence rates. This case illustrates that ligature within the articular trunk protects intraneural recurrence from occurring in the primary “parent” nerve (ie, sural nerve) but does not prevent intraneural recurrence from occurring in distal branches arising from the articular branch (ie, anterior branches of the lateral calcaneal nerve in this case). In fact, in this example, prominent descent of intraneural cyst in these branches can occur from the increased resistance.

References


![FIGURE 6](image)

FIGURE 6 Drawing of the normal anatomy, pathoanatomy of the intraneural ganglion cyst initially and at follow-up. The proposed mechanism for the intraneural extraparental recurrence within the articular trunk blind stump and the anterior branches of the lateral calcaneal nerve is illustrated. (With permission of the Mayo Foundation for Medical Education and Research. All rights reserved.)