4. Peripheral Nerves

BOOK CHAPTER

Peripheral Nerves

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How to Image Nerves

• *Coils and patient position:* High-resolution images of the small peripheral nerves require the use of phased array surface coils. The large sciatic nerve can be evaluated without a surface coil, but better resolution is possible if surface coils are used. Positioning of the patient is determined by which nerve is being evaluated. Generally, the nerve can be imaged with the same surface coils, in the same position, and with the same field of view and section thickness as would be used for the nearby joint.

• *Image orientation:* If possible, images of nerves should be obtained in two orthogonal planes. Images obtained with the nerve in cross-section (perpendicular to the long axis of the

nerve) avoid partial volume averaging artifacts and allow for assessment of the size, configuration, signal intensity, and fascicular pattern of the nerve. Images that run parallel to the long axis of the nerve (in-plane or longitudinal images) are good for an overview of the course of the nerve and to detect displacement or enlargement; however, partial volume artifacts may complicate the interpretation of these images.

• *Pulse sequences:* T1-weighted (T1W) and some types of T2-weighted (T2W) fat-suppressed (T2 with fat suppression or short tau inversion recovery [STIR]) images are best to evaluate the peripheral nerves. T1W images show the anatomy adjacent to the nerve, and T2W sequences are good for showing pathology of the nerve and the fascicular pattern. Magnetic resonance (MR) neurography is a specialized technique for depicting the anatomy and course of a nerve, similar to how a vessel is displayed on an MR angiogram. The technique requires attention to certain technical details and sophisticated postprocessing of the imaging data. This technique is being adopted more widely, and a few references have been provided for the interested reader.

• *Contrast:* Contrast administration may be helpful for detecting abnormal nerve enhancement in equivocal cases and in determining whether a mass is cystic or solid.

Normal and Abnormal Background

Electrophysiologic studies are a widely used invasive technique for detecting a conduction abnormality in peripheral nerves. These tests are sensitive, but they lack specificity and cannot show anatomic detail that would delineate the precise location of an abnormality, which often affects treatment planning. The ability to noninvasively detect the presence and extent of a nerve abnormality is of great value for preoperative planning.

Magnetic resonance imaging (MRI) is the best imaging technique available at this time to evaluate peripheral nerves. Given its ability to directly display the anatomy and course of a nerve and any compressive lesion or other adjacent pathology, MRI has proved to be a useful, complementary adjunct to electromyography. Additionally, if a nerve is difficult to assess directly on a given scan, abnormal signal intensity within the muscles it supplies is important indirect evidence of nerve pathology.

Nerves are present on every MRI examination of an extremity, and it is important to be familiar with the normal and abnormal appearances of peripheral nerves in order to provide adequate differential diagnoses for the findings.

Normal Anatomy and MRI Appearance

The fundamental unit of a peripheral nerve is the axon, which may be either myelinated or unmyelinated, and which carries efferent (motor) or afferent (sensory) electrical impulses. Peripheral nerves have a mixture of myelinated and unmyelinated axons. A myelinated fiber exists when a single Schwann cell encases a single axon; unmyelinated fibers result if a single Schwann cell encases multiple axons. Layers of Schwann cells form the myelin sheaths.

Large peripheral nerves have three connective tissue sheaths that support and protect the axons and myelin sheaths (Fig. 4.1 (f0010)). The innermost sheath is the endoneurium, which invests each individual myelinated axon. Several axons, along with their Schwann cells and endoneurial sheaths, are bundled together into fascicles that are each wrapped in a dense sheath of perineurium, which serves as a protective barrier to infectious agents or toxins. The third layer is the epineurium, which surrounds the entire peripheral nerve and protects the axons during stretching forces on the nerve. The connective tissue sheaths cannot be detected with MRI; nerve fascicles are the smallest units of nerves that currently can be identified.

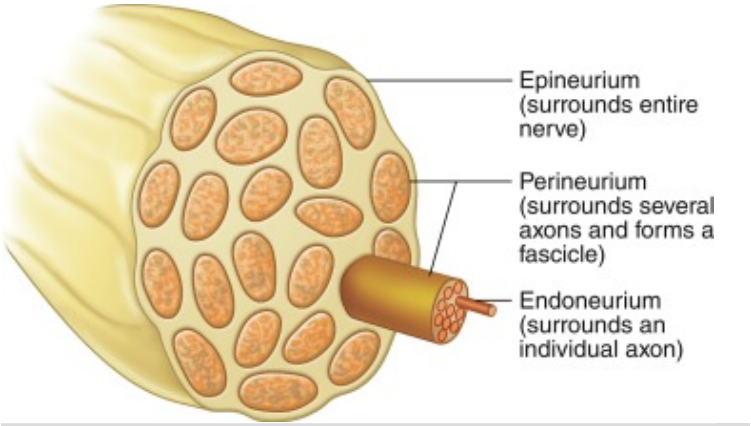


Fig. 4.1

Anatomy of a peripheral nerve. Fascicles are the smallest unit of a nerve visible on MRI. Fascicles are composed of several axons wrapped in a layer of perineurium. Several fascicles form a nerve, which is surrounded by a layer of epineurium. Individual axons are covered by endoneurium but are not visible on MRI.

Variable amounts of fat are present between fascicles, with more present in the nerves of the lower extremities than in the nerves of the upper extremities. Large peripheral nerves contain about 10

fascicles. Each fascicle is composed of motor, sensory, and sympathetic fibers.

MRI shows normal nerves as round or oval in cross-section (Fig. 4.2 (f0015)). The rodlike fascicles in the nerves are seen end on in transverse images as a stippled or honeycomb-like appearance, called a *fascicular pattern* . The fascicles are uniform in size and similar to, or slightly hyperintense to, muscle on T2W images. On T1W images, the fascicles are similar in signal intensity to muscle, with intervening areas of relatively high signal similar to fat (see Fig. 4.2 (f0015)). The fascicular pattern is much easier to detect on T2W than on T1W images, especially in small nerves (Fig. 4.3 (f0020)).

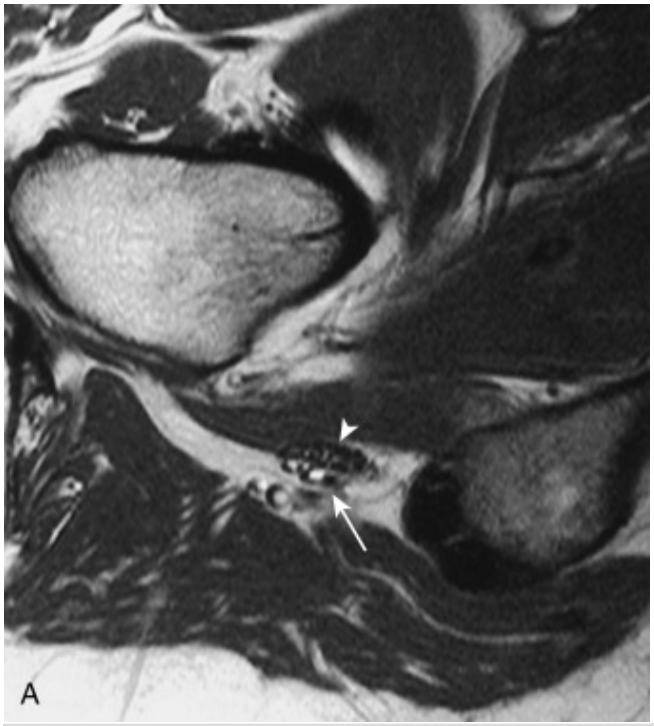
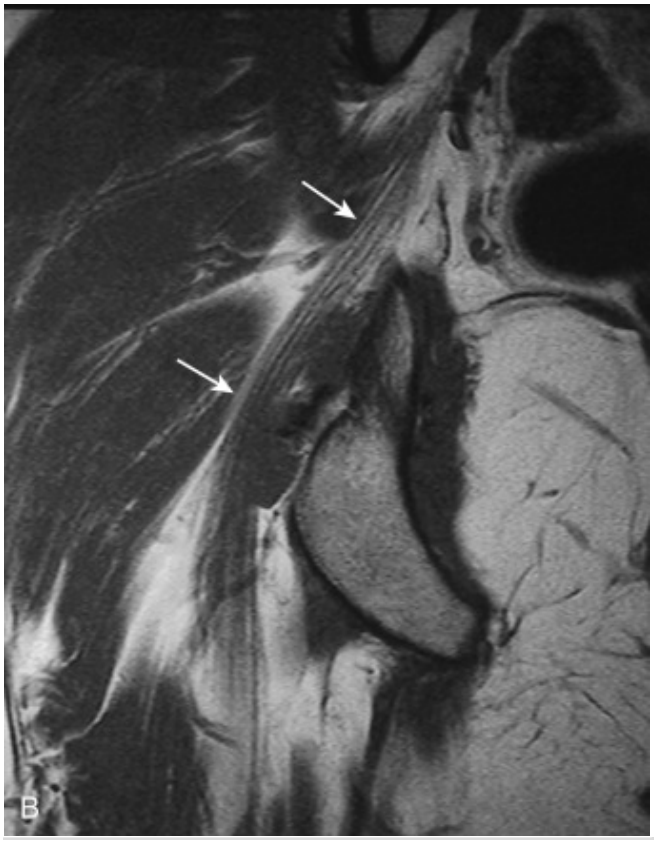
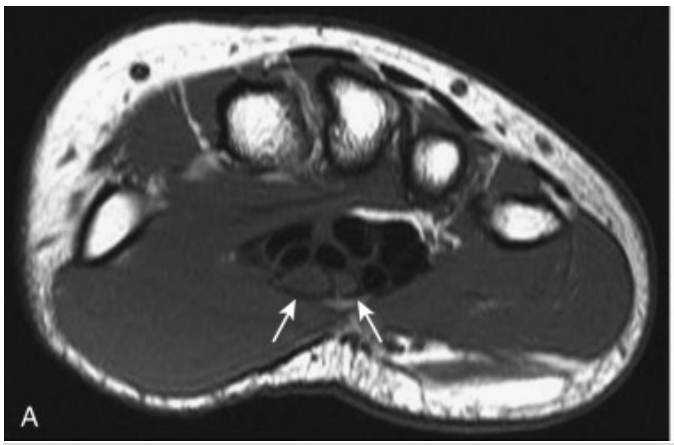


Fig. 4.2

Normal nerve imaged transversely and longitudinally. A , Axial T1 image of the proximal thigh. The *arrowhead* points to the sciatic nerve, which is oval in cross-section. The uniform stippled appearance is the result of intermediate signal fascicles separated by high signal fat. Note the small vessels along its posterior margin (*arrow*). **B** , Coronal T1 image of the pelvis. The sciatic nerve imaged longitudinally appears striated (looks like spaghetti or strands of hair) (*arrows*).





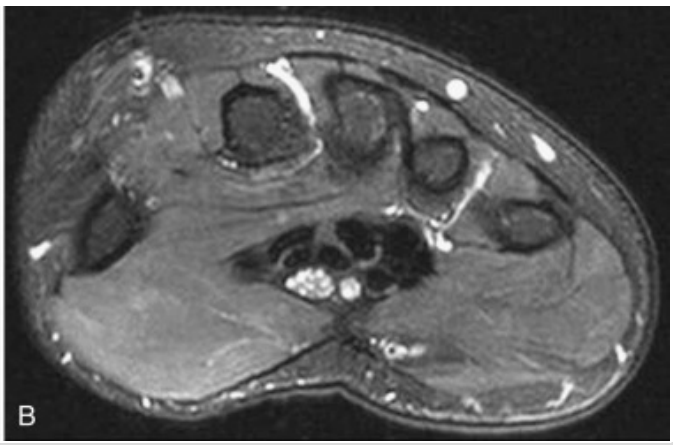


Fig. 4.3

Normal nerve with fascicles more evident on T2 than T1. A , Axial T1 image of the hand. The individual fascicles of the two components (*arrows*) of this bifid median nerve, a normal variant, are difficult to see. **B** , Axial fat-saturated T2 image of the hand. The fascicles are much easier to identify with this sequence.

Large nerves, such as the sciatic nerve, may have a striated appearance when imaged longitudinally (resembling strands of hair or spaghetti), with signal intensity typical of fat separating the fascicles (see Fig. 4.2 (f0015)). Nerves are easy to identify if they are surrounded by fat; however, if they lie adjacent to muscle, without intervening fat, they can be difficult to detect. T2W images in the axial plane give the best chance of identifying and following the nerve in the latter situation.

Abnormalities of Nerves

Peripheral nerves can be affected by trauma, compression, or encasement by an adjacent mass or infiltrative process; nerve entrapment syndromes; nerve sheath tumors; inflammatory neuritis; radiation; hereditary hypertrophic neuropathies; and inflammatory pseudotumors. Nerve problems are evaluated on MRI by directly imaging the nerve and looking for abnormalities in position, size, or signal intensity and by looking for abnormalities that would indicate denervation in the muscles supplied by the nerve (Fig. 4.4 (f0025)).

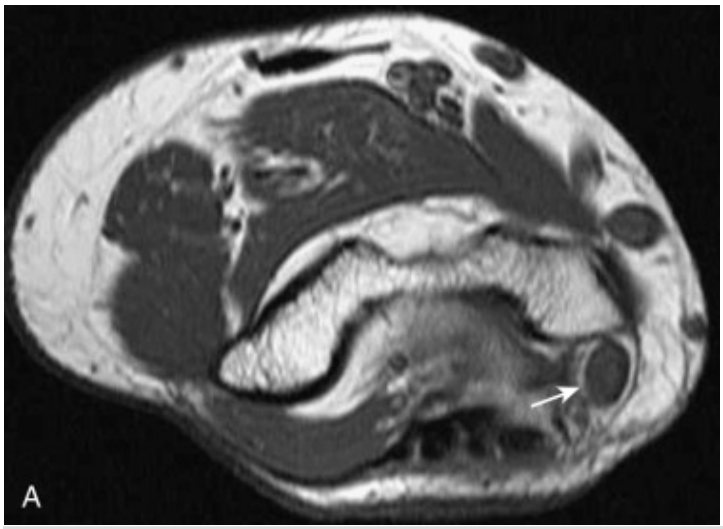
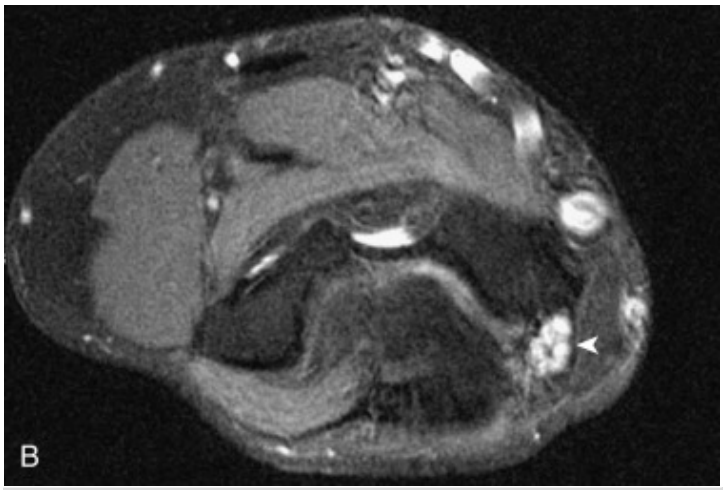
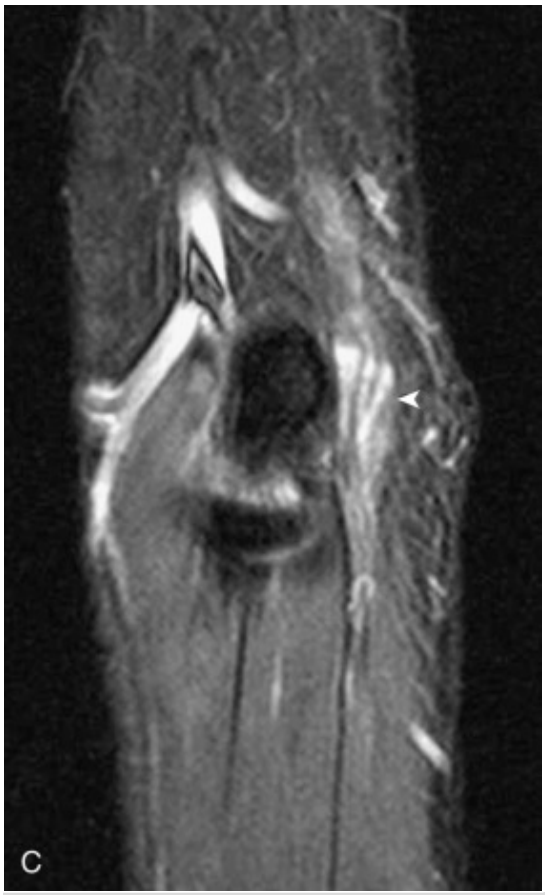


Fig. 4.4

MR features of an abnormal nerve. A , Axial T1 image of the elbow. The ulnar nerve is markedly enlarged within the cubital tunnel (*arrow*) in this patient with symptoms of an ulnar neuropathy. **B** , Axial STIR image of the elbow. Abnormal, enlarged fascicles (*arrowhead*) are better shown within the nerve, compatible with an ulnar neuritis. **C** , Sagittal STIR image of the elbow. The prominent fascicles and focal enlargement of the nerve (*arrowhead*) are well shown in this plane as well.





Nerves may be abnormal if they have diffuse or focal enlargement or diffuse or focal high signal intensity on T2W images. The abnormal appearance should be correlated with the clinical and physical exam findings. Determining whether the signal intensity is too high is a subjective exercise. Alteration in the fascicular pattern may also occur in an abnormal nerve (see Fig. 4.4 (f0025)), although fascicles in an abnormal nerve may be difficult to identify even if the nerve is enlarged or hyperintense. Nerves have a limited spectrum of appearances on MRI and the findings are usually nonspecific, requiring a differential diagnosis, but MRI still adds significant information that can help in the management of patients (Box 4.1 (b0010)).

BOX 4.1

Abnormal Peripheral Nerves

Primary Signs (Nerve)

- Increased size
- Increased signal, T2
- Abnormal position (displacement) due to mass, subluxation, osteophyte
- Fascicular pattern abnormal (nonuniform, enlarged)

Secondary Signs (Muscle)

- Denervation of muscle supplied by nerve
  - < 1 yr: high signal in muscle on T2 from intramuscular edema
  - > 1 yr: high signal in muscle on T1 from fat infiltration

Traumatic Nerve Injury

Neurologic symptoms may be present after a nerve injury due to the disruption of axonal conduction, but the nerve remains intact (neurapraxia). MRI generally is not performed in this setting.

More severe trauma to nerves can result in partial or complete transection of the nerve. With an acute injury, MRI can show the precise location of the nerve abnormality because of the presence of high signal intensity edema on T2W images, and can show the site of nerve disruption. The nerve may respond by forming a neuroma within the first year after the injury, which is sometimes painful.

Trauma to a nerve may result in a focal neuritis with nerve swelling and surrounding soft tissue edema in the acute setting; this appears as focal nerve enlargement with intraneural and perineural high signal intensity on T2W MR images (Fig. 4.5 (f0030)). Enlargement of the nerve can be recognized by comparing the caliber from proximal to distal because it should gradually decrease in size as images progress distally. Similarly, if both sides of the body are imaged (e.g., in the spine or pelvis), a side-to-side comparison can be helpful for recognizing pathologic enlargement (Fig. 4.6 (f0035)).

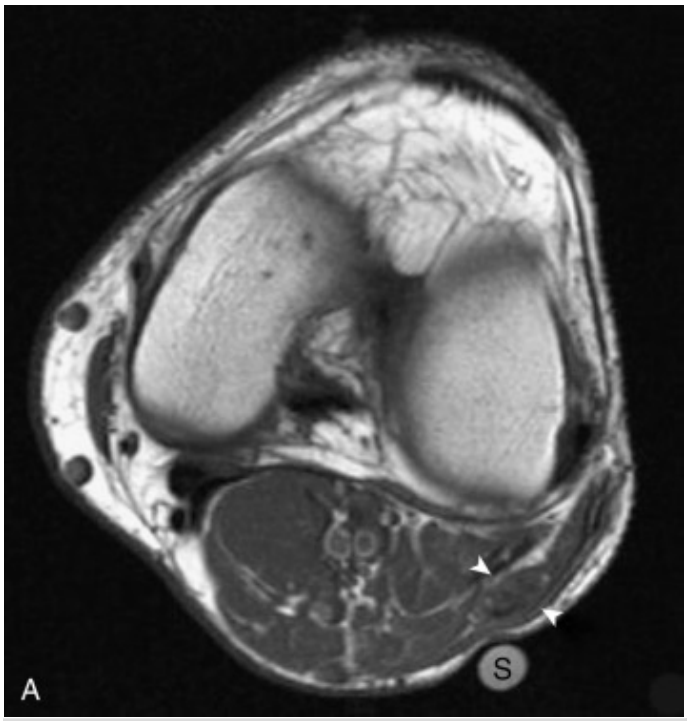
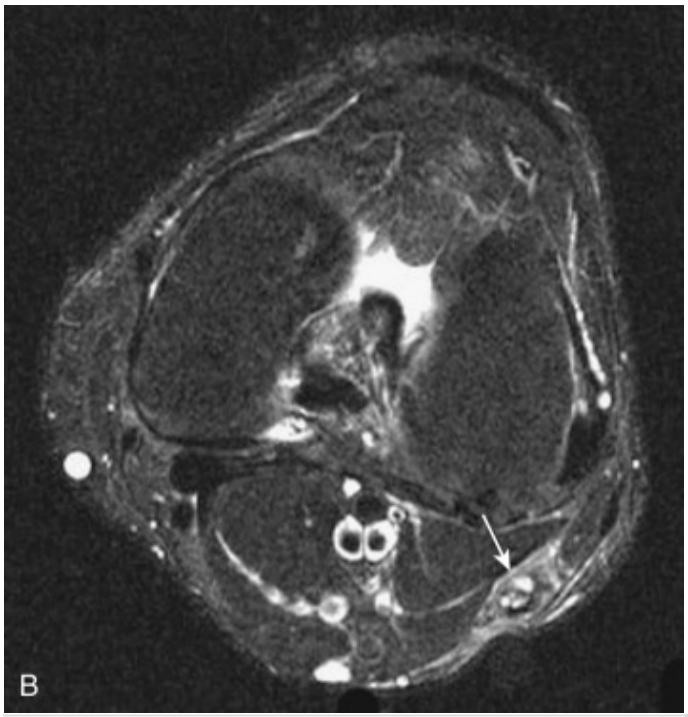


Fig. 4.5

Post-traumatic nerve injury. A , Axial T1 image of the knee. The patient sustained a dog bite along the lateral knee at the level of the skin marker (S). Note the enlarged, amorphous-appearing common peroneal nerve at that level (*arrowheads*). **B** , Axial STIR image of the knee. Foci of increased signal are evident within the nerve (*arrow*) with an absence of normal fascicular architecture, compatible with injury. **C** , STIR axial image of the proximal calf. Associated edema is present within the anterior compartment muscles (*arrowheads*) compatible with denervation injury.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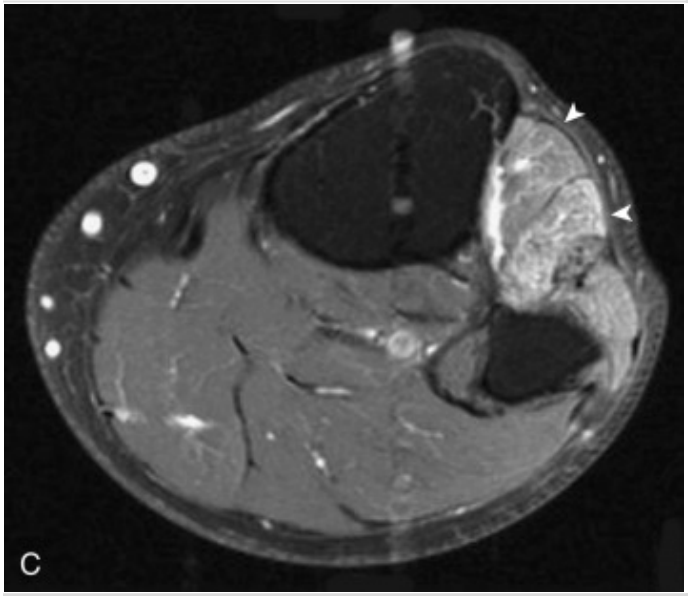
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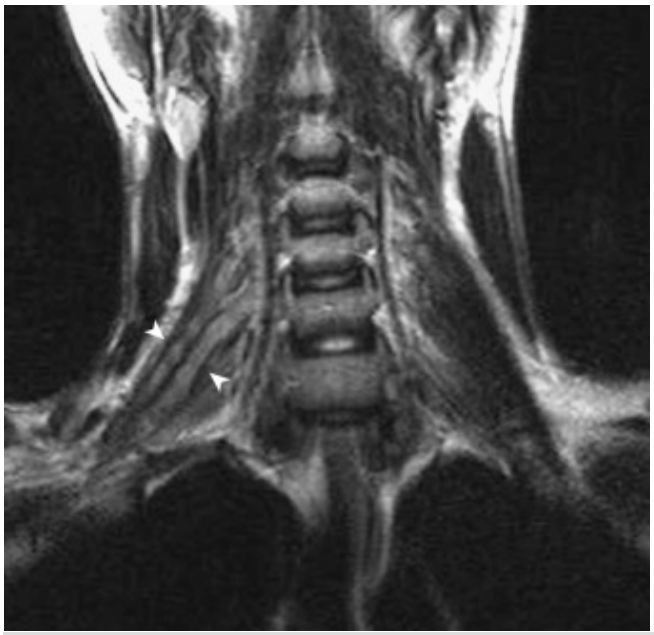


Fig. 4.6

Post-traumatic nerve injury: brachial plexus. Coronal T2 image of the neck. The right C5 and C6 nerves in the proximal brachial plexus (*arrowheads*) are markedly enlarged in this patient with neurologic symptoms in the right upper extremity after trauma. At surgery, the nerves were found to be edematous and scarred together in this region.

Additionally, when a peripheral nerve is severely injured, the muscles it serves undergo denervation changes, which manifest on MR images as high signal intensity (“edema”) on fat-saturated T2W images in the acute to subacute phases, and fatty atrophy (high signal on T1W images) later if the nerve does not regenerate. The detection of these signal abnormalities within the muscles served by one nerve is a useful secondary sign of probable nerve injury, and the specific nerve can be evaluated more closely (Fig. 4.7 (f0040)).

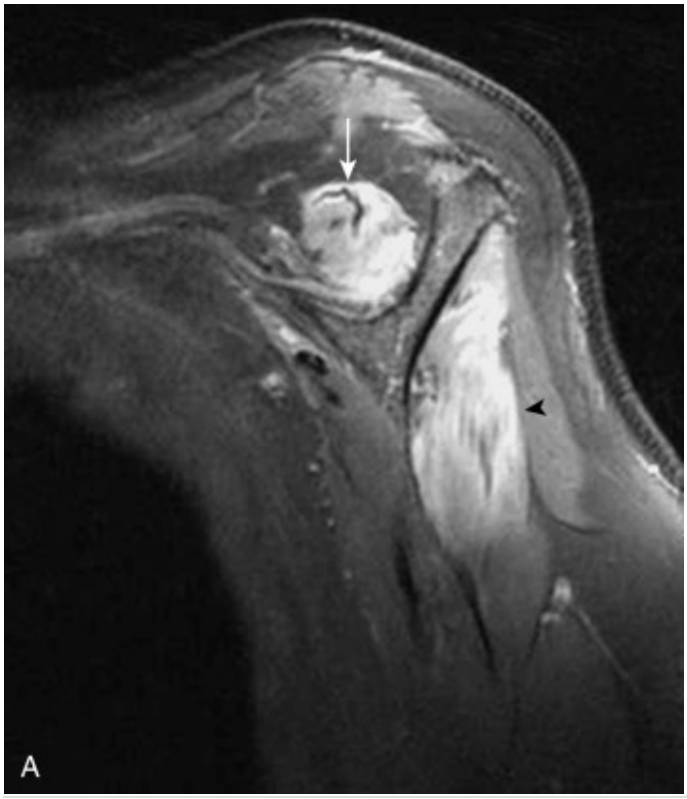
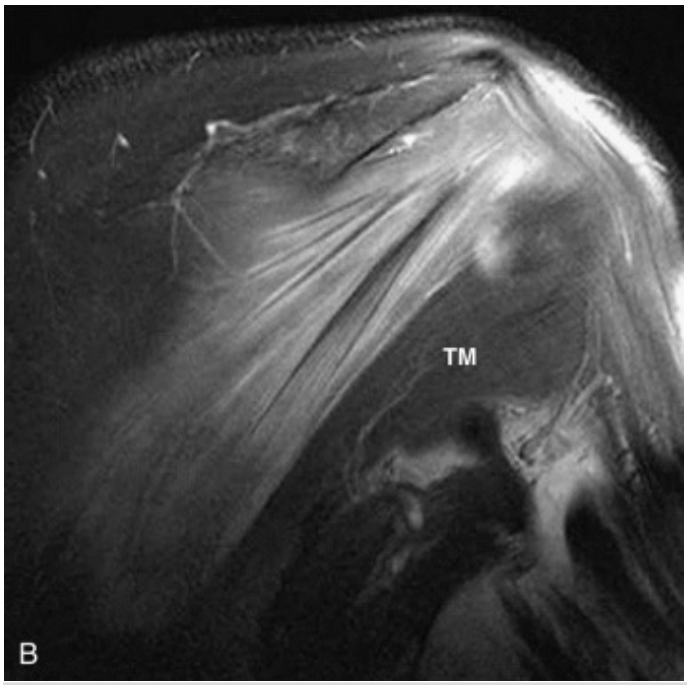


Fig. 4.7

Post-traumatic nerve injury: denervation changes in muscle. A , Oblique sagittal STIR image of the shoulder. This patient sustained trauma to the shoulder. Diffusely increased signal within the supraspinatus (*arrow*) and infraspinatus (*arrowhead*) muscles is compatible with denervation changes related to suprascapular nerve injury. **B** , The high signal edema is well shown throughout the infraspinatus muscle. Note the absence of edema within the teres minor muscle (TM), which is innervated by the axillary nerve. The sharp demarcation between muscles supplied by different nerves is a useful imaging finding for identifying denervation injuries.



Nerves can subluxate over an adjacent bone; the ulnar nerve subluxing around the medial epicondyle of the humerus is a classic example. This subluxation may lead to stretching of the nerve, irritation due to friction, and swelling of the nerve (neuritis), with increased nerve size and increased signal intensity seen on T2W images. A nerve in an abnormal location from subluxation or traumatic transection of a nerve must not be confused with surgical transposition of a nerve to a new anatomic location to avoid

chronic irritation. Transfer of the ulnar nerve at the elbow is a standard surgical procedure that results in the nerve being positioned anterior to its usual location, either in a submuscular or subcutaneous location (Fig. 4.8 (f0045)).

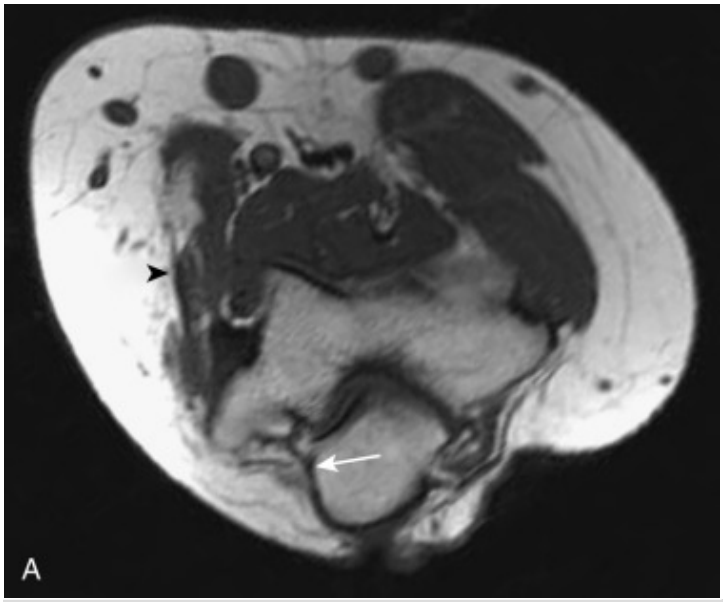
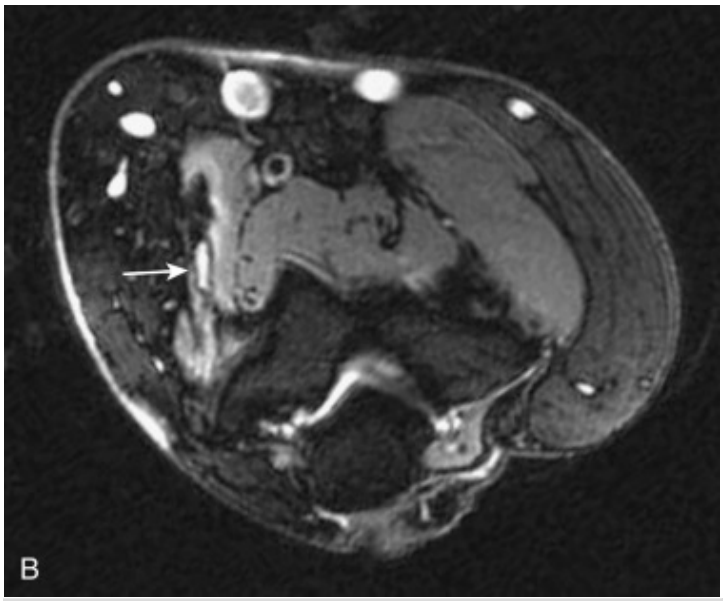


Fig. 4.8

Abnormal position of a nerve from surgical transposition. A , Axial T1 image of the elbow. The ulnar nerve is not present in its usual position within the cubital tunnel (*arrow*). Instead, it is located far anterior to its normal position (*arrowhead*), where it is difficult to separate from adjacent muscle. This is not from an injury or subluxation, but from surgical transfer of the nerve to prevent chronic irritation. **B** , Axial fat-saturated T2 image of the elbow. The nerve is more easily identified on this T2W image (*arrow*) because of its high signal intensity.



Nerve Tumors

Neuromas

Neuromas frequently occur as a consequence of an injury with traumatic (or iatrogenic) transection of a nerve. These tumors may be painful and occur within 1 year of the injury. This phenomenon is well known in the setting of an amputation of an extremity, where a neuroma develops at the distal end of a severed nerve. There is no malignant potential for a traumatic neuroma, which simply represents the attempt of the nerve to repair by disorganized proliferation of cells in multiple directions.

A neuroma appears as a fusiform or bulbous mass of the nerve end with heterogeneous signal intensity, and there may or may not be strandlike regions (disorganized fascicular appearance) of low signal intensity interspersed in the mass. The normal nerve proximal to the mass can be detected entering the mass; if the nerve has not been completely transected, an exiting nerve may be seen distal to the mass. Chronic friction or irritation of an intact nerve also can result in a neuroma with fusiform swelling in a nerve that is not disrupted. A neuroma has intermediate signal intensity on

T1W images and intermediate to high signal on T2W images. Diffuse enhancement of the mass can be expected after intravenous contrast administration (Figs. 4.9 and 4.10 (f0050)).

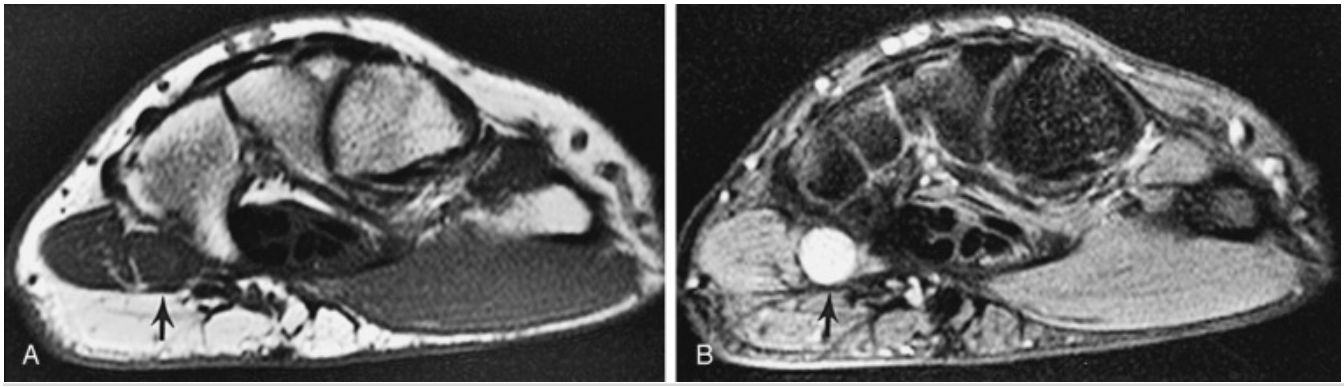


Fig. 4.9

Neuroma from chronic irritation. **A** , Axial T1 image of the wrist. There is an intermediate signal mass (*arrow*) adjacent to the hook of the hamate that blends with the adjacent muscle. **B** , Axial T2* image of the wrist (same level as in **A**). A high signal round mass (*arrow*) is obvious on this sequence. This was a neuroma of the deep branch of the ulnar nerve, likely caused by chronic irritation against the hook of the hamate.

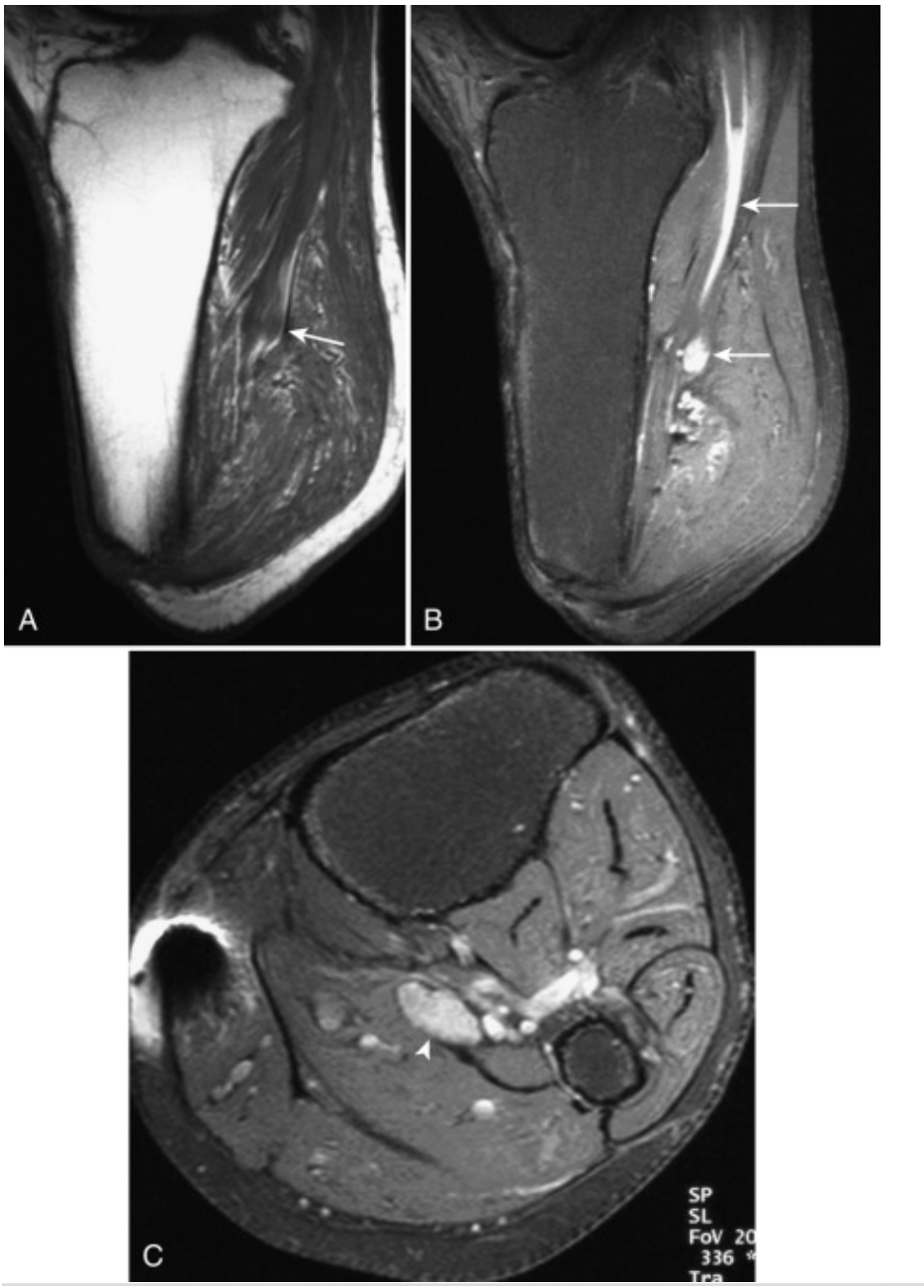


Fig. 4.10

Amputation neuroma. A , T1 sagittal image of the proximal calf. The *arrow* points to an intermediate signal bulbous mass at the cut end of the posterior tibial nerve in this patient, who had a below-the-knee amputation 18 months previously and now has pain symptoms. **B** , Sagittal T1 fat saturation with contrast image, same location as in **A** . The nerve and distal bulbous neuroma enhance (*arrows*). **C** , Axial STIR image through neuroma of posterior tibial nerve. The nerve (*arrowhead*) is markedly enlarged, has high signal intensity, and is devoid of the normal fascicular pattern.

Neurofibroma and Neurilemoma (Box 4.2 (b0015))

Aside from post-traumatic neuromas, the tumors of significance that involve peripheral nerves are neurilemomas (also called *schwannomas*) and neurofibromas. These are benign lesions that are usually difficult or impossible to distinguish from each other; they are often lumped together as *nerve sheath tumors* . The major difference between the two is that neurilemomas arise from the surface of a nerve, whereas neurofibromas arise centrally, with the nerve coursing through the tumor. Both entities have an association with neurofibromatosis, but most lesions are solitary and unrelated to that disease. Patients with neurofibromatosis tend to have multiple nerve sheath tumors or diffuse plexiform neurofibromas. Malignant degeneration may rarely occur; differentiation of benign from malignant nerve sheath tumors is generally impossible with MRI.

BOX 4.2

Nerve Sheath Tumors: Suggestive MRI Features

String Sign

• Fusiform mass with vertical soft tissue “string” extending from either or both ends of the mass; the string represents normal entering or exiting nerve

Split Fat Sign

• Peripheral rim of fat surrounding mass, from displacement of fat in neurovascular bundle

Target Pattern

- T2 and postcontrast T1 MRI with low signal centrally and high signal in the periphery of the mass

On MRI, both of these nerve sheath tumors appear as well-defined, smooth, fusiform-shaped masses. The mass is intermediate to low signal intensity on T1W images and generally shows diffuse, increased signal intensity on T2W images. Nerve sheath tumors may become necrotic, with a cystic or hemorrhagic appearance; this occurs much more commonly with schwannomas than with neurofibromas. Diffuse contrast enhancement occurs in the tumor, unless it has a necrotic or cystic center, or if the target sign is present (see later) (Fig. 4.11 (f0060)).

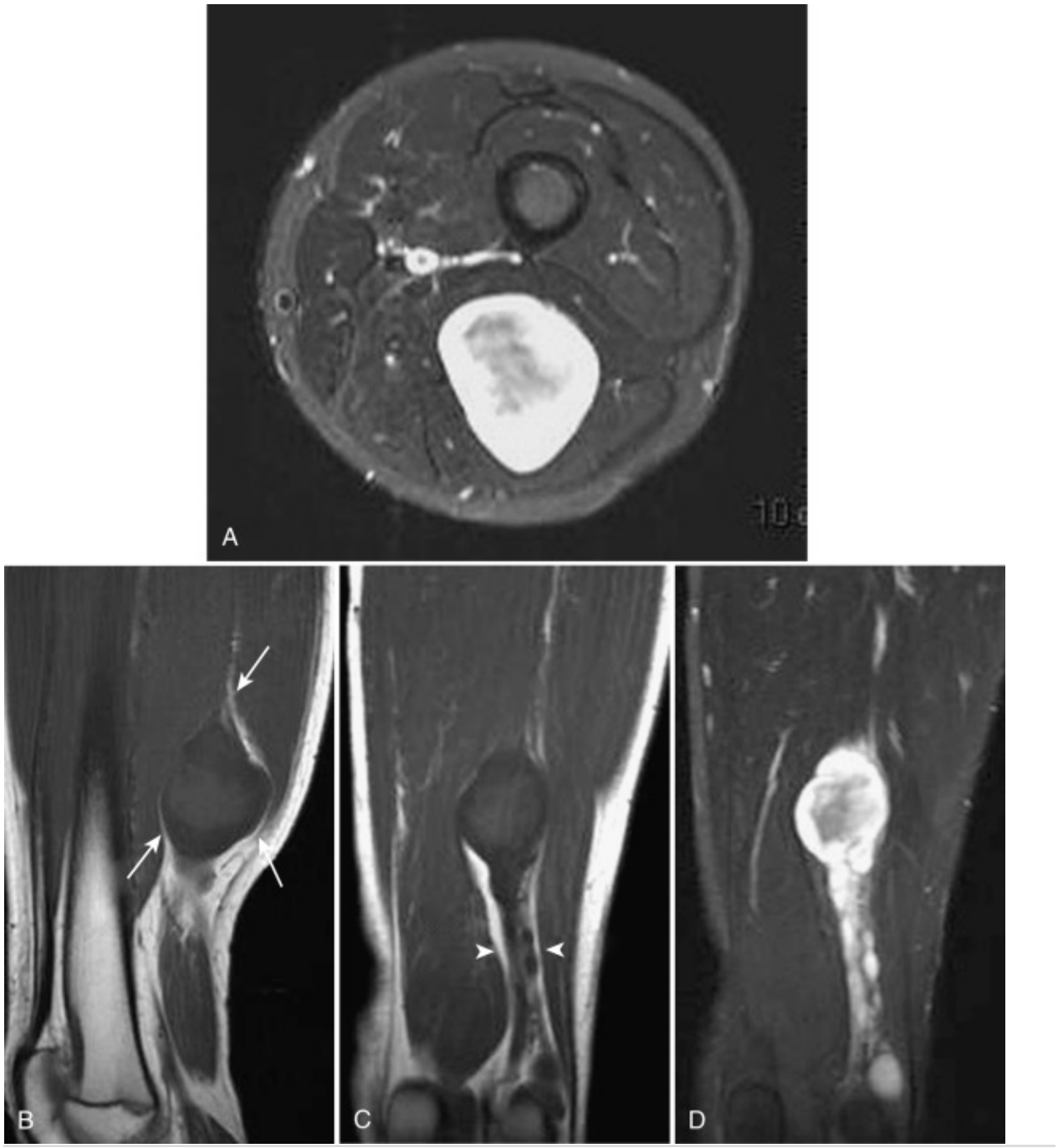

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Fig. 4.11

Neurofibroma: target sign, split fat sign, and string sign. A , STIR axial image of the mid-thigh. There is a large high signal mass in the posterior thigh in this patient with a history of neurofibromatosis. Note the high signal margin surrounding the lower signal centrally (“target sign”). **B** , Sagittal T1 image of the thigh. Note the fat diverging around the margins of the mass (*arrows*) indicating its intermuscular location (“split fat sign”). **C** , Coronal T1 image of the thigh (same patient as in **A** and **B**). There is vertically oriented soft tissue (*arrowheads*) extending from the distal end of the mass related to additional, smaller neurofibromas, creating a “string sign.” **D** , Coronal STIR image of the thigh. The individual tumors are more easily discerned on this image. Note the “target sign” in the large proximal mass.

Three additional signs on MRI may be present and help limit the differential diagnosis of a mass to a nerve sheath tumor, if identified (see Fig. 4.11 (f0060)):

1. String sign
2. Split fat sign
3. Target sign

The string sign consists of the appearance of a fusiform mass with a “string” of vertically oriented soft tissue extending from one or both ends of the mass. The string represents the normal entering or exiting nerve that is in continuity with the nerve sheath tumor. Masses that are not of neural origin may have features that mimic a nerve sheath tumor and must be carefully evaluated to avoid a

misdiagnosis. Vessels adjacent to a mass may create an appearance similar to the string sign and lead to an erroneous interpretation (Fig. 4.12 (f0065)).

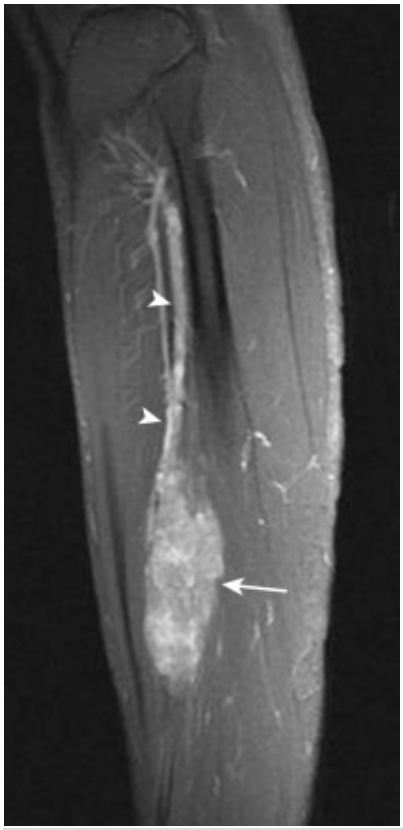

Fig. 4.12

Pseudostring sign. Vertically oriented tissue appears to extend proximally from an enhancing fusiform mass (*arrow* and *arrowheads*) simulating a "string sign" of a nerve sheath tumor. The mass was a Ewing's sarcoma, and the vertically oriented tissue was the anterior tibial neurovascular structures.

The split fat sign describes the peripheral rim of fat that often is seen surrounding the margins of a nerve sheath tumor. The appearance of this rim of fat is thought to relate to the displacement of the fat that normally surrounds the neurovascular bundle, the site of origin of these lesions (see Fig. 4.11 (f0060)).

The target sign consists of low signal intensity centrally and high signal intensity peripherally on T2W and post–contrast-enhanced T1W images (see Fig. 4.11 (f0060)). The target pattern probably reflects the histology of these lesions, with peripheral myxomatous tissue and central fibrous tissue creating the signal characteristics. This sign has been described in neurofibromas, but can probably occur in other nerve tumors.

Fibrolipomatous Hamartoma

Fibrolipomatous hamartoma is a rare lesion of major nerves and their branches and is typically identified in children or young adults. The mesenchymal proliferation that occurs in this entity accounts for the fibrofatty overgrowth. There is gradual infiltration of the nerve by fibrofatty tissue. They can cause an enlarging mass, macrodactyly, and compression neuropathy. The hand is the site most commonly involved, especially the median nerve. MRI shows an enlarged nerve composed of tubular, serpentine-like, longitudinal low signal intensity structures, representing the fascicles with perineural fibrosis, that course through a nerve that has signal characteristics typical of fat (Fig. 4.13 (f0070)). Imaged in cross-section, the nerve resembles a coaxial cable.

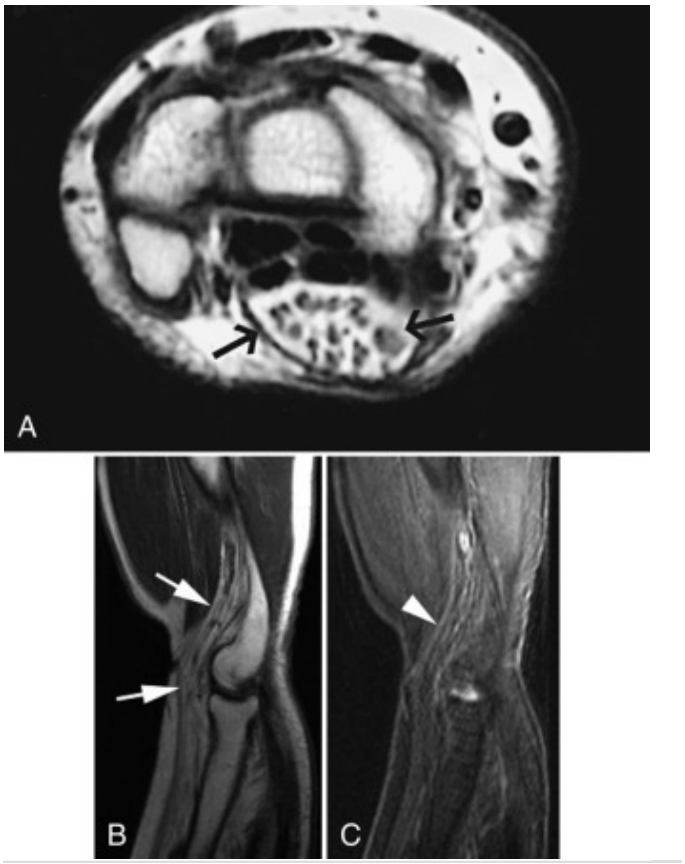

Fig. 4.13

Fibrolipomatous hamartoma. A , T1 axial image of the wrist. The median nerve (*arrows*) is gigantic in the carpal tunnel. The fascicles are larger than normal but otherwise normal in appearance and surrounded by normal high signal fat. This is typical of the appearance and location of a fibrolipomatous hamartoma. **B** , T1 sagittal image of the elbow. A similar lesion is present in a different patient involving the radial nerve (*arrows*). At surgery, an enlarged nerve with extensive fatty infiltration was found. **C** , T2 fat-saturated sagittal image of the elbow. The fascicles of the enlarged nerve show increased signal (*arrowhead*), whereas signal from the infiltrating fat is suppressed.

Pseudotumors of Nerves

Ganglion cysts can develop in a nerve sheath and cause compression of the underlying nerve. The ganglion cyst has the same appearance as elsewhere, with low signal intensity on T1W

images and high signal intensity on T2W images, frequently with lobulated margins and thin septations within the mass. If the ganglion follows a nerve, the diagnosis should be suggested. The peroneal nerve at the knee joint is most commonly affected (Fig. 4.14 (f0075)).

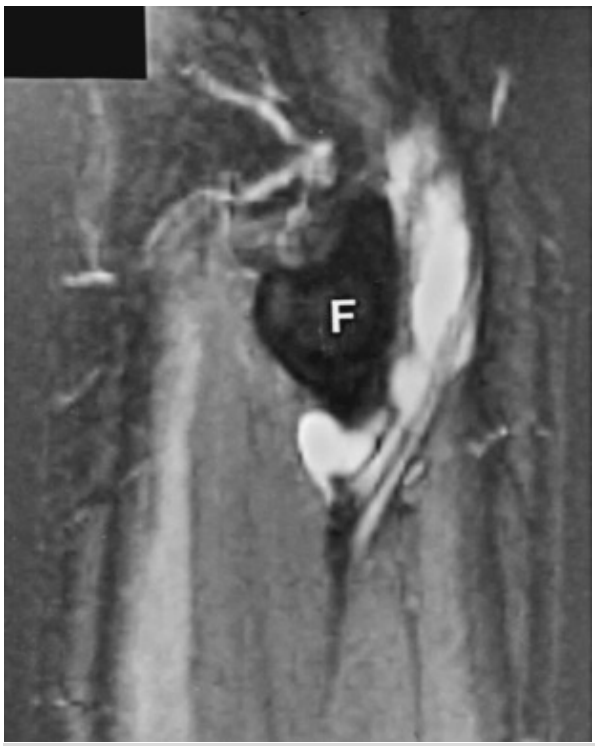

Fig. 4.14

Ganglion cyst of the peroneal nerve. STIR sagittal image at the knee shows a high signal, lobulated, elongated mass wrapping around the neck of the fibula (F), following the distribution of the peroneal nerve. This is a ganglion cyst that caused compression of the nerve.

Morton's neuromas are not true neuromas or neoplasms of the nerve. Morton's neuroma causes severe pain and numbness between the toes, most commonly in the second and third web spaces, and occur as a reaction to the plantar digital nerves in the foot being compressed and irritated between metatarsal heads, resulting in perineural fibrosis, neural degeneration, and inflammatory changes

surrounding the nerve. Morton's neuroma manifests as a teardrop-shaped mass that projects between and plantar to the metatarsal heads. The MRI appearance is delineated in detail in Chapter 16 (chapter://content/3-s2.0-B9780323415606000160&indexOverride=GLOBAL)

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Compressive Neuropathy and Entrapment Syndromes

Compression or entrapment of a short segment of nerve can cause symptoms that vary with the site of compression. There are predictable anatomic sites in muscles, fibrous tissue, or fibro-osseous tunnels, where entrapment may occur. MRI can be used to detect objective findings of nerve compression by demonstrating alterations in the size, signal intensity, or position of a peripheral nerve. Osseous or soft tissue lesions that cause a compression neuropathy can be depicted, if present (Fig. 4.15 (f0080)). Findings of muscle denervation may be evident. These findings consist of increased signal intensity on T2W images of the muscles innervated by the affected nerve, particularly in the acute and subacute setting (Fig. 4.16 (f0085)). Denervation progresses to muscle atrophy with fatty infiltration on a more chronic basis, manifested by high signal intensity typical of fat-infiltrated muscle on T1W images.

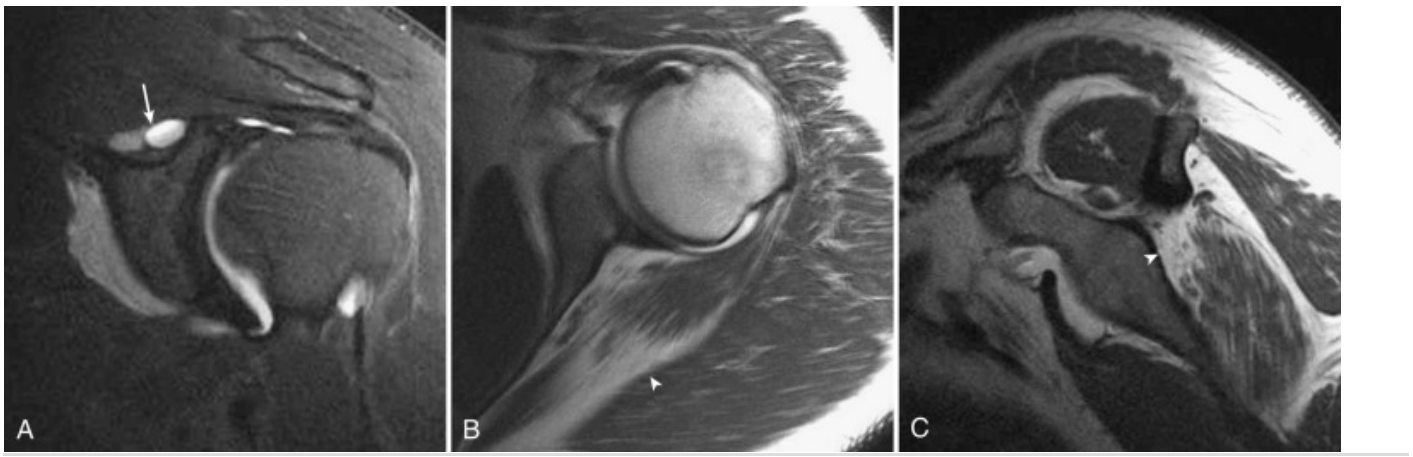


Fig. 4.15

Compressive neuropathy from a mass. A , T2 fat-saturated oblique coronal image of the shoulder. A bilobed, high signal, paralabral cyst (*arrow*) extends into the suprascapular notch. **B** , T1 axial image of the shoulder. There is marked fatty atrophy of the infraspinatus muscle (*arrowhead*) indicating chronic compressive neuropathy of the suprascapular nerve. **C** , T1 oblique sagittal image of the shoulder again demonstrates profound atrophy of the infraspinatus muscle (*arrowhead*).

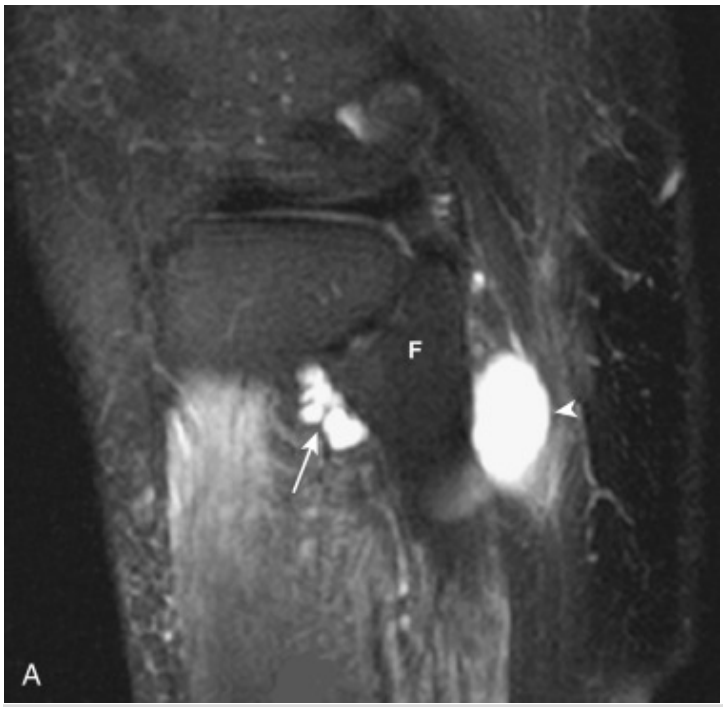
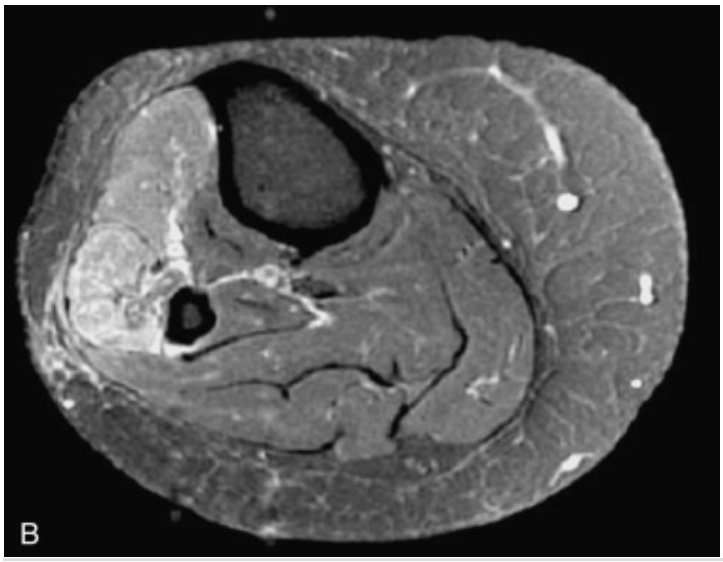


Fig. 4.16

Compressive neuropathy from a mass. A , T2 fat-saturated sagittal image of the knee. A high signal mass shown to represent a ganglion cyst (*arrowhead*) lies posterior to the fibular head (F). Note the additional smaller ganglia along the anterior margin of the proximal tibiofibular joint (*arrow*). **B** , STIR axial image of the proximal calf. Diffuse edema within the anterior and peroneus muscles indicates an associated compressive neuropathy of the common peroneal nerve.



Common sites of compression and entrapment neuropathies are as follows:

- Brachial plexus at the insertion of anterior scalene muscle on first rib (scalenus anticus syndrome) or at the crossing of a cervical rib (cervical rib syndrome)
- Suprascapular nerve in the suprascapular or spinoglenoid notch of the scapula (suprascapular or spinoglenoid notch syndrome, respectively)
- Axillary nerve in the quadrilateral space of the axilla (quadrilateral space syndrome)
- Radial nerve in the axilla (sleep palsy), spiral groove of the distal humerus (from a fracture), or deep to the supinator muscle at the elbow (posterior interosseous nerve syndrome)
- Median nerve in the distal humerus deep to the ligament of Struthers, deep to the pronator teres muscle at the elbow (pronator syndrome), or in the carpal tunnel at the wrist (carpal tunnel syndrome)

• Ulnar nerve in the cubital tunnel of the elbow (cubital tunnel syndrome) or Guyon's canal in the wrist (ulnar tunnel syndrome)

• Sciatic nerve at the greater sciatic foramen in the pelvis (piriformis syndrome)

• Lateral femoral cutaneous nerve at the attachment of the inguinal ligament to the anterior superior iliac spine (meralgia paresthetica)

• Posterior tibial nerve in the tarsal tunnel of the ankle and hindfoot (tarsal tunnel syndrome)

Miscellaneous Nerve Abnormalities

Tumor Encasement/Radiation Changes

Nerves may be encased or displaced by an adjacent tumor, such as a primary carcinoma, lymphoma, or desmoid tumors, which can cause neurologic symptoms and pain. MRI can show the tumor and its relationship to adjacent nerves (Fig. 4.17 (f0090)). Patients who receive radiation therapy for a tumor may develop radiation-induced neuritis as an inflammatory reaction of the nerve to the radiation. The symptoms are not distinguishable from encasement by a tumor. MRI shows if there is a tumor present or if there is increased signal intensity and/or enlargement of the nerves in the radiation portal on T2W images related to radiation neuritis rather than a tumor.

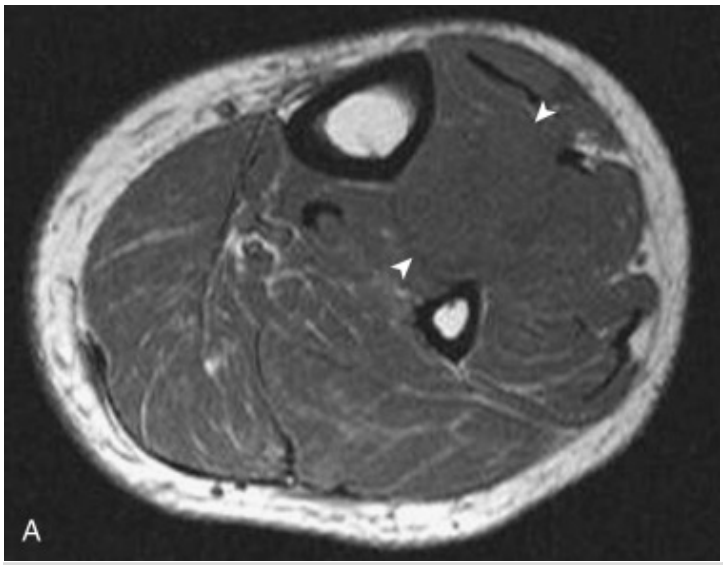
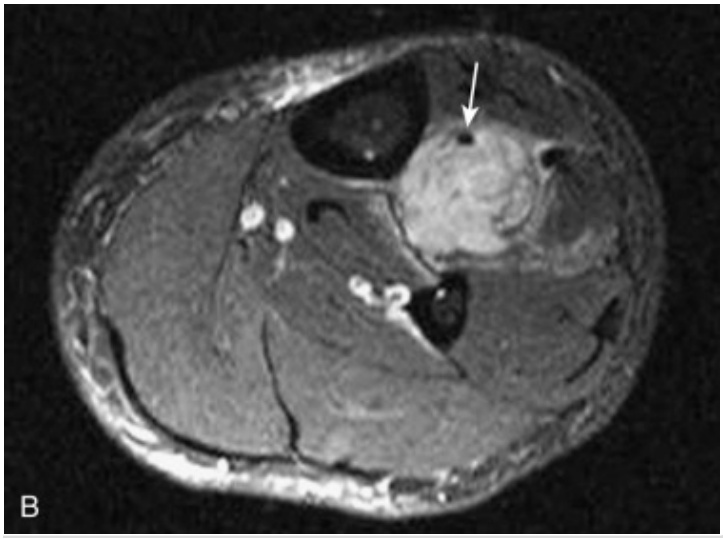


Fig. 4.17

Tumor encasing the neurovascular bundle. A , T1 axial image of the calf. An intermediate signal intensity mass is present (*arrowheads*) but is difficult to distinguish from adjacent muscles. **B** , STIR axial image of the calf. The mass is more easily identified because of its increased signal, as is the anterior tibial neurovascular bundle (*arrow* points to the anterior tibial artery) that has been engulfed by this soft tissue sarcoma.



Inflammatory Neuritis

Nerves may become inflamed and symptomatic for unknown reasons. It is believed that this inflammation often is the result of a viral infection, referred to as *idiopathic inflammatory neuritis* . There is often a history of a recent flulike syndrome that preceded the

onset of neural symptoms. These acute neuromuscular disorders have not shown abnormalities of the nerves on MRI, but have shown abnormalities in the affected muscles.

Acute brachial neuritis, also called *Parsonage-Turner syndrome* , is a painful neuromuscular disorder that affects the shoulder with marked weakness and pain, and which probably is the result of a viral neuritis. The clinical symptoms may be similar to the many other causes of shoulder pain, though typically patients complain of acute onset of pain followed by weakness. MRI is very helpful in making the diagnosis. The findings include muscle edema with high signal intensity on T2W images in the acute or subacute setting, or of muscle atrophy with high signal intensity on T1W images in the supraspinatus, infraspinatus, or deltoid muscles in the chronic clinical setting (Fig. 4.18 (f0095)).

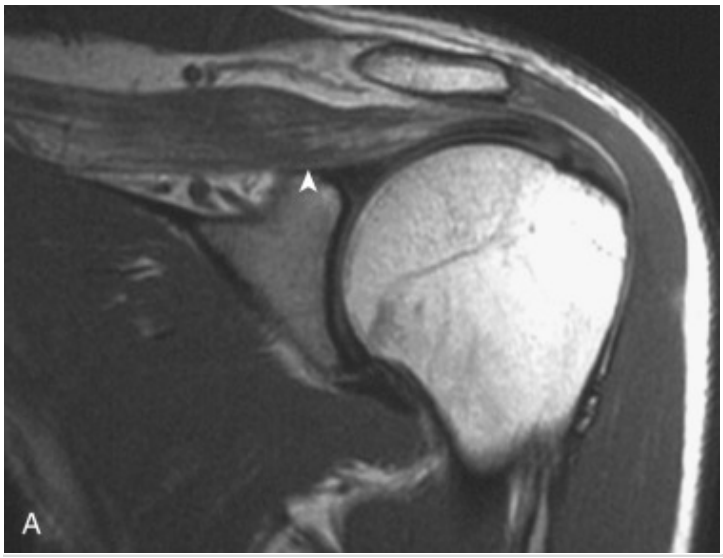
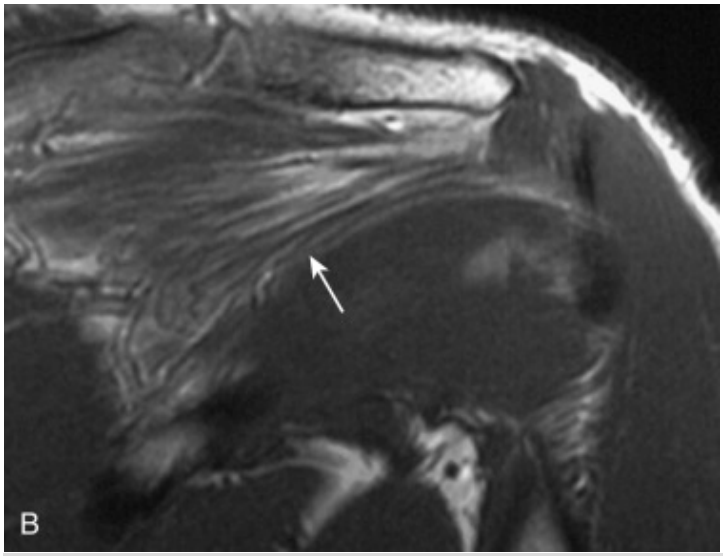


Fig. 4.18

Inflammatory neuritis. A , T1 oblique coronal image of the shoulder. There is fatty infiltration of the supraspinatus muscle (*arrowhead*) without a tear of the rotator cuff, indicating a nerve abnormality. This patient had profound weakness and pain, and this was believed to be from a viral neuritis (Parsonage-Turner syndrome). **B** , T1 oblique coronal image of the shoulder. This image at a more posterior level shows similar extensive fatty atrophy of the infraspinatus muscle as well (*arrow*) related to the brachial neuritis.



Unexplained Neuropathy

Focal or diffuse nerve abnormalities may be seen from an inflammatory pseudotumor of the nerve or from hereditary hypertrophic neuropathies (Charcot-Marie-Tooth disease, Dejerine-Sottas syndrome). The findings are nonspecific on MRI, consisting of nerve enlargement, heterogeneity in the size of the fascicles, and hyperintense signal on T2W images.

Suggested Reading

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