Meniscal Tear Treatment Guidelines

The meniscus, a crescent-shaped fibrocartilaginous structure in the knee joint, plays an essential role in absorbing shock, distributing weight, and providing stability between the femur (thigh bone) and tibia (shin bone). Its resilience allows it to withstand significant forces; however, it is still vulnerable to tears due to trauma, overuse, or degenerative changes.

A meniscal tear can lead to pain, swelling, restricted motion, and sometimes a sensation of locking or giving way in the knee, impacting mobility and quality of life. Treatment strategies vary according to the tear's characteristics and the patient's age, activity level, and symptoms, aiming to relieve pain, restore function, and preserve the meniscus whenever possible to avoid long-term joint damage.

Types of meniscus tears

Meniscus tears are classified based on their location within the meniscus, the pattern of the tear, and the extent of tissue involvement. Proper classification is essential for developing an optimal treatment plan, as some tear types may heal conservatively while others require surgical repair. The main types of meniscal tears include:

Intrasubstance tear (Incomplete tear)

An intrasubstance tear is a small, localized injury often confined within the meniscal tissue without reaching the surface. Typically asymptomatic, these tears are generally found incidentally on MRI scans performed for other reasons. They are most commonly associated with age-related degenerative changes within the meniscus rather than acute trauma.

Radial tear

A radial tear extends outward from the inner edge of the meniscus toward the outer rim, disrupting the natural load distribution capabilities of the meniscus. These tears are frequently located in the lateral (outer) meniscus and are caused by sudden twisting motions or high-impact activities, making them common in sports-related injuries. Radial tears impair the meniscus's ability to handle compressive forces, often leading to pain and instability.

Horizontal tear

Horizontal tears split the meniscus along a plane parallel to the tibial surface, dividing it into upper and lower sections. These tears are typically associated with degenerative changes rather than acute injury and are more common in middle-aged and older adults. The horizontal orientation allows synovial fluid to enter the tear, potentially causing cyst formation or swelling in the joint.

Bucket-handle tear

A bucket-handle tear is a large, longitudinal tear that causes the inner portion of the meniscus to displace centrally, often creating a "locking" sensation in the knee joint. This type of tear is more prevalent in athletes and results from forceful twisting or hyperflexion injuries.

Complex tear

Complex tears involve multiple tear patterns—such as combinations of radial, horizontal, or oblique tears—and often affect multiple parts of the meniscus. These tears are more common in older individuals or those who have sustained significant trauma. Their irregular shape and involvement of various meniscal zones make complex tears difficult to treat with repair alone.

Flap tear

A flap tear occurs when a portion of the meniscus becomes loose and forms a “flap” that can shift within the joint, often leading to a catching or locking sensation. These tears are usually caused by sudden twisting or pivoting movements and are common in sports injuries.

Treatment options for meniscus tears

Meniscal tears are managed based on various factors, including the patient’s age, tear complexity, tissue quality, symptoms, and surgical risk (Doral et al., 2018). The goal is to preserve meniscal tissue whenever possible, as it plays a critical role in knee joint stability and preventing osteoarthritis. Treatments are divided into nonsurgical approaches, which are commonly used for mild or degenerative tears, and surgical interventions, often indicated for more severe cases.

Blood supply zones and healing potential

Zone	Description	Healing potential	Treatment examples
Red zone (Outer one-third)	This area has a rich blood supply, promoting healing either naturally or with surgical repair.	**High:** Tears in this area often heal well with nonsurgical care or sutures.	Longitudinal tears; surgical suturing.
White zone (Inner two-thirds)	Avascular region lacks sufficient blood flow, making natural healing unlikely.	**Low:** Tears here typically require surgical intervention like partial meniscectomy to remove damaged tissue.	Partial meniscectomy for irreparable tears.
Red-white zone (Middle zone)	Transitional area with mixed blood supply, partially nourished by synovial fluid.	**Moderate:** Healing depends on tear severity, location, and treatment approach.	Case-dependent; may respond to suturing.

Nonsurgical treatment

Conservative management is suitable for mild symptoms, degenerative tears, or when patients cannot undergo surgery. Nonsurgical methods aim to relieve symptoms and maintain joint function (Luvsannyam et al., 2022).

RICE protocol

The RICE protocol (Rest, Ice, Compression, and Elevation) is a standard initial treatment for meniscus tears. Rest limits joint stress, allowing healing. Ice reduces swelling and pain; compression with an elastic bandage controls inflammation, and elevation minimizes fluid buildup (Raj & Bubnis, 2021).

- **Rest:** Avoiding weight-bearing activities protects the knee and reduces inflammation.
- **Ice:** Ice is applied for 15–20 minutes several times a day to minimize pain and swelling.
- **Compression:** An elastic bandage reduces swelling and supports the knee.
- **Elevation:** Keeping the leg elevated above the heart aids in fluid drainage.

Medications

Nonsteroidal anti-inflammatory drugs (NSAIDs), such as ibuprofen, reduce pain and inflammation. Nonsteroidal anti-inflammatory drugs (NSAIDs), however, should be used with caution over extended periods due to potential side effects (Doral et al., 2018). Corticosteroid injections provide temporary relief for more persistent inflammation but may not promote healing and are generally limited due to potential cartilage damage (Beaufils & Pujol, 2017).

Physical therapy

Physical therapy aims to strengthen muscles around the knee, supporting joint stability and range of motion. Exercises that avoid knee strain, such as cycling and swimming, are encouraged (Luvsannyam et al., 2022). Research shows that quadriceps-strengthening exercises done three times a week for ten weeks improved knee function by 35% in patients with osteoarthritis (Mangione et al., 1999).

Surgical treatment

When symptoms persist, or the tear type and location suggest poor healing potential, surgical intervention may be recommended. Surgical procedures, including partial meniscectomy, meniscus repair, and meniscal reconstruction, vary in approach based on the tear location and severity (Doral et al., 2018; Luvsannyam et al., 2022).

Knee arthroscopy

Arthroscopy, a minimally invasive procedure, involves inserting a camera and instruments through small incisions to repair or remove damaged meniscal tissue. It minimizes recovery time and reduces the risk of complications (Bhan, 2020; Doral et al., 2018).

Partial meniscectomy

In partial meniscectomy, only the damaged portion of the meniscus is removed, preserving as much healthy tissue as possible to maintain knee function. Though effective in restoring short-term function, partial meniscectomy is associated with an increased long-term risk of osteoarthritis due to loss of meniscal cushioning (Beaufils & Pujol, 2017). Partial meniscectomy is often limited to non-repairable tears in the "white-white zone" (non-perfused areas) (Doral et al., 2018).

Meniscal repair

Meniscal repair, which involves suturing the torn meniscal tissue, is particularly beneficial for tears in the vascularized "red zone," as it allows natural healing and maintains more meniscal structure, which supports long-term joint stability. Techniques vary based on tear location:

- **Inside-out technique:** Sutures are passed from inside the knee to an external incision, primarily used for posterior horn tears (Doral et al., 2018).
- **Outside-in technique:** Suitable for anterior horn tears, this approach passes sutures from outside the knee into the joint, posing less risk of nerve damage (Beaufils & Pujol, 2017).
- **All-inside technique:** Often used for extreme posterior meniscus tears, this technique involves bioabsorbable implants to stabilize the tear without additional incisions (Beaufils & Pujol, 2017).

Meniscal reconstruction

For cases with substantial meniscal damage, meniscal reconstruction may be necessary to restore knee function. This involves using meniscal scaffolds or meniscal allograft transplantation (MAT). MAT replaces the meniscus with a preserved allograft, while meniscal scaffolds use synthetic, biodegradable materials to encourage tissue growth within the knee joint (Doral et al., 2018). Scaffolds allow for vascular integration, which aids in structural reinforcement over time.

Cell-based tissue engineering

Tissue engineering is emerging as a novel approach to meniscus regeneration. It uses mesenchymal stem cells (MSCs) to stimulate tissue regeneration, allowing the meniscus to regain its natural function and structure (Scotti et al., 2013). MSCs, particularly those derived from bone marrow, are promising for their ability to differentiate and deposit extracellular matrix (ECM) elements, such as collagen and glycosaminoglycans, essential for meniscal structure (Marsano et al., 2013). This approach includes intra-articular injections or MSCs seeded onto bioengineered scaffolds, aiming to replace or regenerate damaged meniscal tissue (Scotti et al., 2013).

Additional notes

References

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