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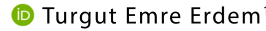
REVIEW

Medial and Lateral Meniscus Bucket Handle Tears: A Comprehensive Review

Medial ve Lateral Menisküs Kova Sapı Yırtıkları: Kapsamlı Bir Derleme


Turgut Emre Erdem[1]

[1]Akdeniz University, Faculty of Medicine, Department of Orthopedics and Traumatology, Antalya, Türkiye

ABSTRACT

Bucket-handle tears represent a distinct and clinically significant subgroup of meniscal injuries characterized by displacement of a longitudinally torn meniscal fragment into the intercondylar notch. These lesions commonly produce mechanical symptoms, including knee locking, restricted range of motion (ROM), and acute functional impairment, often necessitating prompt surgical intervention. Although medial bucket-handle tears are encountered more frequently, lateral bucket-handle tears pose unique diagnostic and therapeutic challenges because of their stronger association with acute trauma and anterior cruciate ligament injuries. Accurate diagnosis relies heavily on magnetic resonance imaging (MRI), where classic findings such as the double posterior cruciate ligament sign, absent bow-tie sign, and fragment-in-notch sign facilitate detection. Current treatment strategies emphasize meniscal preservation through repair rather than meniscectomy, given the critical role of the meniscus in load transmission, joint stability, and long-term cartilage preservation. Surgical decision-making should consider tear chronicity, reducibility, tissue quality, vascular zone involvement, and concomitant procedures such as anterior cruciate ligament reconstruction. Differences between medial and lateral bucket-handle tears influence repair techniques, healing potential, and postoperative rehabilitation protocols. This comprehensive review summarizes the current evidence regarding the epidemiology, pathomechanics, clinical presentation, imaging characteristics, treatment strategies, and outcomes of medial and lateral bucket-handle meniscal tears. By emphasizing the anatomical and biomechanical distinctions between these entities, this review aims to provide a practical framework for optimized diagnosis, individualized treatment planning, and improved clinical outcomes in patients with bucket-handle meniscal injuries.

Keywords: Bucket handle tear, meniscus, medial meniscus, lateral meniscus, meniscal repair, knee arthroscopy

ÖZET

Kova sapı menisküs yırtıkları, longitudinal menisküs yırtığının bir parçasının interkondiler çentiğe yer değiştirmesi ile karakterize, klinik açıdan önemli bir menisküs yaralanması alt grubunu oluşturur. Bu lezyonlar sıklıkla diz kilitlenmesi, hareket kısıtlılığı ve akut fonksiyon kaybı ile seyreder ve çoğu zaman cerrahi müdahale gerektirir. Medial kova sapı yırtıkları daha sık görülmekle birlikte, lateral kova sapı yırtıkları genellikle akut travma ve ön çapraz bağ yaralanmaları ile daha yakın ilişkilidir ve tanı ile tedavi açısından özgün zorluklar barındırır. Tanıda manyetik rezonans görüntüleme (MRG) temel rol oynamakta olup, double posterior cruciate ligament bulgusu, bow-tie kaybı ve interkondiler çentikte fragman bulgusu gibi klasik işaretler yol göstericidir. Tedavi yaklaşımında güncel eğilim, menisküsün biyomekanik ve kondral koruyucu rolü nedeniyle menisektomi yerine menisküs onarımını ön plana çıkarmaktadır. Cerrahi karar sürecinde yırtığın süresi, redükte edilebilirliği, doku kalitesi, vasküler zon yerleşimi ve eşlik eden cerrahiler dikkate alınmalıdır. Medial ve lateral kova sapı yırtıkları arasındaki anatomik ve biyomekanik farklar, cerrahi teknik seçimi, iyileşme potansiyeli ve rehabilitasyon protokollerini doğrudan etkilemektedir. Bu derleme, medial ve lateral menisküs kova sapı yırtıklarının epidemiyolojisi, patomekaniği, klinik bulguları, görüntüleme özellikleri, tedavi stratejileri ve prognozunu güncel literatür ışığında bütüncül olarak değerlendirmeyi amaçlamaktadır.

Anahtar Kelimeler: Kova sapı yırtığı, menisküs, medial menisküs, lateral menisküs, menisküs onarımı, diz artroskopisi

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Corresponding Author: Turgut Emre Erdem, Akdeniz University, Faculty of Medicine, Department of Orthopedics and Traumatology, Antalya, Türkiye
e-mail: turgutemreerdem@gmail.com

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INTRODUCTION

The menisci are essential fibrocartilaginous structures that play a critical role in knee joint biomechanics by contributing to load transmission, shock absorption, joint stability, lubrication, and proprioception (1–3). Disruption of meniscal integrity alters tibiofemoral contact mechanics and has been consistently associated with accelerated cartilage degeneration and the development of early osteoarthritis (4,5). Bucket-handle tears constitute a clinically important subgroup of meniscal injuries. They are defined as displaced longitudinal tears in which a central fragment of the meniscus is displaced into the intercondylar notch, often resulting in mechanical knee locking and limitation of extension (6,7). Bucket-handle tears account for approximately 10–26% of meniscal injuries and frequently require surgical treatment because of persistent mechanical symptoms (8).

Medial bucket handle tears are more commonly encountered, largely attributed to the lower mobility and stronger capsular attachments of the medial meniscus (9). In contrast, lateral bucket handle tears are more frequently associated with acute traumatic events and concomitant anterior cruciate ligament (ACL) injuries, and may present with subtler clinical findings (10,11). Despite sharing a similar morphological pattern, medial and lateral bucket handle tears differ substantially in terms of injury mechanism, reducibility, tissue quality, vascular supply, and healing potential (12). Historically, bucket handle tears were predominantly treated with partial or subtotal meniscectomy to rapidly alleviate mechanical symptoms. However, long-term follow-up studies have demonstrated that meniscectomy significantly increases joint contact pressures and is associated with a higher risk of radiographic and symptomatic osteoarthritis (4,13). These findings have contributed to a paradigm shift favoring meniscal preservation, with repair now favored whenever technically and biologically feasible. Advances in arthroscopic techniques, repair devices, and biological augmentation have expanded the indications for meniscal repair, even in complex and displaced tear patterns such as bucket handle lesions (14,15). Nevertheless, successful repair remains technically demanding and is influenced by several factors, including tear chronicity, tissue quality, vascular zone involvement, and the presence of concomitant procedures such as ACL reconstruction (16,17).

Timely and accurate preoperative diagnosis is essential to optimize surgical outcomes. Magnetic resonance imaging (MRI) remains the gold standard for detecting bucket handle tears, with classic signs such as the double posterior cruciate ligament sign, absent bow-tie sign, and fragment-in-notch sign commonly described (18,19). However, diagnostic pitfalls persist, particularly in lateral bucket handle tears and in cases with associated ligamentous injuries, potentially leading to delayed treatment and reduced reparability (20). Despite their clinical importance, the literature on bucket handle meniscal tears remains fragmented, with many studies focusing on isolated aspects such as imaging features or surgical techniques. Comprehensive reviews that integrate diagnostic strategies, treatment decision-making, and prognostic factors-while explicitly addressing differences between medial and lateral bucket handle tears-are limited. Therefore, an updated and holistic synthesis of current evidence is warranted. The purpose of this review is to provide a comprehensive evaluation of medial and lateral meniscus bucket handle tears, focusing on epidemiology, pathomechanics, clinical presentation, imaging characteristics, treatment strategies, and outcomes. Emphasis is placed on anatomical and biomechanical distinctions between medial and lateral lesions to support individualized clinical decision-making and improve patient outcomes.

Definition and Classification

A bucket handle meniscal tear is classically defined as a displaced longitudinal tear in which a central fragment of the meniscus is detached and displaced toward the intercondylar notch while remaining attached at its anterior and posterior horns (21,22). This displacement produces the characteristic "handle-like" configuration, from which the injury derives its name, and frequently results in mechanical knee symptoms such as locking, catching, or loss of full extension. Bucket handle tears differ fundamentally from simple longitudinal meniscal tears due to their unstable and displaced nature. While nondisplaced longitudinal tears may remain asymptomatic or minimally symptomatic, bucket handle tears typically cause acute functional impairment and often require urgent surgical intervention (23). The displaced fragment may intermittently reduce or remain permanently incarcerated within the intercondylar notch, influencing both clinical presentation and reparability. From an anatomical perspective, bucket handle tears most commonly involve the medial meniscus, particularly the posterior horn and midbody regions (11). This predominance is attributed to the relative immobility of the medial meniscus, its firm capsular attachments, and its role as a secondary stabilizer in the anterior cruciate ligament–deficient knee (24). In contrast, lateral bucket handle tears occur less frequently but are strongly associated with acute rotational trauma and concomitant ACL injuries, often presenting in younger and more athletic populations (25).

Several classification approaches have been proposed to better characterize bucket handle tears and guide treatment decisions. One commonly used method categorizes tears based on reducibility into reducible and irreducible bucket handle tears. Reducible tears can be anatomically repositioned during arthroscopy, whereas irreducible tears are often associated with chronicity, deformation of the fragment, synovial scarring, or poor tissue quality, limiting repair options (26). Another clinically relevant classification considers tear chronicity, typically divided into acute and chronic lesions. Acute bucket handle tears, usually defined as those treated within six weeks of injury, demonstrate higher rates of successful reduction and healing following repair. Chronic tears, by contrast, are more likely to exhibit plastic deformation, fraying, and compromised vascularity, reducing the likelihood of successful meniscal preservation (27). Bucket handle tears may also be classified according to vascular zone involvement, including red–red, red–white, and white–white zones. Tears involving the peripheral vascularized zones show superior

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healing potential and are more amenable to repair, whereas centrally located tears carry a higher risk of repair failure (28). This classification remains particularly important when selecting repair techniques and counseling patients regarding prognosis.

Finally, bucket handle tears should be distinguished from other displaced meniscal lesions, such as flap tears, parrot-beak tears, and meniscal root tears, which differ in biomechanical consequences and treatment strategies (29). Accurate classification of bucket handle tears is therefore essential for appropriate surgical planning, prognostic assessment, and comparison of outcomes across studies.

EPIDEMIOLOGY AND MECHANISM OF INJURY

Bucket handle tears account for approximately 10–26% of all meniscal tears and represent one of the most common causes of a mechanically locked knee (30). They predominantly affect young and middle-aged adults, with a higher incidence reported in males, likely reflecting greater exposure to high-demand occupational and sporting activities (31). Athletic populations, particularly those involved in pivoting sports such as soccer, basketball, and skiing, demonstrate an increased risk of bucket handle meniscal injuries (32). From an epidemiological standpoint, the medial meniscus is involved in the majority of bucket handle tears, with reported medial-to-lateral ratios ranging from 2:1 to 4:1 (11). This disparity is attributed to fundamental anatomical and biomechanical differences between the medial and lateral menisci. The medial meniscus is more firmly attached to the joint capsule and medial collateral ligament, resulting in reduced mobility and increased susceptibility to shear forces during rotational loading (33). Lateral bucket handle tears, although less frequent, exhibit a distinct epidemiological profile. They are more commonly observed in younger patients and are strongly associated with acute traumatic events, particularly in the setting of anterior cruciate ligament (ACL) rupture (34,35). Several studies have demonstrated that lateral bucket handle tears are disproportionately represented in acute ACL-injured knees, suggesting a shared injury mechanism involving high-energy rotational forces and anterior tibial translation (36).

The mechanism of injury in bucket handle tears typically involves a combination of axial loading, knee flexion, and rotational stress. In medial bucket handle tears, injury often occurs during a twisting movement on a flexed knee with the foot planted, producing excessive posterior horn loading and longitudinal fiber disruption (37). In contrast, lateral bucket handle tears are more frequently associated with acute pivot-shift–type mechanisms, where rapid internal rotation of the femur on a relatively fixed tibia leads to sudden meniscal displacement (37). Chronicity also plays a key role in the epidemiological characterization of bucket handle tears. Medial bucket handle tears are more likely to become chronic due to intermittent reduction of the displaced fragment and delayed presentation, particularly in patients without dramatic acute trauma (27,38). Conversely, lateral bucket handle tears often present acutely with pronounced mechanical symptoms, prompting earlier diagnosis and intervention (25). The relationship between bucket handle tears and ACL injury is of particular clinical importance. The medial meniscus functions as a secondary stabilizer in ACL-deficient knees, and repetitive instability episodes increase the risk of medial bucket handle tearing over time (24). Conversely, lateral meniscal bucket handle tears are frequently sustained at the time of initial ACL rupture, reflecting acute overload rather than chronic degeneration (39).

Understanding the epidemiological patterns and injury mechanisms of medial and lateral bucket handle tears is essential for accurate diagnosis, anticipation of associated injuries, and formulation of appropriate treatment strategies. These distinctions have direct implications for surgical timing, repair feasibility, and long-term prognosis.

CLINICAL PRESENTATION AND PHYSICAL EXAMINATION

Bucket handle meniscal tears typically present with acute mechanical symptoms driven by displacement of the torn fragment into the intercondylar notch. The hallmark clinical feature is a mechanically locked knee, most commonly manifesting as an extension block with inability to fully extend the knee (7). Patients frequently describe a sudden painful episode during twisting or pivoting, followed by catching, locking, or a sensation that "something is stuck inside the knee" (40). Pain is often localized to the involved compartment and may be accompanied by joint line tenderness. However, pain intensity can be variable and may be less prominent than the mechanical limitation, particularly when the displaced fragment remains incarcerated and the knee rests in a flexed position (41). Effusion is common, especially in acute traumatic tears, and when concomitant ligamentous injuries are present (34,35). In ACL-injured knees, symptoms related to instability may coexist or dominate the presentation, potentially obscuring the diagnosis of a bucket handle tear (25,36). Several features may help differentiate medial from lateral bucket handle tears clinically. Medial bucket handle tears more often occur in the setting of chronic or recurrent instability episodes (e.g., ACL deficiency) and may present after a period of intermittent symptoms before frank locking develops (24). Lateral bucket handle tears are more frequently associated with acute pivot-shift–type trauma and may present abruptly with prominent locking, particularly in young athletic patients with acute ACL rupture (39). Nevertheless, clinical overlap is substantial, and definitive compartmental differentiation based on symptoms alone is unreliable.

Physical examination begins with assessment of ROM, where a true mechanical block-most commonly preventing terminal extension-should raise suspicion for a displaced meniscal fragment (7). Joint line tenderness remains a widely used sign but has only moderate diagnostic accuracy when used in isolation (42). Traditional provocative tests such as the McMurray test may reproduce pain or a palpable click; however, reported sensitivity varies widely and performance is examiner-dependent (43). The Thessaly test was initially described as highly accurate, yet subsequent studies and meta-analyses have demonstrated more modest diagnostic performance and limited utility as a standalone test, particularly in acute settings

with pain and guarding (44). Therefore, while a combination of history and examination findings can raise suspicion, imaging-most commonly MRI-remains critical for confirmation and surgical planning. Importantly, clinicians should distinguish a true locked knee from "pseudo-locking," which may occur due to pain, effusion, or muscle spasm without a mechanical obstruction. Pseudo-locking is more typical of acute synovitis, loose bodies, or severe effusion and may improve with analgesia and aspiration, whereas mechanical locking due to a bucket handle tear typically persists until reduction or surgical treatment (45). In cases of suspected locked knee, early orthopedic evaluation is recommended because prolonged displacement may reduce reparability by promoting fragment deformation and synovial scarring (26,27).

Overall, clinical presentation and examination provide essential early recognition cues for bucket handle meniscal tears, but diagnostic certainty generally requires MRI. Recognizing patterns of mechanical locking and considering associated injuries-particularly ACL ruptur-are key to timely management and optimal outcomes.

Imaging Evaluation

Magnetic resonance imaging (MRI) is the imaging modality of choice for the evaluation of suspected bucket handle meniscal tears, owing to its high soft-tissue contrast resolution and ability to visualize meniscal morphology, displacement, and associated intra-articular pathology (8,18). Accurate preoperative identification of a bucket handle tear is critical, as delayed diagnosis may result in chronic displacement, reduced reparability, and inferior clinical outcomes (26,27). Several classic MRI signs have been described to facilitate the diagnosis of bucket handle tears. The double posterior cruciate ligament (PCL) sign is one of the most well-known findings, occurring when a displaced meniscal fragment lies parallel and anterior to the intact PCL, mimicking a second ligamentous structure (Figure-1) (8,18). This sign is highly specific but relatively insensitive, as it is primarily observed in displaced medial meniscus tears and requires sufficient fragment size and orientation to be visualized (46). Another commonly reported finding is the absent bow-tie sign, which refers to the loss of the normal meniscal body appearance on consecutive sagittal images (19). In a normal knee, the meniscal body is visualized on at least two adjacent sagittal slices; absence of this configuration suggests meniscal displacement. Although sensitive, this sign is not specific to bucket handle tears and may be observed in other complex or macerated meniscal injuries (18,47).

Additional supportive signs include the fragment-in-notch sign, characterized by visualization of the displaced meniscal fragment within the intercondylar notch on coronal or axial images, and the anterior flipped meniscus sign, in which the fragment is displaced anteriorly toward the anterior horn (Figure-2)(18,19). Evaluation in multiple imaging planes is essential, as reliance on a single sign or plane increases the risk of misdiagnosis. MRI diagnosis of lateral bucket handle tears presents unique challenges. The greater mobility of the lateral meniscus, combined with its anatomical relationship to the popliteus tendon and hiatus, may allow partial reduction of the fragment during imaging, leading to false-negative findings (20). Moreover, lateral bucket handle tears are frequently associated with acute ACL rupture, hemarthrosis, and synovial reaction, which may obscure meniscal morphology and complicate interpretation (34,36). False-negative MRI examinations have been reported in up to 15–30% of bucket handle tears, particularly in the lateral compartment and in the acute post-injury setting (22,48). Conversely, false-positive interpretations may occur when normal variants, postoperative changes, or meniscofemoral ligaments are mistaken for displaced meniscal fragments (49). Therefore,

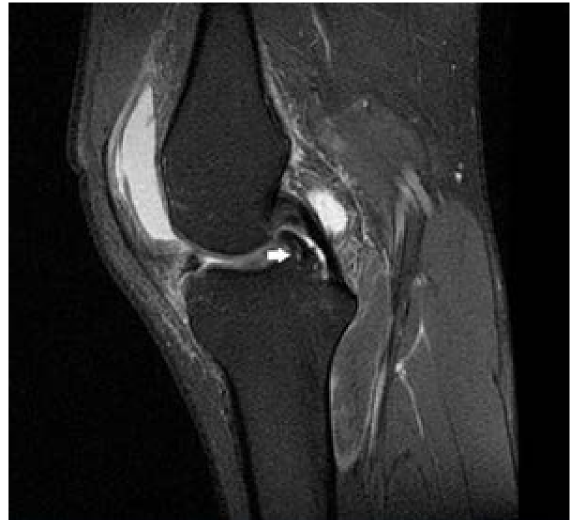

Figure 1. Double posterior cruciate ligament (Double PCL) sign on MRI

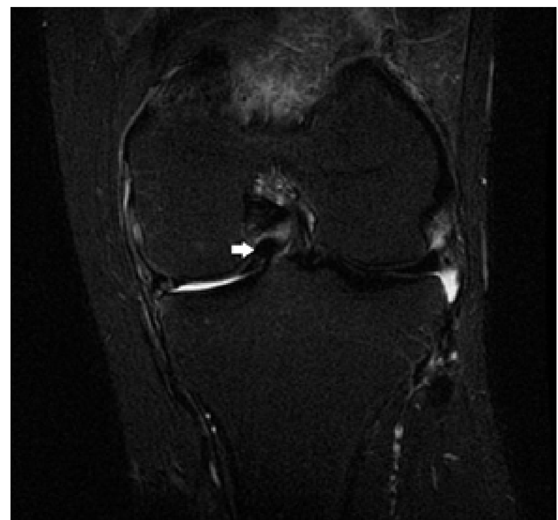

Figure 2. Coronal magnetic resonance imaging demonstrating a displaced medial meniscal fragment within the intercondylar notch.

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MRI findings must always be interpreted in conjunction with clinical presentation and physical examination.

Advanced imaging techniques, including three-dimensional MRI sequences and higher-field-strength scanners, have demonstrated improved visualization of meniscal anatomy; however, their routine clinical superiority over standard protocols remains under investigation (50). Recently, artificial intelligence–assisted MRI interpretation has shown promise in meniscal tear detection, but its specific role in identifying displaced bucket handle tears has yet to be fully validated (51). In summary, MRI plays a pivotal role in the diagnosis and preoperative assessment of bucket handle meniscal tears. Familiarity with classic imaging signs, awareness of diagnostic pitfalls-particularly in lateral tears-and correlation with clinical findings are essential to optimize diagnostic accuracy and guide timely surgical management.

TREATMENT STRATEGIES

The primary goals in the treatment of bucket handle meniscal tears are relief of mechanical symptoms, restoration of meniscal anatomy, and preservation of long-term knee joint function. Because displaced bucket handle tears frequently result in a locked knee, surgical intervention is generally indicated, particularly in the presence of persistent mechanical block, pain, or functional limitation (7,26).

Indications for Surgery

Nonoperative management has a very limited role in bucket handle tears due to the unstable and displaced nature of the lesion. Conservative treatment may be considered only in rare cases where spontaneous reduction occurs, symptoms resolve completely, and imaging confirms a stable meniscal configuration (38). In most patients, however, delayed treatment increases the risk of chronic displacement, fragment deformation, and reduced reparability (26,27). Urgent arthroscopic intervention is recommended in cases of true mechanical locking to prevent irreversible meniscal damage and secondary chondral injury (7,13).

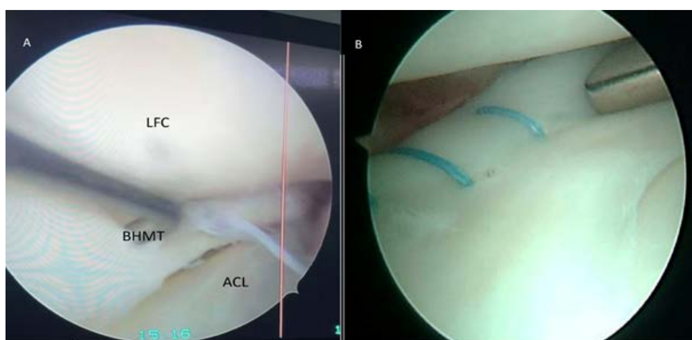

Figure 3. A. Lateral bucket handle meniscal tear arthroscopic image B. Arthroscopic image after meniscus repair (LFC : Lateral femoral condyl, ACL : Anterior cruciate ligament, BHMT : Bucket handle meniscal tear)

Meniscal Repair versus Meniscectomy

Current treatment paradigms strongly favor meniscal preservation whenever feasible. Numerous biomechanical and clinical studies have demonstrated that meniscectomy-particularly subtotal or total resection-leads to increased tibiofemoral contact pressures and a significantly higher risk of early osteoarthritis (4,13,52). Consequently, meniscal repair is preferred, especially in young and active patients.

Meniscal repair is generally indicated when the tear is:

- Reducible
- Located in the vascularized red–red or red–white zone
- Associated with good tissue quality
- Addressed in an acute or subacute setting (16,28)

Partial meniscectomy may be necessary in irreducible tears, severely degenerated tissue, chronic plastic deformation, or when stable fixation cannot be achieved despite adequate reduction (13,53).

Repair Techniques

Several arthroscopic repair techniques are available for bucket handle tears, including inside-out, outside-in, and all-inside methods (Figure-3). The inside-out technique remains the gold standard for many surgeons due to its strong fixation and versatility, particularly for large displaced fragments (14,15). All-inside devices offer reduced operative time and lower neurovascular risk, though concerns regarding implant-related complications and cost persist (54). Hybrid techniques combining inside-out sutures with all-inside devices are frequently employed to optimize fixation along the entire tear length (55).

Medial versus Lateral Considerations

Medial bucket handle tears are often more challenging to reduce due to chronicity and tissue stiffness, particularly in ACL-deficient knees (24). However, when successfully repaired-especially in conjunction with ACL reconstruction-healing rates are favorable (17,25). Lateral bucket handle tears, although less common, tend to be more acute and exhibit superior healing potential due to better vascularity and meniscal mobility (25,34). Repair success rates for lateral tears are generally higher, particularly when performed at the time of acute ACL reconstruction (25,39).

Role of Concomitant ACL Reconstruction

Concomitant ACL reconstruction has been shown to significantly enhance meniscal healing by improving joint stability and increasing intra-articular bleeding, which may promote biological repair (16,17). Therefore, combined procedures are often recommended when bucket handle tears coexist with ACL rupture. Overall, treatment strategies for bucket handle meniscal tears should be individualized, taking into account tear characteristics, patient factors, chronicity, and associated injuries, with a strong emphasis on meniscal preservation.

POSTOPERATIVE REHABILITATION

Postoperative rehabilitation after bucket handle meniscal repair aims to protect the repair construct, facilitate biological healing, restore range of motion (ROM), and enable safe return to function while minimizing the risk of re-tear. Rehabilitation

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protocols vary widely in the literature, reflecting differences in tear patterns, repair techniques, concomitant procedures, and surgeon preference (56,57). Nevertheless, most contemporary approaches balance early controlled motion with protection from excessive shear and compressive loads across the repair site.

Weight-Bearing

Weight-bearing recommendations typically depend on tear location, fixation stability, and whether concomitant anterior cruciate ligament (ACL) reconstruction is performed. For isolated bucket handle repairs, many protocols advocate protected or partial weight-bearing for the first 2–4 weeks, progressing to full weight-bearing as tolerated by 4–6 weeks, often with the knee in a brace locked in extension during ambulation in the early phase (58,59). The rationale is to reduce posterior horn shear forces and limit deep flexion loading that may jeopardize suture integrity.

Range of Motion

Early controlled ROM is generally encouraged to reduce stiffness and prevent arthrofibrosis, particularly after locked-knee presentations. However, excessive flexion may increase meniscal extrusion and posterior horn stress. Consequently, many protocols limit flexion to 0–90° during the first 4–6 weeks, followed by gradual progression toward full flexion (60). Extension is commonly allowed early, as terminal extension typically imposes less shear stress on the meniscal repair compared with deep flexion positions.

Bracing

A hinged knee brace is frequently used in the early postoperative period, especially for displaced bucket handle repairs, to control ROM and maintain extension during ambulation. Bracing may be used for 4–6 weeks depending on stability, patient compliance, and associated procedures (15,58).

Strengthening and Functional Training

Quadriceps activation is initiated early using isometric exercises and closed-chain activities within protected ROM. Strengthening typically progresses from isometrics and straight-leg raises to closed-chain strengthening (e.g. mini-squats within limited flexion) and proprioceptive training after the early healing phase (57,61). High-load open-chain hamstring exercises and deep squatting are generally avoided early due to increased posterior horn strain.

Return to Sport

Return-to-sport decisions should be individualized, incorporating clinical examination, functional testing, and the presence of concomitant ACL reconstruction. For isolated meniscal repairs, running is often permitted around 10–12 weeks, while pivoting sports may be delayed until 4–6 months, depending on healing and neuromuscular recovery (62). When combined with ACL reconstruction, rehabilitation is primarily guided by ACL timelines, and return to pivoting sports is often delayed to 6–9 months or longer, based on strength symmetry and functional readiness (63).

Medial versus Lateral Considerations

Although evidence is limited, some clinicians advocate slightly more cautious progression for medial bucket handle repairs, particularly when chronicity or posterior horn involvement is prominent, due to potentially higher shear forces during daily activities (17). Lateral repairs, often performed in the acute setting with better tissue quality, may tolerate earlier progression, but robust comparative evidence remains insufficient. Therefore, rehabilitation should be tailored primarily to tear characteristics, fixation security, and associated injuries rather than laterality alone.

In summary, postoperative rehabilitation after bucket handle meniscal repair should follow a structured, criterion-based approach that emphasizes early controlled motion, protected loading, progressive strengthening, and individualized return-to-sport criteria. Close coordination between surgeon, physiotherapist, and patient is crucial to optimize healing and functional outcomes.

OUTCOMES AND PROGNOSIS

Clinical outcomes after bucket handle meniscal tears depend primarily on whether the meniscus is preserved, the biological environment of healing, and the presence of concomitant injuries-most notably anterior cruciate ligament (ACL) rupture. Across multiple cohorts, meniscal repair has consistently been associated with superior long-term joint preservation compared with meniscectomy, albeit with a higher short-term risk of reoperation due to re-tear or incomplete healing (13,23).

Repair Success and Failure Rates

Reported healing and success rates after arthroscopic repair of bucket handle tears vary due to heterogeneous definitions of “healing,” differences in tear chronicity, repair techniques, and follow-up duration. In general, contemporary studies report clinical success rates commonly in the 70–90% range, particularly in acute, reducible tears with good tissue quality and peripheral vascular zone involvement (64). Failures most frequently occur within the first 1–2 years and are driven by recurrent displacement, suture failure, inadequate biological healing, or unrecognized instability (16,56).

Impact of Concomitant ACL Reconstruction

Concomitant ACL reconstruction is among the most influential prognostic factors. Combined procedures have been associated with higher healing rates and lower failure risk compared with isolated meniscal repair, likely due to restoration of stability and increased intra-articular bleeding that may enhance healing biology (17). Conversely, uncorrected ACL deficiency increases repetitive shear forces on the meniscus, which may predispose to repair failure, particularly for medial posterior horn lesions (25,27).

Medial versus Lateral Bucket Handle Tears

Although bucket handle tears share a common displaced longitudinal morphology, outcomes may differ by laterality. Lateral bucket handle tears are often repaired in the acute setting and may demonstrate favorable healing potential due to better mobility and vascular characteristics of the lateral meniscus, with several series reporting comparatively higher success rates (25,54). Medial bucket handle tears, particularly when chronic or occurring in ACL-deficient knees, may be more

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difficult to reduce and may exhibit lower tissue compliance, potentially increasing the risk of incomplete healing or subsequent re-tear if stability is not addressed (24,27). Nonetheless, when medial tears are repaired promptly and/or combined with ACL reconstruction, clinical outcomes are generally good and joint-preserving compared with resection (17,27).

Meniscectomy and Osteoarthritis Risk

While partial meniscectomy reliably alleviates mechanical symptoms, substantial evidence links meniscal tissue loss to increased contact stresses and accelerated osteoarthritic change. This is especially relevant in bucket handle tears, where the temptation to resect a displaced fragment must be balanced against long-term cartilage preservation (5,13,52). Consequently, modern consensus emphasizes "save the meniscus" whenever feasible, particularly in young active patients (23,53).

Prognostic Factors

Key predictors of favorable outcome after bucket handle repair include: acute treatment, reducible tears, peripheral vascular zone involvement, good tissue quality, stable fixation, and correction of concomitant instability (e.g., ACL reconstruction) (6,16,27). Negative prognostic factors include chronicity with fragment deformation, poor meniscal tissue quality, central avascular location, high-grade chondral lesions, and persistent instability (27,30,52). In summary, outcomes after bucket handle meniscal tears are optimized when meniscal preservation is achieved under stable biomechanical conditions and within a biologically favorable window. Appreciating differences between medial and lateral lesions and addressing associated ACL pathology are central to improving healing rates and long-term joint health.

CONCLUSION

Bucket handle tears of the meniscus represent a distinct and clinically important subset of meniscal injuries due to their displaced morphology, propensity to cause mechanical knee locking, and frequent need for surgical intervention. Although medial bucket handle tears are encountered more commonly, lateral bucket handle tears pose unique diagnostic and therapeutic challenges, particularly because of their strong association with acute trauma and anterior cruciate ligament (ACL) rupture. Accurate and timely diagnosis is critical. Magnetic resonance imaging remains the cornerstone of preoperative evaluation, yet clinicians must be aware of its limitations-especially in lateral tears and acute injury settings-to avoid false-negative interpretations. Correlation of imaging findings with a characteristic clinical presentation of true mechanical locking is essential to guide early and appropriate management. Contemporary treatment strategies emphasize meniscal preservation whenever feasible. Arthroscopic repair of bucket handle tears has demonstrated favorable clinical outcomes and superior long-term joint preservation compared with meniscectomy, despite a higher short-term risk of reoperation. Factors such as tear chronicity, reducibility, tissue quality, vascular zone involvement, and correction of concomitant instability-most notably through ACL reconstruction-play decisive roles in determining healing and prognosis.

Medial and lateral bucket handle tears should not be regarded as a single entity. Differences in meniscal mobility, vascularity, injury mechanism, and association with ligamentous pathology influence reducibility, repair strategy, rehabilitation, and ultimate outcomes. Appreciating these distinctions allows for more individualized surgical decision-making and optimized patient counseling. Postoperative rehabilitation is a critical component of successful treatment and should follow a structured, criterion-based approach that balances protection of the repair with early controlled motion and progressive functional restoration. Failure patterns and complications are most often related to inadequate stabilization, poor biological healing environments, or unaddressed knee instability. In conclusion, optimal management of bucket handle meniscal tears requires an integrated understanding of anatomy, biomechanics, imaging, and surgical principles. A tailored approach that prioritizes meniscal preservation, addresses associated injuries, and accounts for medial–lateral differences is essential to improve healing rates, preserve joint health, and achieve durable long-term outcomes.

DECLARATIONS

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Address correspondence to: *Turgut Emre Erdem, Akdeniz University, Faculty of Medicine, Department of Orthopedics and Traumatology, Antalya, Türkiye*
e-mail: *turgutemreerdem@gmail.com*

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