Management of Painful Malleolar Gutters After Total Ankle Replacement

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Introduction

Total ankle replacement (TAR) is a technically challenging and demanding surgical procedure. The main objective is to restore a stable and pain-free mobile ankle. First- and second-generation TARs had a high rate of failure due to instability and loosening, respectively [1]. Third-generation TARs have significantly improved results by using techniques of mobile bearing, cementless fixation, and minimal bone resection [2]. Despite their higher satisfaction rates reported in the literature, the number of studies reporting case series of patients complaining about painful malleolar gutters after TAR has increased in the recent years [1–4]. This issue has been reported in different TAR prosthesis designs and the exact cause has not been fully understood, but seems to be multifactorial. Therefore, a detailed preoperative and postoperative analysis is essential to identify potential individual factors and risks. This chapter explores the potential inciting factors of residual and recurrent gutter pain after TAR and how they can be managed.

Incidence

The incidence of malleolar gutter pain after TAR varies from 2 to 23.5 % between various TAR prosthesis systems and original etiology of ankle arthritis [1, 2, 4–15]. Schuberth et al. [4] showed that a prophylactic gutter resection at the time of primary TAR implantation could significantly reduce the postoperative incidence of malleolar gutter pain. Only 2 % of patients with a prophylactic gutter resection required a secondary gutter resection. However, when patients did not have prophylactic gutter resection, the incidence could increase up to 18 % [4]. Therefore, extra care should be taken when interpreting the reported incidences of gutter pain if prophylactic gutter resection was a component of the index TAR procedure itself [4].

Etiology

The exact cause of recurrent gutter pain after TAR has not been fully understood, but based on the available findings from the literature seems to be multifactorial [1–4]. Factors commonly incriminated for gutter pain include technical errors [10], prosthesis design [9, 16, 17], residual gutter arthritis [4], oversized or undersized TAR components [17–19], ongoing instability, soft-tissue impingement [5], ectopic bone formation [2, 9, 15], and subsidence of the prosthesis [19, 20]. By far, medial impingement symptoms appear to be more common than lateral and the reasons behind this will be examined.

Initial Ankle Arthritis Diagnosis

Initial diagnosis of ankle arthritis has been pointed out as a potential explanation for malleolar gutter pain after primary TAR. It was hypothesized that patients with posttraumatic arthritis have a higher incidence of heterotopic ossification in the gutters causing recurrent symptoms. However, Schuberth et al. [4] clearly demonstrated that there is no significant difference among specific diagnosis groups with regard to the incidence of patients requiring secondary gutter resection.

Heterotopic Bone Formation

The development of heterotopic bone formation is not uncommon after TAR implantation and has been identified in different types of TAR prostheses [8, 14, 21].

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Recent studies have demonstrated that heterotopic ossification was however not associated with the outcome after primary TAR [8, 21]. Therefore, surgeons should be extremely careful in attributing pain symptoms of TAR to the presence of heterotopic bone formation.

Aseptic Loosening

Studies reported that osseous overgrowth in the talar–malleolar articular facets could potentially be a consequence of a loose talar component [3, 14, 22]. They suggest that surgeons should look for the presence of subtle signs of loosening and to test stability of the talar component on the talus perioperatively during revision surgery.

Prosthesis Design

TAR implants are composed with either fixed- or mobile-bearing polyethylene insert with each design having different benefits and drawbacks. Fixed-bearing designs are known to provide a stable joint without the risk of subluxation of the polyethylene insert [16, 23], but are prone to loosening of the tibial component due to high shear forces at the prosthesis–bone interface [24]. In contrast, mobile-bearing designs have a more flexible articulation with lower shear forces. Recently, the mobile-bearing TAR designs have been incriminated as potential cause of malleolar gutter pain, which could be induced by excessive anterior–posterior or lateral subluxation of the mobile-bearing polyethylene insert [16, 25]. Therefore, a fixed-bearing TAR design has been adopted by surgeons to avoid the concerns of midterm and long-term pain from malleolar impingement [16]. However, recent biomechanical studies have shown only minimal movement of insert in mobile-bearing TAR implants [26–28] which is probably not sufficient to contribute to the development of malleolar gutter pain, and, to the author's knowledge, no studies yet have shown a significant difference in incidence of gutter pain between these two prosthetic bearing designs.

Prosthesis Positioning and Technical Errors

Studies suggested that the emergence of symptomatic gutter pain could potentially be linked to the subsidence of the talar component or to the migration of the talar and tibial metallic components into the mortise exposing the remaining talar–malleolar articular surfaces and talar bone mass to increasing axial loads and further degeneration and gutter impingement [19, 29]. An undersized talar component was also pointed out as a potential cause of malleolar gutter pain. Cerrato and Myerson [19] reported that insufficient support of the body of the talus under the load of the smaller talar base plate could cause subsidence of the talar component and subsequently leading to malleolar gutter pain [19].

Excessive bone resection on the tibial side can potentially cause seating of the tibial metallic component on soft metaphyseal bone. The prosthetic component sinks into the soft bone, exposing the talus to both malleoli and leading to gutter pain.

Malpositioning of the prosthesis is probably one of the most common intraoperative complications and can provoke painful malleolar gutters postoperatively (Fig. 20.1) [10]. Varus positioning of the TAR components (>4°) can lead to medial gutter pain from impingement, and a valgus positioning of the TAR

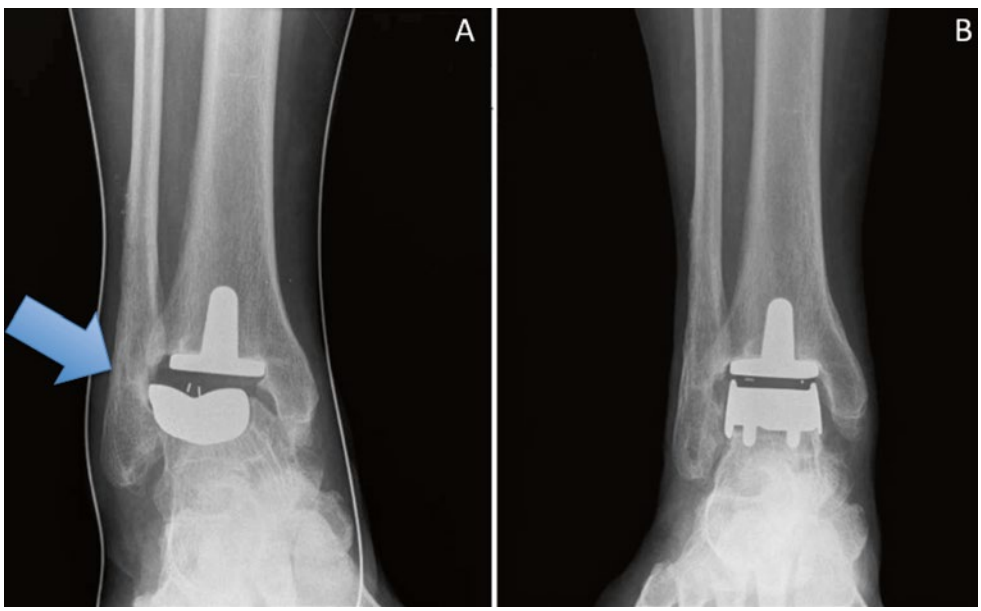

Fig. 20.1 (**a**) 74-year-old male patient with a total ankle replacement implanted in another center was suffering from lateral pain due to excessive lateral malposition of the talar component as demonstrated on weight-bearing anterior–posterior radiograph (**a**). The delay between the implantation of the total ankle replacement and the gutter pain was less than 1 year (**b**). The talar component of the prosthesis was revised with a revision talar component

components (>4°) can potentially lead to lateral gutter pain from subfibular impingement. Malpositioning of the prosthesis in these cases may be corrected by revision arthroplasty or by periprosthetic osteotomies.

Prophylactic Gutter Resection

Studies analyzing complications after TAR are still debating if gutter impingement requiring a reoperation (secondary gutter resection) can be classified as a complication [14] or as a technical error by the fact that no prophylactic gutter resection was performed at the time of the TAR implantation [10, 30]. Most of the current TAR systems do not incorporate prophylactic gutter resection in their surgical technique manuals. Therefore, in the author's opinion, failure to perform a prophylactic gutter resection cannot be classified as a technical error. However, surgeons should check for gutter-related abnormalities such as accumulated debris, osteophytes, and loose bodies at the time of primary TAR implantation [29]. Recent evidence showed that patients with prophylactic gutter resection at the time of primary TAR implantation had a significant lower incidence of secondary gutter resection (2 %) compared to patients without prophylactic gutter resection at the time of primary TAR implantation (7 %) [4].

Malalignment of the Ankle and Hindfoot

Correction of malalignment of the ankle and hindfoot at the time of primary TAR implantation is challenging and requires various associated additional procedures (e.g., calcaneal osteotomy, medial malleolus osteotomy, deltoid release, etc.) to balance the ankle in order to increase the chances of long-term survival of TAR. However, malalignment of the ankle and hindfoot is not always addressed at the time of the primary TAR implantation leading to painful postoperative TAR, which requires additional surgery to recreate a well-balanced ankle.

An uncorrected valgus deformity of the hindfoot at the time of primary TAR implantation can potentially cause an overloading of the medial malleolus and result in medial gutter pain. This deformity can be increased by an eccentric pull of the Achilles tendon [31]. A too medially positioned talar component in association with an uncorrected valgus deformity of the hindfoot can further increase the stress against the medial malleolus and lead to a stress fracture of the medial malleolus [32].

In the presence of a varus deformity of the hindfoot, the load concentrates typically at the medial part of the tibia and medial malleolus. If the varus deformity is not addressed at the time of primary TAR implantation, this can potentially lead to an increased translational force of the talus against the medial malleolus [32]. Over time, this could potentially lead to medial gutter pain.

Medial gutter pain after primary TAR implantation can also be the result of a varus or valgus deformity of the hindfoot, also called the "zigzag deformity" by Barg et al. [32] (Fig. 20.2). This deformity is composed of a valgus deformity of the hindfoot associated with a varus deformity at the ankle due to either a varus malpositioning of the tibial component or varus deformity of the tibia itself [32].

Additional Procedures

Surgeons often perform additional procedures at the time of primary TAR implantation to restore a neutral alignment and congruent ankle joint in order to avoid early failure. However, these procedures can potentially induce medial and lateral gutter pain, especially in cases where intra-articular deformities are corrected. For example, in cases of varus deformity at the level of the ankle joint, a distal tibial cut may not be sufficient to correct the deformity due to contracted deltoid ligament or due to altered morphology of the medial malleolus (distorted or flattened) resulting from the deformity itself [4, 33, 34]. A lengthening medial malleolar osteotomy is a procedure that has the advantage to release the tight medial structures and to also capture the medial talus by restoring a more normal shape of mortise [33]. However, sliding the medial malleolar fragment distally may result in impingement against the prosthesis, and therefore, surgeons must check for any impinging bone in the newly created medial gutter following medial malleolar osteotomy [33, 34].

Differential Diagnosis

Painful Collateral Ankle Ligaments

Valgus positioning of the metallic talar and tibial TAR components in cases of preoperative varus ankle osteoarthritis (>4°) can potentially create medial ossifications due to chronic overstretching of the medial ligaments [28]. Hintermann [29] reported that it is often seen in nonanatomically shaped talar designs where the medial radius is too wide [29].

Anterior–posterior malpositioning of the TAR components leads to anisometric loading of medial and lateral ankle collateral ligaments that could potentially lead to painful restriction of motion and instability during dorsiflexion and plantar flexion movements of the ankle [28].

A varus malpositioning of the TAR components can potentially create excessive stress on the lateral ankle ligaments and provoke either lateral pain or ankle instability [30].

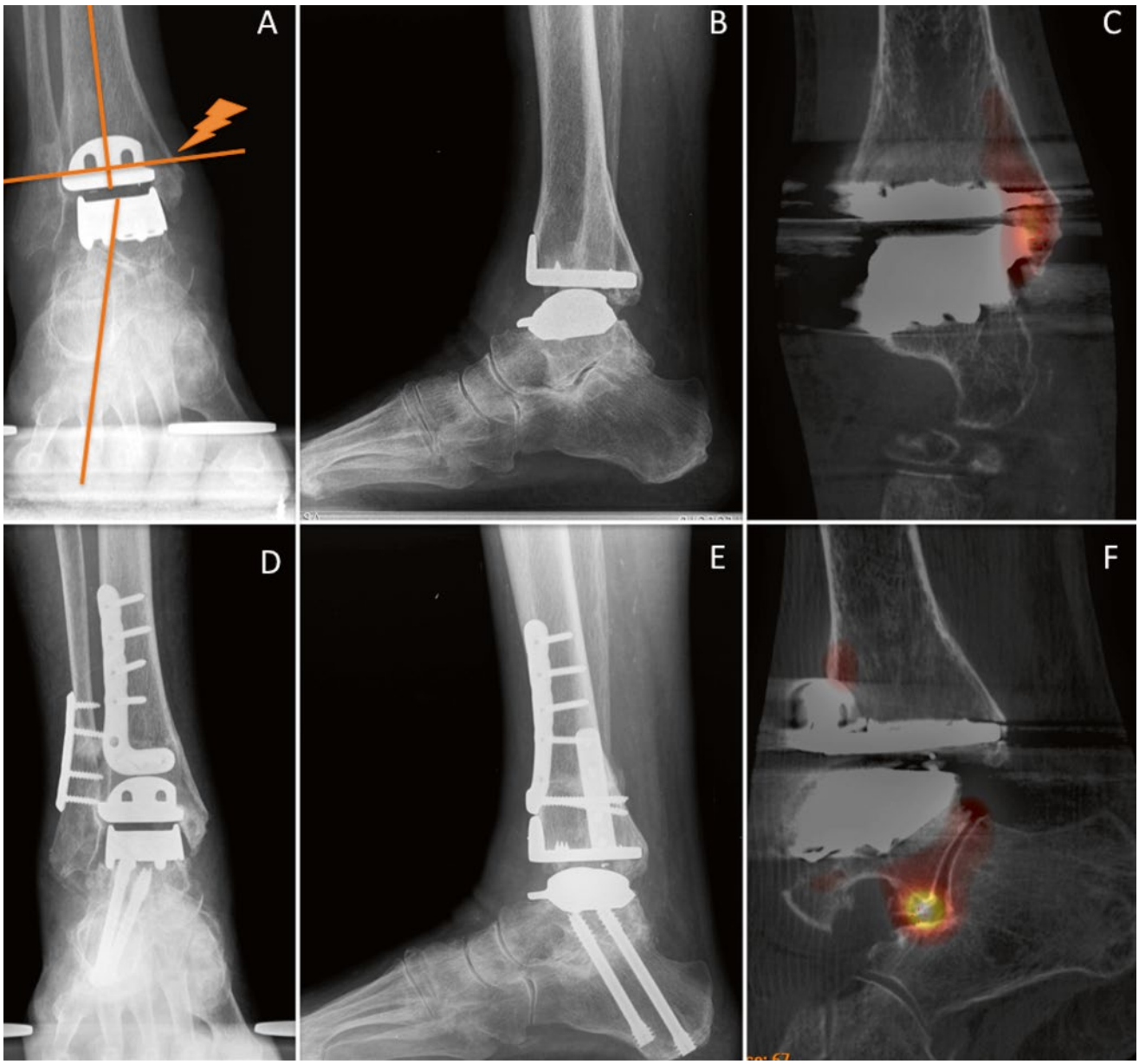

Fig. 20.2 Weight-bearing anterior–posterior (**a**) and lateral (**b**) radiographs of a 76-year-old female patient suffering from medial gutter pain after total ankle replacement induced by a "zigzag deformity" composed of a valgus deformity of the hindfoot associated with a varus of the tibial component with respect to the tibial axis. Single photon emission computed tomography scan isolated the potential symptomatic "hot" spot: medial malleolar gutter pain and subtalar joint pain due to subtalar joint arthritis (**c**, **f**). Weight-bearing anterior–posterior and lateral post-revision radiographs (**d**, **e**)

In presence of a varus deformity in the ankle in association with chronic lateral instability and medial capsular ligament contracture, surgeons tend to choose a thicker polyethylene insert to achieve a perceived improvement in stability. However, this can potentially lead to an excessive stress on the medial capsular ligament and with time cause medial side pain [32–34].

Intraoperative and Postoperative Fracture of the Medial or Lateral Malleolus

Intraoperative medial or lateral malleolar fracture is a well-known complication associated with primary TAR that is almost always treated with open reduction and internal fixation during the operation [35]. Fracture can occur

postoperatively due to excessive force placed across the narrowed medial or lateral malleoli or by repeated episodes of lesser force that exceed the strength gained by the remodeling process of the malleoli [10, 29].

Tibialis Posterior Muscle Pain

Patients presenting with a preoperative varus deformity at the level of the ankle joint may have a relative contracture of the posterior tibial muscle and can experience postoperative medial side pain when the contracture is not addressed at the time of the primary TAR implantation [32–34]. An oversized tibial component extending past the posterior–medial aspect of the tibia can also potentially irritate the tibialis posterior tendon and cause medial retromalleolar pain.

Distal Tibiofibular Syndesmosis Instability

A frequent sequel of posttraumatic ankle arthritis is the presence of distal tibiofibular syndesmosis instability that needs to be addressed before or at the time of primary TAR implantation.

Clinical Evaluation

Careful assessment of the patient's history is essential. The patient is questioned regarding the following aspects: pain, limitations in activities of the daily living, sports activities, and previous treatments. Alignment of the foot and ankle is assessed while standing and walking, with a special attention to obvious deformity and soft-tissue condition. Ankle and syndesmotic stability is tested in both the frontal and sagittal planes. Ankle and subtalar range of motion is evaluated and determined with a goniometer. Localization of the pain is performed through palpation of the medial and/or lateral gutters: the surgeon must be able to provoke a recognizable pain on palpation of the gutters or the posterior compartment.

Investigations

Presence of painful gutter pain does not always implicate that osseous overgrowth is the primary cause of pain. Radiographic determination of true gutter impingement is subjective and sometimes difficult to correlate with clinical examination. As mentioned earlier, gutter pain can potentially be induced by prosthetic and extra-prosthetic factors.

Plain Radiographs

Weight-bearing anterior–posterior and lateral view plain radiographs of the foot and ankle are of primary importance to analyze the position of the TAR prosthesis by measuring the following variables: tibial slope, polyethylene mobile-bearing positioning, anterior–posterior position of the talar component with respect to the tibial axis, the anterior–posterior alignment of the talar component with respect to the tibial component, and the position of the tibial and talar components with respect to the tibial axis in the frontal plane [8, 36–38]. Through the Méary view [36] or the Saltzman view [38], the alignment of the hindfoot is assessed. Length or rotational discrepancy of the malleoli should be analyzed and on a comparative view of both mortises [39].

Stress radiographs in varus and valgus are useful to assess the stability of medial and lateral ligaments around the prosthesis [40].

Computed Tomography (CT) Scan

CT scan is a useful investigation tool, which not only allows evaluation of the exact positioning of the prosthetic components but also assessment of anomalies such as periprosthetic impingement at the interface between bone and the metallic TAR components [40]. Osseous impingements are often underestimated on plain radiographs compared to the more detailed information provided by the CT scan.

Sonography

Ultrasound scans can be useful to confirm any clinical suspicion of tendon injuries, such as the tibialis posterior or the peroneal tendons, which might explain the pain around the malleoli.

Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) does not allow a detailed analysis of the periprosthetic region due to the many artifacts created by the TAR metallic components and is not recommended [40].

Single Photon Emission Computerized Tomography Scan

Pain around ankle prosthesis can be a diagnostic challenge given the complex anatomical relations and structural mechanics. Single photon emission computerized tomography

(SPECT) scan is a diagnostic tool that has an added value in clarifying a diagnosis in unexplained pain around the prosthesis (Fig. 20.2c, f). However, SPECT scan should not be used in isolation, and findings should always be correlated with the clinical findings and patient's symptoms. Williams et al. [41] have shown that not all so-called "hot" spots identified on SPECT scan are symptomatic.

Diagnostic Injection

Fluoroscopically or ultrasound-guided local anesthetic injections with or without corticosteroid can help in clarifying a diagnosis in unexplained pain around the prosthesis. Very often, the injection guided by recognizable pain on palpation will be the most effective. These injections can also have a temporary or definitive therapeutic purpose. Steroids are to be avoided if deep periprosthetic infection has not already been ruled out.

Management of Painful Malleolar Gutters

True correlation between radiographic and clinical evidence of gutter impingement should be clearly identified before planning revision surgery [6]. Studies have found that the postoperative scores were compromised when gutter impingement was only a consequence of an underlying problem which was unmasked secondarily after the gutter débridement [3, 4]. Unfortunately, meaningful literature reporting the effectiveness of conservative and surgical treatments in patients with malleolar gutter pain after TAR is scarce.

Conservative Treatment

To the authors' knowledge, no studies analyzing the effectiveness of conservative treatment in patients suffering from malleolar gutter pain exist. Kurup and Taylor [1] reported that four of the eight patients suffering from medial impingement following primary TAR were treated conservatively and had no further progression of their symptoms. Orthoses to relieve weight bearing and contact in painful malleolar gutters after primary TAR can potentially relieve the pain in patients who are not keen on further surgery. However, it may not be advisable in well-aligned TARs as it may alter the mechanics.

Fluoroscopically or ultrasound-guided local anesthetic injections with or without corticosteroids can also have temporary or definitive therapeutic purposes. However, no studies reported their effectiveness in the literature.

Surgical Procedures

The first question to be answered is whether gutter débridement will be sufficient or not to alleviate malleolar gutter pain. From the authors' experience, additional procedures (supra- or inframalleolar osteotomies, ligamentoplasty, etc.) should be performed in association with gutter debridement in the presence of malalignment of the hindfoot and ankle or metallic component malpositioning in order to restore a stable and pain-free mobile ankle and to prevent recurrent subsidence and osseous overgrowth.

Malleolar gutters can be debrided either by open arthrotomy or arthroscopically [1–3, 5]. Arthroscopy has multiple advantages over open debridement, including a potential shorter recovery time [3, 5]. The surgical technique for arthroscopic debridement following TAR was accurately described by Shirzad et al. [5] and Richardson et al. [3]. Both publications stressed the importance of avoiding contact between the blunt end of the shaver or burr and the metallic components in order to prevent any damage to the TAR components during the surgery (Fig. 20.3).

Unfortunately, meaningful studies analyzing the effectiveness of gutter debridement are limited. Arthroscopic debridement in patients suffering from persistent pain due to osseous impingement has found to be effective in 80–100 % of cases [1, 3]. Kim et al. [6] were more cautious in expressing their success rate and preferred to report the effectiveness of the arthroscopic procedure through the use of the visual analogue scale (VAS), which improved from 7.1 preoperatively to 2.7 at final follow-up. Despite these encouraging results, Richardson et al. [3] reported a high recurrence rate of 37.5 % (6/16 patients).

Conclusions

TAR is a challenging procedure, which has the potential to restore a pain-free mobile and stable ankle. Despite high satisfaction rates reported in the literature, patients complaining about malleolar gutter pain range from 2 to 23.5 % between various prosthesis designs and ankle arthritis etiologies. Malleolar gutter pain is often a sign of overloading caused by malalignment of the hindfoot and ankle or by malpositioning of the TAR metallic components. Therefore, detailed preoperative and postoperative analyses are essential to identify the incriminating factors provoking the malleolar gutter pain. These factors should always be addressed in association with débridement of the malleolar gutters in order to prevent recurrence of the patients' symptoms.

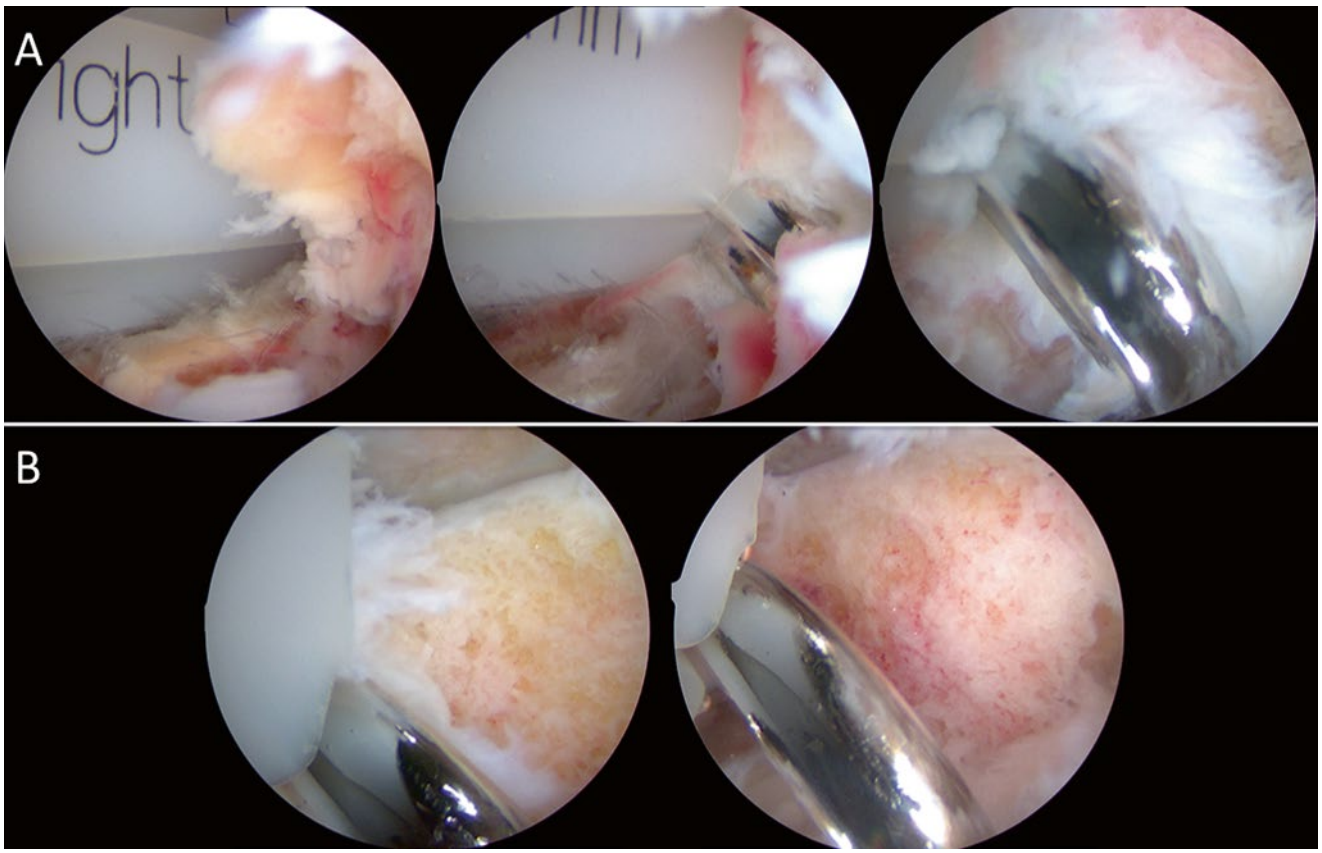

Fig. 20.3 Intraoperative C-arm image intensification views of arthroscopic debridement. Malleolar impingement and residual pain (**a**). Result of débridement under arthroscopy (**b**)

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