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Summary Report of the Arthritis Foundation and the American Orthopaedic Foot & Ankle Society's Symposium on Targets for Osteoarthritis Research: Part 2: Treatment Options

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Abstract

This second of a 2-part series of articles recounts the key points presented in a collaborative symposium sponsored jointly by the Arthritis Foundation and the American Orthopaedic Foot & Ankle Society with the intent to survey current treatment options for osteoarthritis (OA) of the foot and ankle. A meeting was held virtually on December 10, 2021. A group of experts were invited to present brief synopses of the current state of knowledge and research in this area. Topics were chosen by meeting organizers, who then identified and invited the expert speakers. Part 2 overviews the current treatment options, including orthotics, non–joint destructive procedures, as well as arthroscopies and arthroplasties in ankles and feet. Opportunities for future research are also discussed, such as developments in surgical options for ankle and the first metatarsophalangeal joint. The OA scientific community, including funding agencies, academia, industry, and regulatory agencies, must recognize the importance to patients of addressing the foot and ankle with improved basic, translational, and clinical research.

Level of Evidence: Level V, review article/expert opinion.

Keywords: osteoarthritis, arthritis, ankle, foot, subtalar joint

Introduction

Current treatments for OA in the foot and ankle have lower satisfaction and less longevity than in other weightbearing joints.[62] A structured search of PubMed shows that there is at least 10-fold more research activity in knee OA compared to foot and ankle OA. Recognizing this need, the Arthritis Foundation (AF) in partnership with the American Orthopaedic Foot & Ankle Society (AOFAS) convened a virtual meeting of academic thought-leaders to overview the state of science and clinical approaches in OA of the foot and ankle. One of the goals of the meeting was to encourage further research activity in this area that can increase the range of treatment options available to patients and their providers.

A Patient's Perspective

The patient journey is an important aspect of enhancing understanding of patient preferences and acceptability of benefits, risks, and burden. One patient's perspective and impressions of the meeting are provided here to frame this need.

Testimony from Travis Salmon

In my late 20s, I was unexpectedly diagnosed with end-stage OA in one of my ankles. My doctor told me that I would need a [definitive joint destructive procedure] at some point in my life. Fresh out of law school and still playing basketball multiple times per week, the news came as a total shock. As a former college athlete, I was crushed that this diagnosis likely meant my basketball playing days were over, not to mention what it meant for the rest of my life. I was devastated.

For more than 15 years, I tried anything and everything to prove the doctor wrong—including prescription drugs, stem cell therapy, assistive devices, clinical trials, and other reconstructive and arthroscopic surgeries. I envisioned a future where I would be unable to move it at all, and I was determined to avoid this invasive surgery with such permanent results.

During this period, the physical pain I experienced severely impacted what I could do in many parts of my life. But the emotional and mental aspects of OA were challenging and seemingly impacted everything in my life. I was ashamed that it hurt to carry my children when they were babies. As they got older, it was challenging to walk to and from their activities. I felt like I had to secretly plan entire family vacations around places we could go and things we could do that didn't involve lots of walking. I was often discouraged and had a feeling of hopelessness throughout my 30s when I would be in too much pain to do routine things like go grocery shopping without using the shopping cart as a "crutch," or walk the dog for fear that my neighbors would see me limping. While I lived with the physical pain, the nonphysical pain was often more difficult for me.

Eventually, after exhausting my options for managing OA, I had "permanent" surgery, which virtually cured my arthritis pain. My life was completely changed for the better. Recovery took about a year. Today I'm able to do so many things without pain that I hadn't been able to do for nearly 20 years—like go on walks with my wife, jog, run, and play ball with my kids.

Orthotic Management

Dennis Janisse, CPed

Pedorthists design, manufacture, fit, and modify shoes for conservative, first-line management of foot and ankle OA.[36] The basic objectives of orthotics are to transfer forces, correct or support flexible deformities, accommodate fixed deformities (such as fusions or auto-fusions), control joint motion, reduce shock in the gait cycle, and reduce shear and friction that cause pain or skin ulcerations.[37] Specialized shoes are available for wound healing for patients after surgery, as well as for severely deformed feet. Custom devices using a variety of materials like shock-absorbing viscoelastic polymers or low-friction interface materials can be used. Previously, pedorthic shoes were cosmetically unappealing and highlighted the patient's ankle or foot problems to society. Manufacturers have since improved the "look" of products and have also introduced removable inserts that allow for inconspicuous orthotic modification.

Non–Joint Replacing Approaches to Ankle OA

Annunziato Amendola, MD

Because ankle OA affects many younger patients (<55 years old), midstage options such as arthroscopic debridement, periankle osteotomy, biologic resurfacing, and distraction are important to consider prior to joint-destructive procedures.[22,51,64,86,87] Used with arthroscopy, debridement can be performed on mild cases of OA to remove osteophytes and impingements to increase range of motion as well as reduce pain and discomfort.[2,60,73] Combinations of non–joint destructive procedures may be used to correct problems of malalignment due to increased point contact forces, chronic overload, and increased shear stress indicative of existing or future OA.[32]

In patients with ankle OA where only a portion of articular cartilage is affected, peri-ankle osteotomies can be used

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to balance the soft tissues and normalize joint loading.[33] The ultimate goal is to restore neutral talar alignment within the ankle mortise in the sagittal and coronal planes. Large angular corrections that may cause lengthening should be considered with careful patient selection and is not recommended broadly.[43]

Osteochondral lesions of the talus are one of the most common diagnoses for patients with ankle problems.[52,74,79] Bone marrow stimulation, or microfracture, can be used to stimulate formation of fibrocartilage to fill osteochondral lesions less than 8 mm in diameter and have shown good short- and midterm outcomes.[56] Osteochondral autograft/allograft transplantation from the knee for chondral defects is another option that has shown good-to-excellent results.[1,3,23,30,31,58,67] For larger osteochondral defects, scaffold-based techniques such as matrix-induced autologous chondrocyte implantation or matrix-associated autologous chondrocyte transplantation are established treatment methods in larger joints that have shown reliability, significant reduction of pain, and patient satisfaction in the ankle.[47,52,57,72,82]

Loveday and Robinson concluded in a Cochrane Review that there is insufficient evidence from randomized trials to determine which interventions are best for osteochondral effects of the talus.[49] Developments in autografts and allografts for osteochondral lesions have been interesting and helpful. Further research into biologics, such as cell therapies or platelet-rich plasma,[61] would be a welcome expansion of tools to improve and extend the utility of resurfacing.

Distraction ankle arthroplasty may be considered for patients that have exhausted other joint-preserving techniques and are not yet ready for joint-destructive procedures. Distraction uses an external fixator frame to distract the ankle and unload the tibiotalar joint, which can optimize subchondral bone remodeling and restore joint space.[9,69] The hardware can be fixed or hinged to allow for motion.[71] The technique showed clinical benefit but is highly invasive and burdensome to patients and requires further development.[35,65,78]

End-Stage Ankle OA—to Fuse or to Replace

Tyler A. Gonzalez, MD, MBA

In end-stage ankle OA, patients present with pain, loss of function, and loss of mobility.[25,71,77] When nonoperative treatments have been exhausted, often surgery is the next step in treatment. There are joint-preserving surgeries (as detailed above), but if these fail, the next options are to consider an ankle fusion or ankle joint replacement.[6]

In ankle fusion, or ankle arthrodesis, cartilage is removed, and 2 bones (tibia and talus) are fused together. Historically, this has been the most popular option and is generally indicated for patients based on history of neuropathy, significant stiffness, no adjacent joint arthritis, prior infection, bone loss, patient preference, and patients at a younger age.[21,50,59] The relief provided by fusion is long-lasting, but fusion causes loss of motion, altered gait, risk of nonhealing, and longer recovery times.[11] Additionally, an ongoing debate in the literature shows a 24% to 100% possibility of developing adjacent joint arthritis in patients receiving arthrodesis.[15,48] Good outcomes have been found in patients with good subtalar or transtarsal motion. Ankle arthrodesis traditionally requires a large incision and uses screws and/or plates but can be performed with a number of different approaches and allows the flexibility to accommodate the soft tissue limitations imposed by these prior procedures.[6]

Total ankle replacement, or total ankle arthroplasty (TAA), requires metallic implants and plastic spacers to replace the surfaces affected by OA. This option, which is gaining in popularity, is generally indicated for patients with adjacent joint arthritis, relatively good range of motion, good bone stock, patient preference for low-impact activity, and for patients that are 55 years and older.[14,75] With TAA, the patient is generally able to maintain ankle motion and better gait, while also protecting adjacent joints with shorter recovery times.[45] Recent literature suggests that the clinical outcomes for TAA are improving.[76] The expected survival of older models of total ankle replacement was about 15-20 years, as compared to 25-30 years in hip or knee replacement. Newer materials and designs may change those expectations.

Advancements in TAA include improvements in preoperative planning with CT scans to help the surgeon anticipate patient specific variations, predicting implant type and size, and preparing for surgical challenges with the ankle replacment.[34] Three-dimensionally (3D)-printed patient specific guides also improve surgical efficacy, reproducibility, accuracy, as well as shorten surgical times with less anesthesia and improved patient outcomes.[8] Advancements in implant materials and morphology should result in longer lasting TAA with better bone ingrowth, more durable plastics, and improved stability.[16,39] The future of research in end-stage OA will likely focus on TAA in the areas of improved longevity, biomechanics including kinematics, improved revision systems, and further development of patient-specific implants.

Subtalar Joint—Techniques and Outcomes

Alexej Barg, MD

The subtalar joint has a complex, critical relationship to adjacent articulating surfaces and nearby stabilizer ligaments.[26,40] The shape and orientation of a healthy and normal subtalar joint is not well understood, making the definition of pathoanatomy difficult.[41] Although there are manuscripts reporting on the epidemiology of ankle joint OA,[70,81,84] there is limited literature on the epidemiology of subtalar joint OA. The etiology of subtalar joint OA is overwhelmingly posttraumatic at nearly 60% incidence, following the trends seen in the ankle joint. PTOA of the subtalar joint generally occurs after a serious calcaneal fracture. Rothberg and Yoo found in a prospective study of 28 patients with calcaneal fracture that all had prior cartilage injury.[68]

Although ankle instability is a well-known risk factor for ankle OA,[80] the field continues to search for adequate evidence on the difficult-to-diagnose subtalar joint instability.[5,38,54,55] The ankle and subtalar joints are in close proximity and share stabilizing ligaments.[55] A systematic literature review of 23 imaging studies, mostly using radiographs, found that current imaging options do not reliably predict subtalar joint instability.[42] Recently, WBCT with 3D image analysis has been used to investigate and quantify the interaction of loading and torque of the subtalar joint in vitro.[12] A small amount of body torque resulted in significant loading to the subtalar joint, indicating that subtalar joint instability can be properly diagnosed.

High-speed dual fluoroscopy with in vivo ankle arthrokinematics has been used to investigate the role of the subtalar joint in hindfoot motion.[83] The subtalar joint was found to have a significant role in dorsiflexion and plantarflexion in both heel-strike to midstance and midstance to toe-off. In tibiotalar arthrodesis, the flexion provided by the subtalar joint allows for some compensatory motion.[15,46] But the increased motion and burden shifted to the subtalar joint may be a cause of translational secondary OA after ankle fusion. Currently, Barg et al[4] is investigating the range of motion effects of a total ankle replacement, which may reduce the burden shifted to the subtalar joint.[10]

The subtalar joint can compensate for ankle motion in an ankle fusion, and thus may be susceptible to secondary OA. And when an intra-articular fracture occurs, there is a strong inflammatory cytokine response that may need to be controlled to block future OA.[28,29] In the literature, there are very few options studied for early- to midstage OA. In the subtalar joint and in end-stage subtalar OA, arthrodesis is a preferred option. A systematic literature review in preparation found that most patients were satisfied with their fusion (79.6%), and patients saw their pain reduced by nearly half (visual analog scale score 6.3-3.3).[13,63] Healing of the arthrodesis was found to be similar to the ankle joint.

First Metatarsophalangeal Arthritis Approaches for Treatment

Judith Baumhauer, MD

Arthritis of the first metatarsophalangeal (MTP) joint, also known as great toe arthritis or hallux rigidus, is the most common arthritic condition of the foot and affects >2 million adults in the United States, with 60% being women and 80% being affected bilaterally.[27] First MTP joint arthritis can present with localized dorsal, plantar, axial, or neuritic pain due to osteophytes and impingement. There can be a loss of first MTP motion with altered walking patterns due to lateral loading, activity limitations, and complaints due to protruding osteophytes. 3D kinematics have been measured to elucidate the different requirements in first MTP joint dorsiflexion in various weightbearing body positions.[20] A grading system (levels 0-4) is available and incorporates clinical findings of pain and stiffness, range of motion degrees, and radiographic structural changes.[17]

Basic nonoperative treatments include rest, activity modifications to lower intensity, and nonsteroidal anti-inflammatory drugs. Stiff-soled shoe modifications and rigid footplates that limit foot motion to only 4 to 5 degrees can improve pain, function, activity, and other outcomes.[66]

Operative treatments are applied depending on the grade of arthritis and include dorsal cheilectomy, hemiarthroplasty, fusion, and total joint arthroplasty. Dorsal cheilectomy has been found to have 92% good to excellent results, although the procedure may not be suitable for those with 50% or more loss of cartilage.[17,18] Interpositional arthroplasty using soft tissue (such as tendon or autografts) may be an option to preserve the joint for patients with pain and grinding.[85] Another option for these patients is to replace the hemiphalanx and/or the hemimetatarsal head with an implant. Early results were found to be good for implants, although late results were poor and showed loosening, pain, malalignment, transfer metatarsalgia, and sesamoid pain.[24]

Polyvinyl alcohol hydrogel implants have been developed as an answer to the many challenges faced by traditional hemiarthroplasty materials.[7,19] In one large prospective study, patients were found to have greater than 90% pain relief and function at 2 years, with continued pain relief and functional outcome found in 85% of patients at nearly 6 years. If there is recurrent pain, the hydrogel implant can later be removed to allow a first MTP fusion without loss of length with good outcomes.[7] Joint fusion is often recommended for patients with the most severe arthritis (grade 3 and 4) with dorsal pain or plantar joint pain. In this procedure, the joint is sacrificed by reshaping bones and subsequently fixing to eliminate pain and motion. Although there is complete loss of great toe MTP motion, the outcomes for first MTP joint fusion was found to be reliable and have 85% to 95% good to excellent results returning to walking, hiking, biking, and even light jumping and running activities.[44,53]

Conclusions

Patients are painfully disabled by OA in the joints of the foot and ankle and have fewer treatment options with lower satisfaction and longevity compared to other more studied joints. This faculty of experts sought to provide an overview of the current state of treatment approaches in OA of the foot and ankle, areas of active research, and research areas for emphasis:

- Restriction of movement in an affected joint is a solution to eliminate pain while relying on adjacent joints to compensate for the lost movement, but will risk transfer of OA to those adjacent joints.
- Joint replacements (and revisions) are not consistently satisfactory to patients nor sufficiently long-lasting, which drives pursuit of joint preservation techniques for midstage OA.
- Joint-destructive procedures are not suitable for all patients, particularly those that are younger or still progressing toward severe disease, thus driving the need for development of further midstage options and improved joint replacement options.
- Subtalar joint OA often occurs secondary to trauma but can result from longstanding deformity or previous ankle fusion. Solutions other than subtalar fusion are desirable to prevent adjacent joint arthritis.
- Small joints, such as the first MTP, have specific considerations of anatomy and function that need to be reflected in the development of new surgical treatments.

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Ethical Approval

Ethical approval was not sought for the present study because it is a review article.

Declaration of Conflicting Interests

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