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Original Research

ACFAS Clinical Consensus Statements: Hallux Rigidus

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ABSTRACT

The following are clinical consensus statements (CCS) on the topic of hallux rigidus sponsored by the American College of Foot and Ankle Surgeons. A core panel synthesized the data and divided the topic in to twelve sections, each section contained a variable number of consensus statements, based upon complexity. Overall there were 24 consensus statements synthesized for this subject matter. The 24 statements were provided to the expert panel with all available evidence to come to a consensus utilizing all available evidence.

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This document is one of a series of clinical consensus statements sponsored by the American College of Foot and Ankle Surgeons (ACFAS). It is important to appreciate that consensus statements do not represent formal evidence reviews, clinical practice guidelines, recommendations, or evidence -based guidelines. A CCS reflects information created from a group of expert panelists based upon best available evidence. It is important to consider it may contain opinions, uncertainties, and minority viewpoints. The CCS should be utilized to introduce discussion on a topic, rather than attempting to provide definitive answers. This CCS is dedicated to topic that is common to all foot and ankle surgeons, hallux rigidus. The panel attempted to address the most common issues on the topic facing the Foot and Ankle Surgeon, with the best evidence-based literature available.

Materials and Methods

Creation of the Panel

The Board of Directors of ACFAS felt that a creation of a series of Clinical Consensus Statements (CCS) would be beneficial to the members of the College and Foot and Ankle Surgeons at large. The initiative was designed to replace the previous clinical practice guidelines. Invitations were sent to expert Foot and Ankle surgeon members of the college to form the panel of 7 members. The chair (TR) divided the topic into twelve sections and assigned members based upon expertise to each of the sections. Over the course of several months the members engaged in multiple conference calls and Zoom meetings. The goal of which would benefit Foot and Ankle Surgeons and members of the College was to synthesize a series of Clinical Consensus Statements from all current literature in the common pathology of hallux rigidus.

Development of Questions

The first stage in developing questions involved a conference call to discuss relevant basic topics that would be covered in the consensus statements. The panel led by the chair agreed upon the twelve sections of: definition/history, developmental anatomy/etiology, progression/natural course, imaging and diagnostic modality utility, radiographic findings, classification, Indications, functional analysis, physical examination, nonoperative treatment, operative treatment, future considerations. Members were assigned to each of the topics by the chair and asked to perform preliminary data reviews from our agreed upon inclusion criterion. From these general sections, statements were then generated based upon the complexity of the topic and the evidence based clinical literature review that met the inclusion criteria. It is important to note that 2 sections were

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combined in the results section: sections 2, developmental anatomy/etiology and section 3, progression/natural course, which ultimately yielded eleven sections. The group decided that there would be no limit on number of statements created, this would allow for inclusion of all relevant statements to be discussed. At the in-person meeting statements were narrowed to include the current statements based upon clinical evidence, inclusion criteria, and grading.

Literature Review

Panel members performed comprehensive reviews of the published data that included searches of Medline®, EMBASE®, and the Cochrane Database of systematic reviews. The panel decided on the following criteria when selecting articles: No level 4 or level 5 studies, search terms and database inclusion under each group are established by the group, use all articles written in English, articles must be written within the past 25 years, case studies must have at least 20 participants.

Consensus

The group met via Zoom to review the statements. A 5 response Likert scale was initially used anonymously and responses were returned to the chair who complied the results. A subsequent meeting was initiated to discuss the results. After discussion of each statements Likert scale results, the chairman requested a final vote of yes or no on determination if the statements were appropriate which resulted in the panels final approval process. Each individual statement is listed below in the results section includes an appropriateness statement and a percentage of the panels yes or no vote.

Results and Discussion

Definition/History

The panel reached consensus that the statement (agree 100%): "Hallux rigidus/limitus (HR/HL) is defined as a chronic and progressive degenerative condition affecting the first metatarsophalangeal joint (MTPJ) heralded by restriction in sagittal plane motion" was appropriate.

Hallux rigidus/hallux limitus is a common problem affecting the great toe. This pathologic process is characterized by degenerative changes of the first MPTJ joint with diminished range of motion (1). The condition can also involve proliferative periarticular bone formation surrounding the joint (2). The condition was first reported in 1887 by Davies-Colley (3) of which described the condition as plantarflexed position of the proximal phalanx in relationship to the first metatarsal head and used the term *hallux flexus*, months later it was also reported by Cotterill (4) and utilized the term *hallux rigidus*, that is still commonly used today. *Hallux rigidus* and *hallux limitus* are interchangeable terms, however some may distinguish the terms as *hallux limitus* as early stage with decreased range of motion of the first MTPJ, and *hallux rigidus* as a late stage term with loss of motion of the first MTPJ (5-7). The symptoms that are commonly associated with hallux rigidus/limitus include pain with joint motion, soft tissue swelling, and intolerance to shoe wear (2). Symptoms related to hallux rigidus/limitus are often exacerbated by high levels of activity or by occupational demands (1). The condition is noted to be a progressive loss of motion through the first MTPJ with joint space narrowing and osteophyte formation as the condition worsens (7). The condition is a common problem involving the first MTPJ with a magnitude of factors that can lead a patient to seek treatment secondary to progressive pain and decreased function.

Developmental Anatomy AND Etiology and Progression/Natural course

The panel reached consensus that the statement (agree 100%): "No one etiology is responsible for the development of hallux rigidus/limitus" was appropriate.

The panel reached consensus that the statement (agree 100%): "Hallux rigidus/limitus is most likely a progressive problem and efforts to delay progression should be considered when possible" was appropriate.

Multiple etiologies of HR/HL have been described throughout literature. Several authors have proposed potential etiologies ranging from shoe gear, trauma related, elevated first ray, equinus, age, and various other possibilities (8,3,4,10). Coughlin et all provided a comprehensive review concluding that HR/HL was not associated with elevated first ray, first ray hypermobility, increased first metatarsal length, Achilles or gastrocnemius tendon tightness, abnormal foot posture, symptomatic hallux valgus, adolescent onset, shoe wear, or occupation. The comprehensive review did note there was an association with hallux valgus interphalangeus, female gender, and positive family history in bilateral cases (2,9,7). Roukis et al. has published research noting that over a 15 year follow up no significant difference was noted between joint salvage and joint sparing procedures with regards of range of motion after procedures (11,12). The panel concludes that continued research should be done in regards of relationship of HR/HL and potential etiologies.

It is noted that HR/HL is likely a progressive deformity with evidence of progression and worsening of radiographic findings throughout ones lifespan. Overall, the panel agrees that preventative measures should be taken to delay progression when possible. The panel agree more research should be obtained on modalities to slow the progression of hallux rigidus/limitus.

Imaging and Diagnostic Modality Utility

The panel reached consensus that the statement (agree 100%): "The use of weightbearing plain film radiographs is recommended for diagnosis of hallux rigidius/hallux limitus" was appropriate.

The panel reached consensus that the statement (agree 100%): "The routine use of advanced imaging techniques (MRI, CT, MSK US) is not essential for the diagnosis of hallux rigidus/hallux limitus" was appropriate.

Radiographic assessment of hallux rigidus/hallux limitus includes obtaining weightbearing anteroposterior (AP), medial oblique (MO), and lateral projections. These standard weightbearing radiographs provide adequate evaluation of joint space, subchondral sclerosis and cystic changes, periarticular spurring, and intra-articular ossicles (13). Although many of the radiographic findings are well defined, there is still disagreement in the literature on radiographic parameters defining hallux rigidus/hallux limitus (14). Additionally, radiographs allow for assessment of global foot structure and biomechanical contributors to the development of hallux rigidus/hallux limitus (13). Radiographs provide sufficient information for classification systems and surgical algorithms (15). The use of advanced imaging is not essential in the diagnosis and management of hallux rigidus/hallux limitus. Magnetic resonance imaging (MRI) may be indicated in the treatment of athletes when assessing for intra-articular pathology not visible on standard radiographs (16). The use of weightbearing computed tomography (CT) has been shown to be more precise and accurate than standard weightbearing radiographs (17). Weightbearing CT has been shown to be reliable in evaluating hallux rigidus and may prove to be clinically valuable for surgical planning and decision making (17).

Radiographic Findings

The panel reached consensus that the statement (agree 100%): "Many radiographic findings have been proposed for potential development of hallux rigidus/limitus. However, no individual finding is pathognomonic for all cases" was appropriate.

Weightbearing foot radiographs can be utilized to diagnose and grade Hallux rigidus (13). The plain film radiographic findings of early Hallux rigidus is characterized by subchondral sclerosis and mild uneven joint space narrowing (18). Progression of the disease yields osteophytes. These can be seen on the lateral view when they occur

dorsally. Osteophytes may also be visualized on the medial or lateral joint on the anterior-posterior radiograph. Flattening of the metatarsal head may be appreciated in early stages of hallux rigidus (13,19). Later stages are characterized by cystic changes in the metatarsal, hypertrophy of the sesamoids, collapse of the lateral base of the proximal phalanx of the hallux, and intraarticular ossicles (13,18,19). End Stage hallux rigidus may have all the above features with progressive narrowing until total obliteration of joint space occurs (18).

Classification

The panel reached consensus that the statement (agree 100%): "The routine use of classification systems to grade the severity of hallux rigidus/hallux limitus is useful in the clinical setting. Further, the systems employed should be based on the physical exam and radiographic findings" was appropriate.

Hallux rigidus/hallux limitus is often categorized or staged primarily based upon a combination of clinical and radiographic findings (1). Multiple classification systems have been described in the literature. Clinical evaluation of hallux limitus/rigidus is often divided into functional and structural classes. One of the first classifications divided patients into primary or secondary hallux limitus/rigidus (20). Nilsonne and later Cohn and Kanat correlated metatarsus primus elevates and primary hallux rigidus occurring in younger patients and post traumatic and degenerative arthritis with secondary hallux rigidus in elderly patients (20,21).

While there have been a variety of classification systems described in the literature for hallux limitus/rigidus few are utilized. One of the earliest and well known systems was described by Regnauld (22). This classification system was the first to use radiographs and clinical findings to stage hallux limitus/rigidus into 3 distinct grades (Table 1). Another commonly utilized classification has been Hattrup and Johnson that also included 3 grades, however solely relied on only radiographic findings (Table 2) (23). One of the few studies to incorporate a prospective evaluation of outcomes for a grading system was Roukis et al. This commonly used system described a hybrid classification that included the clinical, radiographic, and intraoperative features dividing the deformity into 4 grades (11,24,25) (Table 3). This hybrid classification system has shown to be effective in measuring short term, as well as long term, improvement in the surgical management of hallux rigidus/hallux limitus. Dillard et al recently published a study on the intra- and interobserver reliability of these 3 classification systems (26). The authors found that while the interrater reliability of all the classifications was "excellent" only the Roukis and Hattrup classifications had "good to fair" intrarater reliability. Most recently Coughlin and Shurnas developed a classification system that incorporated range of motion, clinical symptomatology and radiographic findings (27). This classification system listed in Table 4 includes 5 distinct grades from grade 0 through 4 and incorporates surgical and nonsurgical recommendations.

While there is little consensus on which classification system is most useful, a study by Beeson et al reviewed classification systems for hallux limius/rigidus (28). Interestingly the authors found that only 3 of the fourteen systems they included had what was required for a "robust" classification system and the rest fell short. Roukis et al., Vanore et al. and Coughlin and Shurnas were the 3 studies mentioned. They also concluded that the Coughlin and Shurnas system was the closest to a "gold standard" for a classification system noting it one fault was the use of retrospective data. Future studies or classification systems should include a combination of radiographic and clinical findings as well as be validated and its contents tested for reliability.

Table 1
Regnauld classification

Grade 1	Mild limitation of dorsiflexion, mild dorsal spurring, pain, no sesamoid involvement, subchondral sclerosis, mild sesamoid enlargement.
Grade 2	Broadening and flattening of the metatarsal head and base of the proximal phalanx, focal joint space narrowing, structural first ray elevatus, osteochondral defect, sesamoid hypertrophy.
Grade 3	Worsening loss of joint space, near ankylosis, extensive osteophyte formation, osteochondral defects, extensive sesamoid hypertrophy, with or without joint mice.

Table 2
Hattrup and Johnson classification

Grade I	Mild to moderate osteophyte formation, preserved joint space.
Grade II	Moderate osteophyte formation, joint space narrowing, subchondral sclerosis.
Grade III	Marked osteophyte formation, loss of visible joint space, with or without subchondral cyst formation.

Indications

The panel reached consensus that the statement (agree 100%): "Therapeutic management of hallux rigidus/limitus should be considered in the presence of pain and/or when patients activities of daily living are affected, quality of life is diminished, unable to utilize appropriate shoe gear, and/or unable to perform employment requirements" was appropriate.

Hallux Rigidus/Limitus is the leading cause of arthritis of the foot and affecting approximately 1 in 40 adults over the age of 50 (29,10). The role of the first metatarsal phalangeal joint plays a critical role in ambulation and can have a significant affect over ones quality of life when painful (7,30-32,18,11). Indications to begin treatment of this condition depends on the symptoms and degree of degeneration of the joint. Conservative treatment should be a first line treatment option when patient's symptoms consist of pain and/or affect activities of daily living, quality of life, unable to utilize appropriate shoe gear, and or unable to perform employment requirements (30,33). If conservative treatment fails to provide adequate relief of patients symptoms surgical intervention should be considered in appropriate surgical candidates. Literature is limited on specific indications for treatment and pain is the leading cause for patients to seek treatment for this condition. Indications for intervention is multifactorial and patient specific depending on patient's complaint, lifestyle, and career (7,31). Coughlin et al. published results on pain scale of 110 patients. Of those 110 patients presenting for treatment 21 had moderate pain while the remainder had severe or quite severe pain. Of these patients 55/110 had pain of the dorsal bony prominence while the other half had complaint of

Table 3
Roukis et al. classification.

Grade I	Metatarsus primus elevatus with hallux equinus, periarticular subchondral sclerosis, minimal dorsal exostosis, minimal flattening of the metatarsal head.
Grade II	Moderate dorsal exostosis and flattening of the metatarsal head, minimal jointspace narrowing, lateral metatarsal head erosion with or without exostosis, sesamoid hypertrophy, with or without subchondral cysts or loose bodies.
Grade III	Severe dorsal exostosis, focal joint space narrowing, subchondral cyst formation, loose bodies, traction enthesopathic sesamoid hypertrophy with immobilization-induced osteopenia.
GradeIV	Excessive exostosis with trumpeting of the metatarsal head, proximal phalanx base, and sesamoid apparatus; minimal or absent joint space; sesamoid ankylosis; hallux interphalangeal and/or first metatarsal medial cuneiform arthrosis.

Table 4
Coughlin and Shurnas classification

	Range of Motion	Radiographic Findings	Clinical Findings
Grade 0	DF 40_–60_ and/or 10%–20% loss compared with normal side	Normal or minimal	No pain, stiffness, loss of passive motion on examination
Grade 1	DF 30_–40_ and/or 20%–50% loss compared with normal side	Dorsal spurring, minimal joint narrowing, minimal sclerosis, and metatarsal flattening	Mild or occasional pain and stiffness, pain at extreme DF and/or PF on examination
Grade 2	DF 10_–30_ and/or 50%–75% loss compared with normal side	Dorsal, lateral, and possible medial osteophytes; flattened metatarsal head; no more than one-fourth dorsal joint space involvement on lateral view; mild to moderate joint space narrowing and sclerosis; sesamoids typically, not involved	Moderate to severe pain and stiffness, pain before maximal DF and/or PF on examination
Grade 3	DF _10_ and/or 75%–100% loss compared with normal side, loss of PF	As in grade 2, but substantial narrowing, possible cystic changes, more than one-fourth dorsal joint space involvement, sesamoid hypertrophy or cystic changes	Near-constant pain and stiffness, pain throughout range of motion on examination

Grade 4 Grade 3 plus pain at midrange of motion on Examination.

arthralgia (32). Of note hallux rigidus has not shown direct correlate to any specific occupation, shoe gear, or age of onset (18). The panel agrees 100% that therapeutic management of HL/HR should be strongly considered in symptomatic patients

Functional Analysis and Physical Examination

The panel reached consensus that the statement (agree 100%): "The proper assessment of hallux rigidus/limitus involves evaluation of both closed and open chain first MTPJ range of motion" was appropriate.

The clinical evaluation of hallux rigidus is important to distinguish it from similar conditions and to help grade its severity for appropriate treatment selection. Multiple tests for assessment of hallux rigidus/limitus have been described, from specific examination of the metatarsophalangeal joint to broad gait analysis. Evaluation begins with integumentary examination observing for pinch calluses and dorsal osseous protrusion of the first metatarsal head. Open chain range of motion of the first metatarsophalangeal joint is then assessed. Normal measurements for dorsiflexion range from 65 to 110 degrees, and normal measurements for plantar flexion vary between 23 and 45 degrees (34,35). Adapted from the hand literature, compression of the proximal phalanx against the metatarsal head (articular grind test) and the sesamoids against the metatarsal head (sesamoid apprehension test) during range of motion of the first MTPJ can provide additional information regarding the presence of degenerative joint disease, that may assist in guiding treatment choices (36).

Comparison of first MTPJ range of motion in open and closed kinetic chain delineates structural from functional hallux limitus (37). Functional hallux limitus describes a restriction in first metatarsophalangeal motion in the final phase of gait with normal mobility in an unloaded foot. Range of motion of the first metatarsophalangeal joint during static weight bearing (Jack's test or Hubscher maneuver) is widely used to assess for functional hallux limitus. The examiner dorsiflexes the hallux to maximum dorsiflexion while the subject is fully weightbearing. Normal dorsiflexion values are between 37 and 40 degrees (38). However, the validity of this test and its ability to correlate to range of motion during ambulation has been questioned (39). An additional test for functional hallux limitus is the Dananberg test in which the examiner holds the first metatarsal head in dorsiflexion while dorsiflexing the hallux. In a positive test for functional hallux, the first metatarsal head immediately plantarflexes while in a negative test plantarflexion of the first metatarsal head is delayed (38).

A thorough exam of global foot structure including arch height, mobility, and relative length of metatarsals aides in understand the etiology of hallux rigidus/limitus in individual patients, and may assist in both conservative and surgical treatment decisions.

Nonoperative Treatment

The panel reached consensus that the statement (agree 100%): "Any combination of ice/heat, oral NSAID's, and rest are appropriate first line treatments for symptomatic hallux rigidus/limitus" was appropriate.

The panel reached consensus that the statement (agree 100%): "In shoe orthotic appliances and/or shoe modifications are appropriate mechanical interventions for symptomatic hallux rigidus/limitus" was appropriate.

The panel reached consensus that the statement (agree 100%): "Corticosteroid injection may be used in conjunction with other conservative efforts" was appropriate.

The panel reached consensus that the statement (agree 100%): "Physical therapy modalities can provide benefit in select patients with hallux rigidus/limitus" was appropriate.

Nonsurgical treatment of hallux rigidus should be considered as a treatment for patients presenting with a painful 1st metatarsal phalangeal joint. Appropriate first line treatments include any combination of ice/heat, oral NSAIDs, and rest (40-43). In shoe orthotic appliances and/or shoe modifications are appropriate mechanical interventions for symptomatic hallux rigidus (43,44). Corticosteroid injection may be used in conjunction with other conservative efforts (45,46). Physical therapy modalities can provide benefit in select patients with hallux rigidus (47). The panel unanimously agrees that these nonsurgical treatment options are all viable options for the nonsurgical treatment of hallux rigidus.

Operative Treatments

The panel reached consensus that the statement (agree 100%): "Joint sparing procedures should be reserved for low grade hallux limitus/rigidus" was appropriate.

It is important to recognize the etiology and grade of hallux rigidus which can direct the surgeon in the appropriate direction for a successful surgery (48). The goals of any surgery should be to reduce pain, improve some function and improve quality of life. Patient with early stage hallux rigidus (stage 1 or 2) typically benefit joint sparing procedure (48). These procedures would include but are not limited to: Cheilectomy, Phalangeal osteotomy, metatarsal osteotomy, and combinations of the previous listed procedures. Most procedures are relatively simple and preserve motion of the first MPJ.

The panel reached consensus that the statement (agree 100%): "Joint sparing procedures lack long term durability in later stage hallux limitus/rigidus" was appropriate.

While there is good evidence to suggest that early and mid-stage hallux limitus can be treated successfully long term with joint sparing procedures such as cheilectomy, there are fewer studies that describe these procedures have similar results in later stage hallux limitus (49).

While there are several studies that support the use of cheilectomy in later stages of hallux limitus with long term results, it is important to understand the cheilectomy is not the only joint sparing procedure and that others such as metatarsal and phalangeal osteotomies do not have equally successful results on later stage hallux limitus (50,51).

The panel failed to reach consensus that the statement (agree 87%): "In low grade hallux rigidus/limitus, cartilage restoration procedures have shown some benefit in select patients" was appropriate.

It is important to recognize that this statement is treatment for cartilage regeneration only and does not include synthetic replacement grafts. While research continues to evolve in this topic there has been very few high-level studies to suggest significant long term benefits to patients at this juncture for the first MPJ. There are a handful of studies with very good short term results using allograft transplanting, the volume of patients and duration of the studies lead to the lack of consensus on this topic (52).

The panel reached consensus that the statement (agree 100%): "Joint destructive procedures should be reserved for high grade hallux limitus/rigidus" was appropriate.

As discussed in the previous statements regarding early-stage hallux limitus it is of the utmost importance to recognize the etiology and grade of joint destruction involved in each individual patient (48). End stage or late-stage hallux limitus/rigidus has a plethora of clinical data to support the use of joint destructive procedures (53). Joint destructive procedures would include but are not limited to: first MPJ arthrodesis, Keller arthroplasty, joint arthroplasty with implant, and interpositional arthroplasty.

The panel reached consensus that the statement (agree 100%): "Cheilectomy as a joint sparing procedure, can reduce pain, improve function, and may increase range of motion of the 1st MTPJ" was appropriate.

The cheilectomy is one of the most common and reproducible procedures for early to mid-stage hallux limitus (54). It has been shown to be a reliable procedure with favorable results in mid to long term studies (60-62). The cheilectomy may be combined with phalangeal osteotomy to increase its longevity (55). Cheilectomy has often been associated with excellent patient satisfaction (97%), long term survival (70% up to 10 years) and function (92 %)in early stage hallux limitus, however recent studies had shown some promising results in later stage hallux limitus as well (32).

The panel reached consensus that the statement (agree 100%): "The Keller procedure has limited indication in the treatment of hallux rigidus/limitus" was appropriate.

Joint decompression with passive dorsiflexion may be achieved via Keller arthroplasty. The procedures is typically reserved for low demand patients as it is associated with an easier recovery than more invasive procedures such as the arthroplasty (56). The procedure has been proven to be successful in the patient population over the arthroplasty (57) the potential for several complications such as cock-up hallux, a propulsive gait, and transfer metatarsalgia exists, and therefore the procedure is reserved mainly for elderly patients with low demand (56). It has also been reported that an elevated first ray and long second metatarsal are risk factors for transfer metatarsalgia following the Keller arthroplasty.

The panel reached consensus that the statement (agree 100%): "As a joint destructive procedure, prosthetic devices may be effective in relieving pain and improving function in cases of hallux limitus/rigidus" was appropriate.

There have been generations of implant arthroplasty that have been designed to allow for increasing function and relieve pain. While more recent implant arthroplasty procedures have been successful in achieving this goal, often early generation implants failed due to lack of understanding of the biomechanical forces delivered through the first MPJ (66). Increased advances in biomaterials and biomechanics of the first MPJ have led to a variety of implants on the market. Implants can be divided into multiple categories based upon material, however a more broad distinction would be to separate them based upon total versus hemi-arthroplasty (58,51). There is no clear answer as to which is superior in the literature based upon this separation and review of the literature. Outcomes for joint implant arthroplasty compared to arthrodesis are similar with implant arthroplasty (59,60).

The panel reached consensus that the statement (agree 100%): "Durability and long-term survivability rates are a concern for many 1st MTPJ prosthetic devices" was appropriate.

Implant arthroplasty as discussed in the previous section have had a long history of trial and error. There have been several failures in early silicone based implants with rates of failure being reported as high as 74% (61). While these implants have been studied longer than most, they had a high failure rate without the addition of grommets to reduce stress shielding, the failure rates were reduced significantly with survivorship being reported upwards of 97% over 5 years (62). Many of the newer generation implants have shifted to hemi-arthroplasty with coverage of the first MPJ or partial joint replacements with synthetics. The most recent literature has shown however mixed results with these implants (63-65).

The panel reached consensus that the statement (agree 100%): "First MTPJ arthrodesis provides predictable outcomes and reduces pain and improves function as a joint destructive procedure for hallux rigidus/limitus" was appropriate.

The first metatarsal MTPJ arthrodesis is a safe effective treatment option for late-stage hallux rigidus and is widely accepted as the gold standard for this condition. It often provides excellent functional and and pain relieve for patients with limited complications (66). Arthrodesis is often indicated in younger more active high demand patients given its durability and resistance to significant biomechanical forces that can often lead to failures of other procedures described above (67). Despite advances in implant technology the first MTPJ arthrodesis continues to show predictable long term outcomes for patients with late stage hallux limitus (68).

Future Considerations

The panel failed to reach consensus that the statement (agree 87%): "Nonsteroidal biologic injections can be a viable option for hallux rigidus/limitus" was appropriate.

The use of regenerative medicine principles has been proposed for the nonsurgical management of osteoarthritis (69). Regenerative medicine literature remains limited for hallux rigidus but the available literature generally demonstrates nonsteroidal biologic injections into the first metatarsal-phalangeal joint to be a promising option (70,71). Most cited options in the foot include but are not limited to; Hyaluronic acid (HA), and to a lesser degree mesenchymal stem cells (MSC) (72). However, the superiority of one stem cell source from another (i.e., concentrated bone marrow aspirate, concentrated platelet rich/poor plasma, adipose-derived mesenchymal cells) nor the most beneficial grade of hallux rigidus for their use remains unanswered (73,74). A majority of the nonsteroidal biologic injection data involves the use of HA for treatment of hallux rigidus/limitus (75,76). Interestingly the 2 available randomized trials with HA injections had differing results. Pons et. al., found that HA injections lead to reduced pain and increased AOFAS scores vs steroid injection (75). Whereas Munteanu et. al. found no difference in 3 groups (HA, Steroid and placebo) in primary or secondary outcome measures (76). The panel failed to reach consensus that nonsteroidal biologic injections can be a viable option for hallux rigidus/limitus.

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