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Arthroscopic Treatment of Ankle Anterior Bony Impingement: The Long-term Clinical Outcome

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Abstract

Background: Arthroscopic treatment of anterior ankle bony impingement provides good results, with a tendency to decrease over time. The purpose of this study was to analyze the factors affecting long-term results.

Methods: Eighty consecutive patients with a mean age of 37.3 years were treated between 2000 and 2004. Impingement lesions were identified according to Scranton-McDermott classification. Preoperative ankle osteoarthritis was documented by van Dijk scale upon the x-rays. Bone spurs were analyzed and classified according to location and size. The associated chondral lesions were classified following the International Cartilage Repair Society (ICRS) criteria. Patient data, foot morphology, and previous traumas were recorded. Patients were evaluated after a mean of 104.6 months follow-up with the American Orthopaedic Foot and Ankle Society (AOFAS) scale. The influence of different factors on outcomes was statistically analyzed.

Results: The mean preoperative AOFAS score was 50.9, while at follow-up it was 70.7 ($P < .05$). The different grades of Scranton-McDermott impingement classification did not affect the results, but the different grades of van Dijk scale significantly affected the result but not the preoperative stage. Tibial localized spurs had better outcome at follow-up. The grade of the chondral lesions significantly affected the outcome. Other factors negatively affecting the results were age, cavus foot morphology, and history of previous ankle fracture.

Conclusion: Arthroscopic treatment provides overall good results, but the long-term presence of associated conditions such as chondral lesions, advanced age, and previous trauma are relevant as prognostic factors. Based on these results, a new classification for bony impingement syndrome system is proposed.

Level of Evidence: Level IV, case series.

Keywords: arthroscopy, impingement, osteoarthritis

Introduction

Anterior ankle bony impingement is characterized by the presence of bony spurs on the anterior aspects of the tibia and/or talus, limitation of motion and pain in forced dorsiflexion with joint stiffness that makes squatting and climbing stairs or slope difficult. The cause of pain is thought to be not the osteophyte itself, but a soft tissue component that can be squeezed between the tibia and talus during dorsiflexion.[24]

Currently, ankle bony impingement is classified on the basis of size and location of the spurs on x-ray according to the Scranton and McDermott classification,[20] while according to the van Dijk[29] classification it is evaluated the degree of osteoarthritis. (Scranton and McDermott[20] classification: type 1: tibial spur less than 3 mm; type 2: tibial spur more than 3 mm; type 3: significant tibial exostosis with secondary spur on the neck of the talus, with eventual fragmentation of the osteophytes; type 4: osteophytes associated with arthritic joint destruction; van Dijk[29] classification: grade 0: normal joint or subchondral sclerosis; grade 1: osteophytes without joint space narrowing; grade 2: Joint space narrowing with or without osteophytes; grade 3: [sub]total disappearance or deformation of the joint space.)

The purpose of this study was to describe the long-term clinical outcome of a series of 80 patients consecutively treated by isolated arthroscopic removal of anterior

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impingement. An evaluation of the factors affecting long-term clinical outcomes was performed, which led to the proposal of a new outcome-oriented classification system for anterior bony impingement of the ankle joint, in order to define a population of patients able to gain the most advantage from an arthroscopic osteophytectomy.

Methods

Patients

Eighty consecutive patients affected by anterior ankle impingement were arthroscopically treated between 2000 and 2004. Signed informed consent was obtained, and the study was approved by the institutional review board. The patients included 55 males and 25 females with a mean age of 37.3 ± 12.5 years (range, 69-15). Mean BMI was 25.6 ± 3.7 (range, 18-35). Inclusion criteria were a diagnosis of anterior ankle impingement syndrome unresponsive to at least 3 months of conservative therapy and the presence of tibialis anterior, talar, or tibiotalar anterior osteophytes. Conservative treatment consisted of rest, heel lift, non-steroidal anti-inflammatory drugs, physical therapy, and intra-articular steroid injections.[13,18,20,21]

Exclusion criteria were the presence of rheumatologic diseases, posterior ankle pain associated with posterior osteophytes, previous surgery of the affected ankle (except open reduction and internal fixation for malleolar fracture and hardware removal), subtalar/midtarsal arthritis, or ankle instability. The instability was evaluated by patient history and anterior draw test and with talar tilt test.[1,28]

Patients were also excluded if their spurs were associated with acute or chronic focal osteochondral lesions grade III-IV (International Cartilage Repair Society [ICRS] classification[4]) even if previously treated with regenerative techniques (ie, ACI or bone marrow–derived cells transplantation). (ICRS classification[4]: grade 0: normal; grade I: nearly normal [soft indentation and/or superficial fissures and cracks]; grade II: abnormal [lesions extending down to less than 50% of cartilage depth]; grade III: severely abnormal [cartilage defects more than 50% of cartilage depth]; grade IV: severely abnormal [through the subchondral bone]).

Subjects with Scranton grade I impingement were not included in the study because these were treated conservatively.

Etiology was traumatic in 55 cases: 10 ankle sprains and 45 ankle fractures (24 malleolar fractures, 17 bimalleolar fractures, 1 trimalleolar fracture, and 3 closed tibial pilon fractures). Twenty-five patients were not able to recall any specific traumatic event.

American Orthopaedic Foot and Ankle Society (AOFAS) score[10] was recorded preoperatively (T0), at intermediate check (T1) at 24 months, and at the final follow-up (T2), at a minimum of 6 years from treatment. The ankle was checked for range of motion (ROM), if normal or reduced

as reported on the AOFAS scale, alignment, and stability. The foot was checked for deformities.

X-rays evaluation included standard weightbearing x-rays and oblique anteromedial and anterolateral views.[25] Patients were classified on x-ray according to Scranton impingement[20] and to van Dijk arthritis scale.[29]

In all cases an MRI was performed to exclude the presence of focal cartilage lesions, which could have benefited from other treatments.

Surgical Technique

Two standard anteromedial and anterolateral ankle arthroscopic approaches were performed in all cases. A 4-mm, 30 degree angle arthroscope was used. During arthroscopy, precise localization and size of the lesion was verified with a hook probe, confirming the correspondence with the X-ray pattern.

The osteophytes were removed by an osteotome, and burr and flexion and extension of the ankle was performed in order to verify the recovery of the range of motion.

No weightbearing was allowed for 15 to 21 days.

Frequent active and passive mobilization of the ankle was advised throughout the first month.

Statistical Analysis

All continuous and interval variables were expressed in terms of mean and standard deviation of the mean. The paired t-test was used to determine any significant differences between the pre- and postoperative scores. One-way ANOVA was performed to test hypotheses about means of different groups. When the Levene test for homogeneity of variances was significant ($P < .05$), the Mann-Whitney test (2 independent groups) or the Kruskal Wallis test (3 or more independent groups) were used. The Sceffé test was performed as post hoc pairwise analysis of ANOVA, and the Mann-Whitney test with Bonferroni correction was performed as post hoc pairwise analysis of the Kruskal Wallis test. Pearson's correlation analysis was performed to investigate relationships between 2 quantitative measurements. For all tests, $P < .05$ was considered significant. Statistical analysis was carried out by means of the Statistical Package for the Social Sciences (SPSS) software version 14.0 (SPSS Inc, Chicago, Illinois).

The AOFAS improvement was calculated, as well as the percentage recovery: (postoperative − preoperative) / (100 − preoperative) × 100.

Results

No intraoperative or postoperative severe complications were reported.

Five cases had a superficial infection of the arthroscopic wounds, resolved by oral antibiotics. Two patients had
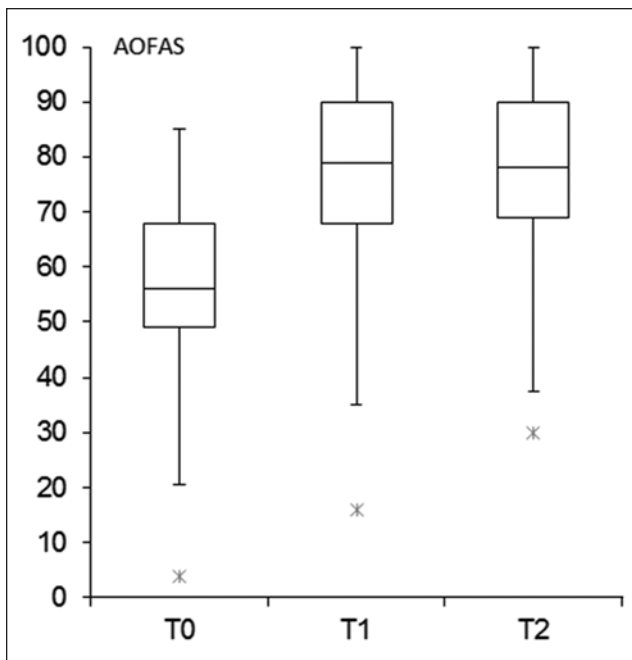
Figure 1. Box-plot distribution showing the general American Orthopaedic Foot and Ankle Society (AOFAS) scores at different follow-up.

numbness on the dorsal foot that disappeared in 6 months without any specific treatment.

A marked improvement was noticed in terms of clinical score from T0 (mean AOFAS score 50.9 ± 19.0) to both T1 (mean AOFAS score 78.0 ± 14.8; $P < .0005$) and T2 (mean AOFAS score 70.7 ± 17.2; $P < .0005$) (Figure 1). Nevertheless 40% of the patients (32 cases) reported a clinical score inferior to 70 points at follow-up; 15 were dissatisfied with the long-term outcome and scheduled for another surgery.

Sex and BMI were not found to influence the outcome at any follow up ($P = 1.22$; $P = .96$), while age was found to have a negative impact on clinical score at T2 ($P < .0005$). The presence of a cavus (13 patients) or a flat foot (10 patients) did not affect the outcome; however, the mean values showed a tendency to be worst in the presence of a cavus foot ($P = .17$).

Patients with a previous ankle sprain had better results than those who had a previous fracture ($P < .0005$) or those who were not able to recall a traumatic etiology ($P = .04$). Patients with previous ankle sprain were mean 7 years younger than those with previous fracture. No significant differences could be detected between the Scranton impingement classification[20] and the clinical outcome ($P = .37$).

According to the van Dijk arthritis classification,[29] the cases rated as grade I had a better outcome at T2 with respect to grade II and III ($P < .0005$). Furthermore, cases rated as grade II or III showed a reduction of the scores at

T2 with respect to T1 ($P = .05$). This reduction was not significant in grade I cases ($P = .14$).

The data showed that the commonly used classifications were not related to the outcome, so it was decided to develop a new classification.

Therefore, subjects were also classified according to this new classification system looking at both the size and distribution of the spurs (Figure 2) and the general cartilage status of the ankle joint (Figure 3).
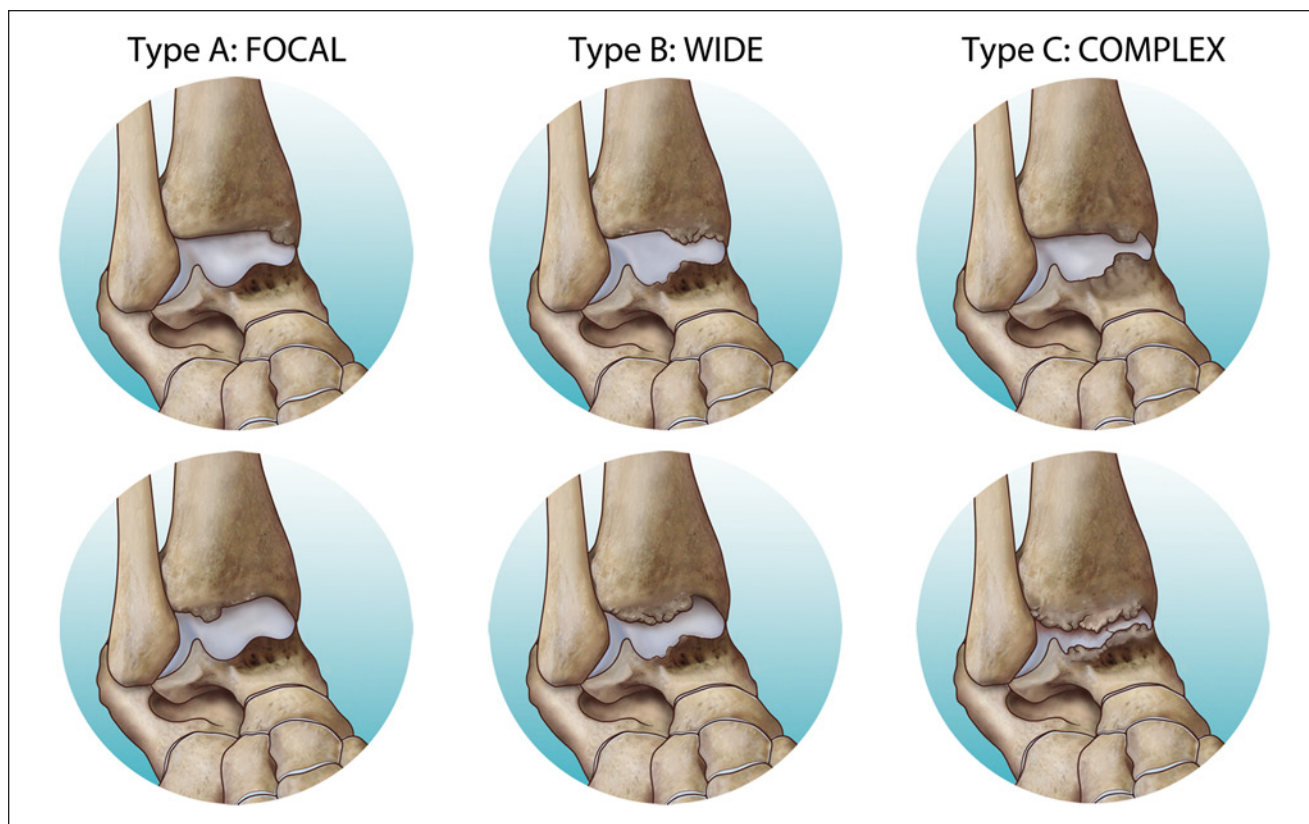
The impingement lesions were divided into three groups:

A: Focal: lesion less than one-third of the anterior articular margin (tibial anteromedial, central, anterolateral, or talar);

B: Wide: lesion from one-third to two-thirds of anterior articular margin (with eventual talar hyperostosis, no kissing lesion);

C: Complex: lesion more than two-thirds of the anterior articular margin (kissing lesion, whole tibial, multiple tibial, or talar lesions).

Results Related to the Newly Proposed Classification System

Based on the radiographic spur size and distribution (Figure 2), higher clinical scores were evident preoperatively in groups rated as A or B compared to group C (T0: A vs C $P = .05$; B vs C $P = .047$). At T1 a difference was noticed in the percentage of clinical improvement between the groups (A vs C $P = .018$; B vs C $P = .05$). At T2 the difference was maintained only in the percentage of improvement between groups A and C ($P = 0.05$) (Figure 4). According to the modified radiographic general cartilage status (Figure 3), no differences in the clinical score between the different groups were found at T0 ($P = .20$). At T1 a correlation in the percentage of clinical improvement was found between group 0 and, respectively, groups 2 and 3 (0 vs 2 $P < .0005$; 0 vs 3 $P = .001$). This finding was maintained also at T2 (0 vs 2 $P = .002$; 0 vs 3 $P = .005$) (Figure 5).

Combining the 2 newly proposed classification systems (Figure 6), a table capable to take into account both size and distribution of the spurs and general cartilage status classifications was designed. Three groups of patients (indicated as yellow, orange, and red, in order of severity) were finally identified in the table, according to outcome at T2. Preoperatively the yellow group had higher clinical scores with respect to the red one ($P = .008$). At T1 the percentage of clinical improvement of the yellow group was more satisfactory with respect to the red one ($P = .022$), while no difference was observed between yellow and orange groups ($P = .35$; $P = .27$). At T2 a difference was maintained in the percentage of improvement between groups yellow and red ($P = .014$), and also between yellow and orange ($P = .027$) (Figure 7).

Figure 2. Newer classification of the impingement lesions according to size and distribution of the spurs: A Focal: lesion less than one-third of the anterior articular margin (tibial anteromedial, central, anterolateral, or talar); B Wide: lesion from one-third to two-thirds of anterior articular margin (with eventual talar hyperostosis, no kissig lesion); C Complex: lesion more than two-thirds of the anterior articular margin (kissing lesion, whole tibial, multiple tibial, or talar lesions).

Discussion

Ankle impingement syndrome consists of a heterogeneous set of conditions. In addition, a wide spectrum of lesions may be associated, varying the clinical presentation and influencing the choice of treatment and the quality of the results. Several studies showed satisfactory short-term results after arthroscopic resection of the spur[2,6,7,24,25,27]; however, the results are prone to deteriorate over time.[5,26] The Scranton and McDermott classification,[20] although widely used, did not show in our series any statistical correlation with midterm or long-term clinical outcome. A relationship between the severity of osteoarthritis and the long-term results after arthroscopic impingement removal was previously reported by several studies[5,15,26] and shown to be a key factor also in this series. Patients with osteoarthritis grade II and III according to the van Dijk classification in fact showed significantly worse results over time.[5,19,26]

Nevertheless, the van Dijk classification of ankle arthritis was not specifically designed for impingement, taking into account the presence of the impingement itself in only 2 stages. Furthermore, we believe the size and distribution of the spurs need to be taken into account.

This study aimed to identify the factors influencing the long-term clinical outcome in order to define a population of patients able to gain the major advantage from an arthroscopic exostectomy procedure. With this goal, a new morphological classification of the anterior bony impingement was developed, taking into account both size and distribution of the spurs on x-ray and confirmed then by arthroscopy. The new classification was significantly correlated both to T0 and to the long-term follow-up. Furthermore, a 4-stage classification focusing on the general status of the cartilage alone was developed. These 2 important variables were finally combined in a single table where 3 groups of patients (indicated as yellow, orange and red) were identified, according to outcome at T2.

In cases of focal or wide lesions with or without low degree osteoarthritis, arthroscopic treatment represents the gold standard. The improvement obtained is significant and durable over time. Patients with small spurs associated with severe osteoarthritis or patients with complex spurs with low degree of osteoarthritis can be treated arthroscopically,
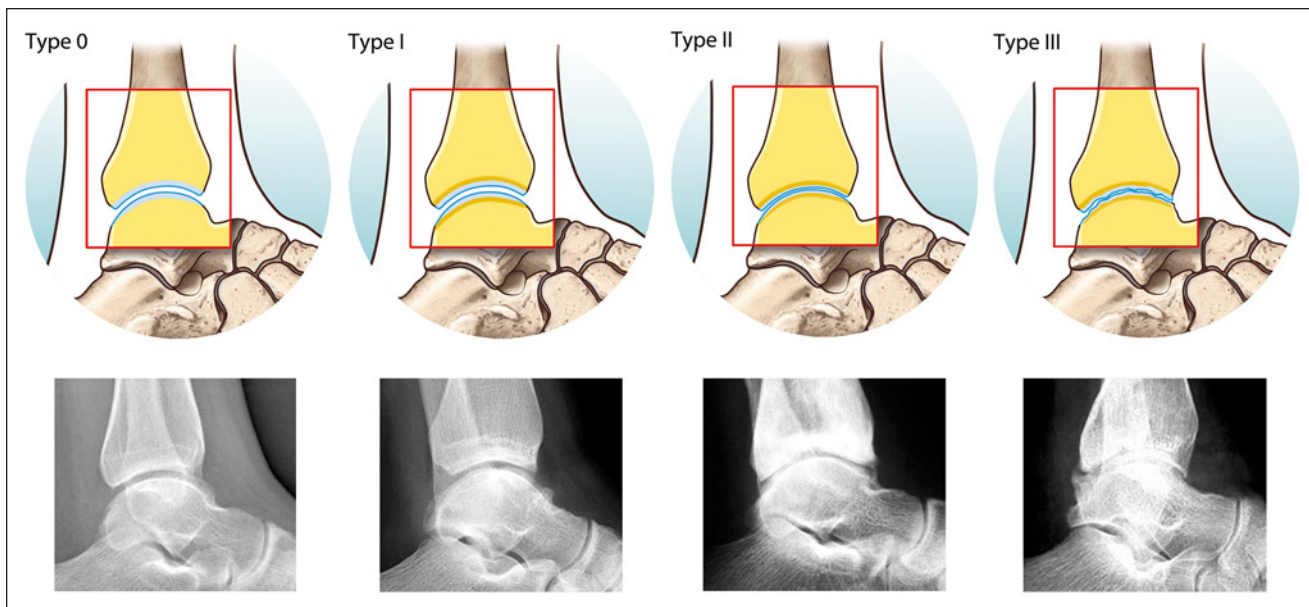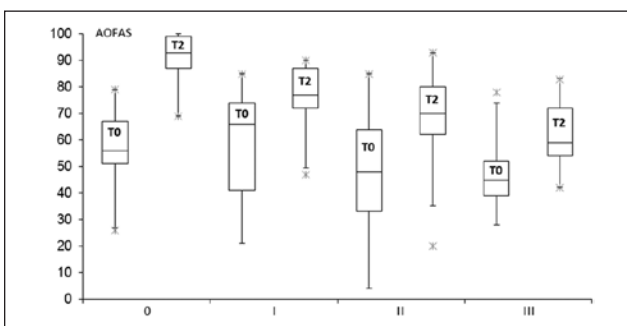
Figure 3. Newer classification of the general cartilage status in presence of ankle bony impingement: type 0: normal joint; type 1: subchondral sclerosis; type 2: joint space narrowing; type 3: (sub)total disappearance of the joint space.
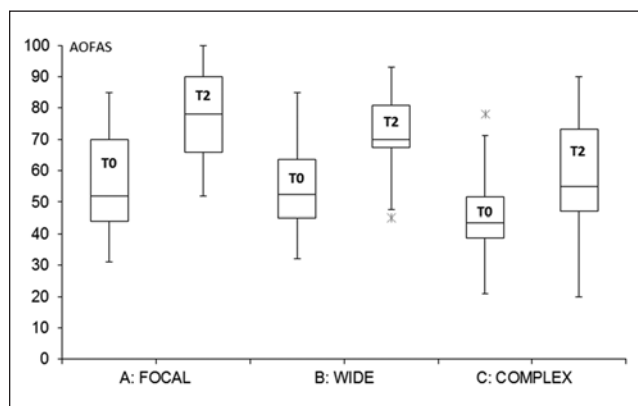
Figure 4. Box-plot distribution of postoperative American Orthopaedic Foot and Ankle Society (AOFAS) score according to size and distribution of the spurs: A Focal: lesion less than one-third of the anterior articular margin (tibial anteromedial, central, anterolateral, or talar); B Wide: lesion from one-third to two-thirds of anterior articular margin (with eventual talar hyperostosis, no kissing lesion); C Complex: lesion than two-thirds of the anterior articular margin (kissing lesion, whole tibial, multiple tibial, or talar lesions).

Figure 5. Box-plot distribution of postoperative American Orthopaedic Foot and Ankle Society (AOFAS) score according to general cartilage status: type 0: normal joint; type 1: subchondral sclerosis; type 2: joint space narrowing; type 3: (sub)total disappearance of the joint space.

Figure 6. Combined outcome predicting classification system that considers both the size and distribution of the spurs and the general cartilage status.

but patients should be aware that the result is prone to deteriorate over time. In cases with complex lesions and severe osteoarthritis, arthroscopy provides short-term relief but poor long-term results. In these cases other surgical solutions should be considered.
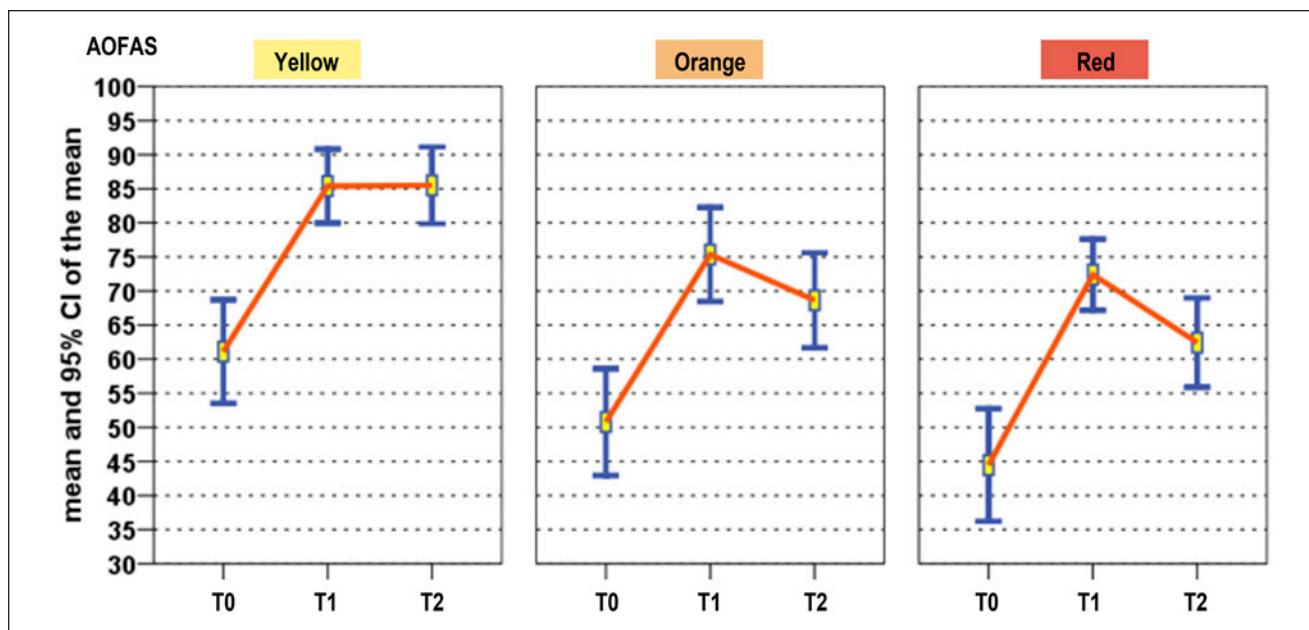
In this study a large variability of results was observed, conditioned by the degree of osteoarthritis as well as by the presence of a possible previous trauma.

Figure 7. Graph showing the distribution of American Orthopaedic Foot and Ankle Society (AOFAS) scores according to the combined outcome predicting classification system that considers both the size and distribution of the spurs and the general cartilage status.

The subjects with previous fractures showed proportional scores to the degree of damage of cartilage and to the morphological joint alteration. Perhaps in this case the development of osteophytes was a biological response to the overload of the joint, with the purpose of increasing the loading surfaces, the inherent stability and reducing the motility, causing inflammation.[14,15,29]

Patients who had previous sprains showed better results over time, but this finding must be considered with care; these patients were younger, active, and motivated, but at the same time they did not have problems of joint instability detectable with clinical testing and medical history. The subjects who were clinically unstable were excluded from the study and directed to other procedures, such as ligament reconstruction.

The link between joint instability and bony impingement is well known. In 2000 Scranton et al[21] found that impingement spurs were present in 57% of patients with chronic instability, compared to 17% of 200 randomly selected individuals. They thought that ankle instability is associated with arthritic changes, so that impingement spurs in case of instability are the expression of joint degeneration, and thus different from localized spurs in case of local microtrauma. Further studies demonstrated that chronic ankle instability is indeed significantly correlated with osteophytic formation in the medial and lateral ankle compartment.[9,11,27] Bonnel et al[3] explain how the ankle cannot be considered a separate system from the rest of the foot and that the factors that determine the joint stability are multiple and not only ligament.

As the link between the impingement and joint stability is demonstrated, it cannot be excluded that subjects who did not report a previous trauma may have had laxity without clinically detectable instability. Thus, in some patients with an "idiopathic" lesion, impingement could be considered an adaptive response, aimed at increasing the stability of the foot-system, and its removal may not necessarily lead to well-being in the long term.

An important role is certainly played by the microtraumatic mechanism as spurs are more evident in athletes, runners, dancers, high-jumpers, and kickers.[8,23] In this case, bone formation is considered to be a response of the skeletal system to intermittent stress and injury, causing bone remodeling.[30] Repetitive forced dorsiflexion causes jamming of the anterior tibial lip against the talar neck, resulting in microfractures in the trabecular bone and subperiosteal hemorrhage, which can lead to new bone formation.[12,22] In addition, in the majority of supination traumas, damage to the anterior cartilage rim occurs.[27]

In this sense, the cavus foot seems to be a predisposing factor, as already shown by Myers,[16] and it is possible to hypothesize that in this case the stiffness of the foot is a contributory cause of an impingement lesion as well as making one susceptible to supination trauma. However, in this series, the cavus foot showed just a statistic tendency to be a negative prognostic factor. This suggests that in this patient population the etiology of the impingement syndrome should be investigated.

The authors postulated that impingement as a biological response to the loss of balance of the biomechanical system of the ankle, which affects both the congruence of the articular surface and the state of the cartilage as well as its dynamic stability. This would occur in close relation, as in other joints, with inflammation of the soft tissues and of intra-articular microenvironment. Depending on the amount of damage, chondral and bone cell stimuli start a repair reaction that affects the cartilage, scar tissue formation, and calcification.[17]

In conclusion, in association with the high degree of osteoarthritis is the wideness of the osteophyte that negatively affects the future recovery after arthroscopy. This outcome-predicting new classification system that has been proposed in this study can be useful to perform a surgical procedure that better meets the expectations of the patients. With its long-term prognostic value, this classification is able to discriminate on the basis of complex clinical and radiographical pattern the patients who may gain long-lasting satisfactory results by the arthroscopic resection of osteophytes in contrast with patients who may have only temporary relief and those who should be addressed by other surgical approaches.

Declaration of Conflicting Interests

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