

# Rehabilitation and Return to Sports: Proceedings of the International Consensus Meeting on Cartilage Repair of the Ankle

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## Abstract

**Background:** The evidence supporting best practice guidelines in the field of cartilage repair of the ankle are based on both low quality and low levels of evidence. Therefore, an international consensus group of experts was convened to collaboratively advance toward consensus opinions based on the best available evidence on key topics within cartilage repair of the ankle. The purpose of this article is to report the consensus statements on Rehabilitation and Return to Sports developed at the 2017 International Consensus Meeting on Cartilage Repair of the Ankle.

**Methods:** Seventy-five international experts in cartilage repair of the ankle representing 25 countries and 1 territory were convened and participated in a process based on the Delphi method of achieving consensus. Questions and statements were drafted within 11 working groups focusing on specific topics within cartilage repair of the ankle, after which a comprehensive literature review was performed and the available evidence for each statement was graded. Discussion and debate occurred in cases where statements were not agreed upon in unanimous fashion within the working groups. A final vote was then held, and the strength of consensus was characterized as follows: consensus, 51% to 74%; strong consensus, 75% to 99%; unanimous, 100%.

**Results:** A total of 9 statements on rehabilitation and return to sports reached consensus during the 2017 International Consensus Meeting on Cartilage Repair of the Ankle. All 9 statements reached strong consensus, with at least 86% agreement.

**Conclusions:** The rehabilitation process for an ankle cartilage injury requires a multidisciplinary and comprehensive approach. This international consensus derived from leaders in the field will assist clinicians with rehabilitation and return to sports after treatment of a cartilage injury of the ankle.

**Keywords:** return to sports, ankle cartilage, talus, osteochondral lesion, rehabilitation

## Introduction

Osteochondral lesions of the talus (OLT) can have a substantial impact on overall quality of life and on athletic performance, resulting in the delay or inability of an athlete to train or compete.<sup>3,15,39</sup> The primary goal of the process of the rehabilitation is to return the patient to his or her preinjury activity level without pain, which is particularly important for athletes. With respect to athletes, the

time to return to high-impact sports after operative treatment of OLT ranges from 3 to 6 months and is dependent mainly on the type of lesion and specific treatment strategy employed.<sup>23</sup> To our knowledge, no objective criteria exist to assist clinicians with progressing rehabilitation activities after cartilage repair of the ankle. Moreover, the optimal rehabilitation protocols and strategies for returning patients to work or sports after treatment of an OLT remain subjects of frequent debate.

As a whole, the current body of evidence regarding ankle cartilage repair is based on both low-level and low-quality of evidence.<sup>32</sup> In fact, the majority of studies are of level IV evidence and consist of short-term follow-up time periods. Therefore, an international, multidisciplinary group of experts was assembled to develop expert- and evidence-based consensus statements to assist clinicians in managing this difficult pathology. The purpose of this article is to report the results of the working group on “Rehabilitation and Return to Sports” that were developed at the 2017 International Consensus Meeting on Cartilage Repair of the Ankle.

## Materials and Methods

Seventy-five national and international multidisciplinary experts in cartilage repair of the ankle were convened to participate in a 1-year consensus building effort, which culminated with the International Consensus Meeting on Cartilage Repair of the Ankle on November 17 to 18, 2017, at the University of Pittsburgh and University of Pittsburgh Medical Center in Pittsburgh, Pennsylvania. Delegates from 25 countries and 1 territory encompassing 6 continents were represented in the initiative. Experts were assigned to one of 11 working groups defined by specific subtopics within cartilage repair of the ankle, including “Rehabilitation and Return to Sports.” Specifically, this working group on “Rehabilitation and Return to Sports” consisted of 7 participants in total.

Each working group was assigned a liaison who served as the primary point of contact and dealt with communication and the distribution of surveys. In addition, liaisons were the responsible for writing the surveys, performing data analysis, and carrying out literature reviews. To reduce the potential for bias in the data analysis and/or literature review, liaisons did not submit answers to the questionnaires or partake in the voting process. One individual (C.D.M.) maintained oversight of the consensus process to ensure consistency across the working groups.

A list of questions for each working group was devised on the basis of a literature review and discussion with the expert participants. These were drafted with the aim of addressing areas of current controversy within cartilage

repair of the ankle, leading to answers that may assist clinicians in the management of this difficult clinical pathology. A total of 10 questions were formalized on “Rehabilitation and Return to Sports,” at which point the process to answer the questions and develop consensus statements was initiated.

A modification of the Delphi format described by Linstone and Turoff was used to pursue agreement among the experts on each question.<sup>23</sup> Blinded, electronic surveys were distributed, through which no identifying information was collected. Initially, participants were asked to provide their answer to each question in an open-ended format. These initial open-ended answers then facilitated the development of a more structured questionnaire, with emphasis on identifying areas of common ground and resolving aspects of disagreement. Using the results of the second questionnaire, preliminary consensus statements were developed and a comprehensive literature review was performed to identify, where possible, whether each statement was supported or refuted by the best available evidence. In addition, the available evidence for each statement was graded (Table 1). After the literature review, each group had the opportunity to amend the preliminary statements. Thereafter, a third questionnaire requested that each participant “agree” or “disagree” with each preliminary statement.

For questions that were agreed upon unanimously within the working group, these were progressed to a final vote among all 75 members of the consensus group. For questions that did not achieve unanimous agreement within the working group, these were advanced to an in-person discussion among all participants at the meeting in Pittsburgh.

Five questions in this working group were not agreed upon unanimously and were therefore advanced to the full group, with in-person discussion based on a standardized format. Briefly, each question and proposed answer was presented to the group, after which an opportunity for amendments was provided. Each proposed amendment required 2 additional participants to second and third the motion. If the amendment was successfully furthered, an opportunity for rebuttal was provided, followed by a vote of agreement or disagreement. In cases where 66% (two-thirds supermajority) or greater of the total votes received were in

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**Table 1.** Grades of Evidence.

A1	Multiple (2 or more) level I RCTs with similar findings, or a meta-analysis
A2	A single level I RCT
B1	Prospective cohort study
B2	Any comparison group that is not level I (eg, case control)
C	Case series
D	Case report
E	Expert opinion / basic science

favor of the proposed amendment, the statement was amended accordingly. This process was repeated for any further amendments that were desired, after which a final vote on the entirety of the statement was undertaken. Voting was conducted using electronic keypads. Similar to the survey data that were collected, all votes were anonymous and of equal weight among participants.

After the final votes for each question occurred, the degree of agreement was expressed using a percentage rounded to the nearest whole number. Consensus was defined as 51% to 74%, whereas strong consensus was defined as 75% to 99%, and unanimous was indicated by receiving 100% of the votes in favor of a proposed statement.

## Results

Of the 10 total questions and consensus statements in this group, 9 achieved strong consensus, and 1 question was removed as a result of redundant information provided in a similar question and statement in this same working group.

**Question:** What are the general concepts and time points to consider in patients returning to activities of daily living, recreational and/or elite athletic activities after cartilage repair of the ankle?

**Answer:** The general concepts of rehabilitation to consider in returning patients to activities of daily living, recreational and/or elite athletic activities after cartilage repair of the ankle are (1) allowing biological healing by limiting shear forces and (2) progression of activities based on a clinical evaluation.

The following aspects of the clinical evaluation can be used when deciding whether to progress rehabilitation activities: (1) pain, (2) proprioception, (3) stability, and (4) swelling.

In general, shear forces should be limited for 3 months, at which time rehabilitation/training can be progressed. Sport-specific training is considered 3 to 6 months after surgery and is individualized depending on the type of procedure. Return to competition after cartilage repair of the ankle is considered 6 months to 1 year after surgery and is individualized depending on the type of procedure.

**Vote:** Agree: 92%; Disagree: 8% (Strong Consensus).

**Grade of Evidence:** E

**Question:** What procedure-specific advice can patients be given with regard to their likelihood of returning to sport at the previous level of athletic play after ankle cartilage repair?

**Answer:** There are no validated specific recommendations to consider for rehabilitation and return to sports after cartilage repair of the ankle. Advising patients with regards to their likelihood of returning to sports at the previous level of athletic play is individualized. It can be conveyed that pain and function are likely to improve with diligent rehabilitation. When available, data from a representative population should be provided to the patient in order to quantify likelihood of returning to sport at the previous level.

The following prognostic factors should be used to identify athletes MORE likely to return to the previous level of athletic play: (1) biomechanics (eg, stability, alignment); (2) lesion size less than 1 cm<sup>2</sup>; (3) low fear of reinjury (eg, psychological readiness to return to sports); (4) patient compliance; (5) previous involvement in a high level and frequency of competition with a strong desire to return; (6) primary procedure; and (7) younger age.

**Vote:** Agree: 86%; Disagree: 14% (Strong Consensus).

**Grade of Evidence:** C for age and lesion size; E for others

**Question:** What effect(s) do concomitant procedures (eg, osteotomy, lateral ligament reconstruction) have on the overall process of rehabilitation and return to sports after cartilage repair of the ankle?

**Answer:** The rate-limiting factor in the process of rehabilitation is limited by the procedure that requires the most protection, which is most often the cartilage repair procedure. Thus, concomitant procedures typically have no impact on return to sport after cartilage repair of the ankle, but procedure-specific impairments related to the concomitant procedure may need to be addressed in the rehabilitation program. In cases of osteotomy, weight-bearing may be delayed to allow time for bone healing. It is important for the surgeon and physical therapist to communicate such that both are fully aware of concomitant procedures performed and the potential surgery-specific implications on rehabilitation activities and associated precautions.

**Vote:** Agree: 86%; Disagree: 14% (Strong Consensus).

**Grade of Evidence:** E

**Question:** Is there a benefit(s) to early versus delayed weight bearing after cartilage repair of the ankle?

**Answer:** Early weightbearing is beneficial, so long as shear forces are minimized, and should be utilized after cartilage repair of the ankle. Early weightbearing is defined as beginning at 4 weeks postoperatively.

**Vote:** Agree: 87%; Disagree: 13% (Strong Consensus).

**Grade of Evidence:** A2

**Question:** Is there a benefit(s) to early versus delayed motion after cartilage repair of the ankle?

**Answer:** Early motion is beneficial and should be utilized after cartilage repair of the ankle. Early motion can begin within 1 week following surgery and should consist of free, active range of motion. Maneuvers such as forced passive movements that extend the patient beyond their available range of motion should be avoided.

**Vote:** Agree: 98%; Disagree: 2% (Strong Consensus).

**Grade of Evidence:** C

**Question:** What criteria can be utilized in the clinical decision-making process of clearing an athlete to return to play after cartilage repair of the ankle?

**Answer:** The following clinical criteria can be utilized in the clinical decision-making process of clearing an athlete to return to play after cartilage repair of the ankle: (1) lack of negative effects with impact/loading, (2) pain, (3) physical function testing assessed in comparison to the contralateral (healthy) limb, (4) sport-specific tasks at 100% in an unopposed setting, (5) strength, and (6) swelling.

The following procedure-specific criteria should be utilized in the clinical decision-making process of clearing an athlete to return to play after cartilage repair of the ankle: (1) size of lesion, (2) type of lesion (eg, chondral vs osteochondral), and (3) type of procedure.

It is not necessary to use imaging in the decision-making process of clearing athlete to return to play after cartilage repair of the ankle.

**Vote:** Agree: 88%; Disagree: 12% (Strong Consensus).

**Grade of Evidence:** E

**Question:** For how long after returning to play following cartilage repair of the ankle should an athlete be advised to follow up with the surgeon clinically?

**Answer:** An athlete can be advised to follow up with the surgeon clinically for a total of 2 years after cartilage repair of the ankle. Further follow-up beyond 2 years is ideal, but only necessary in cases where the patient is or becomes symptomatic.

**Vote:** Agree: 86%; Disagree: 14% (Strong Consensus).

**Grade of Evidence:** E

**Question:** Should psychological factors be considered in the process of rehabilitation and return to sport in athletes? If so, how?

**Answer:** Yes, psychological factors can be considered in the process of rehabilitation and return to sport in athletes and should be assessed by a trained sports psychologist and/or via the mental health/psychological components of the Short-Form 12 or 36 questionnaires. This should be assessed

preoperatively for baseline, as well as at routine postoperative intervals in conjunction with posttreatment outcome scores.

**Vote:** Agree: 86%; Disagree: 14% (Strong Consensus).

**Grade of Evidence:** E

**Question:** Are there special considerations to be made in the process of rehabilitation and return to sports in elite athletes?

**Answer:** Close and frequent communication should occur between the surgeon, athlete, and support group around the athlete, with the team athletic trainer or physical therapist acting as the point person for these discussions given that they work most closely with the athlete on a daily basis.

It is imperative that the athlete not be overly aggressive in the process of rehabilitation of cartilage repair of the ankle, as biological healing must be allowed to occur. Elite athletes may proceed through the later phases of rehabilitation at an increased rate secondary to their body awareness and skilled movement patterns, but this should not be influenced by outside circumstances such as time of season, in addition to pressure from coaches, management, or agents.

**Vote:** Agree: 89%; Disagree: 11% (Strong Consensus).

**Grade of Evidence:** E

## Discussion

A total of 9 statements on “Rehabilitation and Return to Sports” reached consensus during the 2017 International Consensus Meeting on Cartilage Repair of the Ankle. All 9 statements reached strong consensus (greater than 75% agreement), and 1 question was removed as a result of redundancy in information. There is a deficiency in the literature pertaining to consistent, meaningful return to play (RTP) timelines following the treatment of cartilage lesions in the ankle. Published studies vary considerably in the metrics that used for measuring patient-reported outcomes, and few actually track them. Therefore, it is suggested that rehabilitation be performed according to the biological phases of healing. Full range of motion (ROM), a normal running pattern without pain and a 90% preinjury score on functional tests are considered the minimal requirements for RTP.<sup>24</sup>

It was the consensus of the group that both early range of motion and early weightbearing protocols can be employed after treatment of a cartilage lesion of the ankle. To our knowledge, no clinical data exist to substantiate the superiority of a recommendation of early motion within 1 week after surgery. However, previous animal studies have demonstrated that continuous passive motion (CPM) demonstrated faster healing, as well as thicker cartilage with an increased concentration of proteoglycans as compared to cast immobilization.<sup>12,30,35</sup> With regard to weightbearing, it was previously common practice to unload patients for

6 weeks after arthroscopic bone marrow stimulation (BMS), but immediate partial weight-bearing is now encouraged.<sup>4,9,14,19,20,24,29,36,37,40,41,44</sup> Allowing full weightbearing depends on the size and location of the lesion. In this regard, lesions measuring <1 cm can generally progress to full weightbearing within 2 to 4 weeks, whereas larger lesions and anteriorly located lesions can benefit from partial weightbearing for up to 6 weeks.<sup>13</sup> Several studies exist to evaluate early weightbearing after ankle cartilage repair. Li et al performed a retrospective review of a cohort that was allowed to bear weight immediately postoperatively in a splint after microfracture for osteochondral lesions of the talus, and reported excellent results with the VAS and AOFAS scores.<sup>22</sup> A separate study by Lee et al studied weightbearing after microfracture for osteochondral lesions of the talus.<sup>20</sup> The study compared early weightbearing at 2 weeks postoperatively versus delayed weightbearing at 6 weeks and found no overall differences in outcomes per AOFAS, VAS, and AAS. Therefore, early weightbearing can be used in postoperative protocols without causing apparent adverse effects in the setting of arthroscopic bone marrow stimulation. The course of rehabilitation in larger or secondary lesions depends on the specific operative technique, but generally involves longer periods of partial weightbearing. In the case of fixation or procedures involving malleolar osteotomy, weightbearing can be modified such that 6 weeks of nonweightbearing is typically advised.<sup>24,28</sup>

Before returning to activity and/or sports after debridement and bone marrow stimulation of an osteochondral injury, it is important to quantify patient activity level for arthroscopic bone marrow stimulation, a 4-level activity rehabilitation program has been proposed, with gradual progression to normal walking, running, noncontact sports, and contact sports, respectively.<sup>42</sup> A lesion up to 1 cm can commence partial weightbearing within 4 to 6 weeks, but larger and anteriorly located lesions require 6 to 8 weeks to start partial weightbearing. The consensus of this expert group was that weightbearing should commence early at 4 weeks posttreatment. Full return to noncontact sporting activities is advised at 20 to 24 weeks postoperatively, whereas contact sports are permitted from 24 weeks and beyond. Final training for speed, strength and endurance should begin with running on uneven ground, generating explosive force, changing direction(s), and other sport-specific movements. Also, as ankle sprains are the major cause of cartilage injuries, the use of ankle injury prevention strategies (including neuromuscular training and the use of tape or brace) should be considered.

An average RTP length of  $15 \pm 4$  weeks in athletes treated with bone marrow stimulation has been reported. With regard to elite athletes after bone marrow stimulation, a 94% RTP is described,<sup>37</sup> although studies in a mixed population generally report lower rates (63%-79%).<sup>17</sup> Increasing

age may be a negative predictor for the ability to return to peak performance after surgery. In a study analyzing return to sport after microfracture in male professional soccer players with an average age of 27 (range, 18-32 years), 21 (95%) players returned to their previous level in the following season.<sup>25</sup> The one player who did not return was the oldest player of the cohort at the age of 32 years. Increased years of age negatively correlated with continued play postinjury. In a separate study evaluating 38 patients who underwent second-look arthroscopy 1 year after autologous chondrocyte implantation, both patient age and size of the lesion were found to be the statistically significant factors impacting RTP.<sup>21</sup> Larger lesion size is also well described as a factor for poorer patient outcomes after bone marrow stimulation and may similarly affect return to sport, as well. Return to play in patients treated with autologous bone grafts is significantly longer than that of the bone marrow stimulation ( $19.6 \pm 5.9$  vs  $15.1 \pm 4$  weeks, respectively).<sup>37</sup> The addition of a concomitant medial malleolar osteotomy resulted in 2 weeks longer time to RTP. In a case series of athletes who underwent autologous bone grafting, 90% of the athletes were still competing at a mean of 6 years.<sup>9</sup> Moreover, approximately 90% of athletes can RTP after autologous graft procedures, which has been reported in both amateur and professional athletes.<sup>11</sup>

Recent studies have attempted to augment healing of cartilage lesions by injecting platelet-rich plasma<sup>2,26,27</sup> or hyaluronic acid<sup>1,26,31,34</sup> as an adjunct to arthroscopic microfracture.<sup>16,38</sup> Although functional improvement has been reported following injection, further double-blinded evaluations in greater numbers are necessary.<sup>25</sup> Despite this, no studies suggest that the addition of a biologic will speed physiological healing. Nonetheless, potential factors reducing the rehabilitation time are a younger age<sup>5-7,9,18,33</sup> lower BMI,<sup>9,20</sup> smaller defect size,<sup>8-10,14</sup> mobilization, and treatment with bisphosphonates and pulsed electromagnetic field therapy.<sup>42</sup>

This consensus effort is not without limitations. By definition, consensus statements are considered level V data and represent a blend of expert-opinion and the best available evidence.<sup>43</sup> Nonetheless, the lack of high-quality clinical evidence to date in this field encouraged us to seek alternative methods for developing best practice guidelines in conjunction with leaders in the field. Further high-level studies should be required to substantiate the statements that have been developed as part of this initiative. The consensus will be updated in the event that further evidence for or against a current statement becomes available. The questions that were developed were a potential source of bias in that there was no standardized process for soliciting questions from all members of the working groups at the same time and in a blinded fashion. In future iterations, we will be adding an additional questionnaire to solicit questions from

all members to ensure that the most comprehensive and clinically relevant topics are addressed.

This international consensus derived from leaders in the field will assist clinicians with rehabilitation and return to sports after treatment of a cartilage injury of the ankle.

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