

Return to Sports after Articular Cartilage Repair in the Football (Soccer) Player

Cartilage
3(Suppl. 1) 575–625
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DOI: 10.1177/1947603511410419
<http://cart.sagepub.com>



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Abstract

Background: The ability to return to football (soccer) presents a critical aspect for successful treatment of articular cartilage injury in the football (soccer) player. **Methods:** Information about sports participation after articular cartilage repair was collected from the literature. Special focus was placed on data in football athletes with information on return rate, timing of return, level of postoperative competition, and the ability to compete in the sport over time. **Results:** Twenty studies describing 1,469 athletes including football players with articular cartilage injury were reviewed. Average return to sport was 79% without a significant difference in return rate or postoperative level of play between cartilage repair techniques. Time to return varied between 7 to 17 months, with the longest time for autologous chondrocyte transplantation (ACI). Advanced sport-specific rehabilitation was able to reduce recovery time. Durability of results was best after ACI, with up to 96% continued sport participation after more than 3 years. Player age, time between injury and treatment, competitive level, defect size, and repair tissue morphology affected the ability to return to play. Sports participation after cartilage repair generally promoted joint restoration and functional recovery. **Conclusions:** Articular cartilage repair allows for a high rate of return to high-impact sports including football, often at the preinjury competitive level. The time of return and durability can be variable and depend on repair technique and athlete-specific factors. Advanced, sport-specific rehabilitation can facilitate return to football.

Keywords

sport, athletics, cartilage, articular, injury, repair, resurfacing, knee

Introduction

Knee injuries are observed frequently in football (soccer) players and can sideline the player for prolonged periods of time.¹ Research studies by the Fédération Internationale de Football Association (FIFA) Medical Assessment and Research Center (F-MARC) have identified articular cartilage injuries as a serious knee injury that can be associated with inability to play.² While some players with articular cartilage injury may be able to return to their sport initially, a significant decline of athletic activity often develops over time with increasing athletic disability.³ Correspondingly, several independent studies have demonstrated up to 12-fold increased incidence of knee osteoarthritis in competitive football players.^{4,5} Due to the forceful, repetitive joint loading in football, joint surface restoration in these athletes presents a significant therapeutic challenge and requires a repair cartilage that can withstand the significant mechanical joint stresses generated during football. Because return to sports presents a key measure of successful outcome for injured players, we investigated the ability to return to sport following articular cartilage repair, with a special focus on football players and the factors that can influence their ability to return to competition.

Materials and Methods

A comprehensive search of the English literature was performed to identify any published and unpublished clinical studies on cartilage repair in athletes using MEDLINE, MEDLINE preprints, EMBASE, CINAHL, Life Science Citations, and the British National Library of Health including the Cochrane Central Register of Controlled Trials (CENTRAL) medical electronic databases. The search period was January 1, 1966 to December 31, 2010. The medical databases were searched using the terms “sport”, “athlete”, “football”, “soccer”, “return to sport”, “athletic activity”, “chondral defect”, “articular cartilage repair”, “articular resurfacing”, “microfracture”, “marrow stimulating technique”, “osteochondral transfer”, “autograft”, “allograft”, “OATS”, “mosaicplasty”, and “autologous chondrocyte implantation”. Specific attention was placed on identifying

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studies that described information about sports activity and especially information regarding football (soccer) players.

We identified 65 clinical studies on primary screening that reported on articular cartilage repair in the knee and sports activity. All prospective randomized controlled studies (level I and II) were included in the study if they provided information on postoperative athletic function and included football players. Level III and IV studies were included if they provided postoperative follow-up data of ≥ 24 months or macroscopic or histological data. Twenty studies met the final inclusion criteria and were used to systematically extract information about demographics, defect characteristics, surgical technique, and associated procedures. Focus was placed on collecting data on sports and football participation after cartilage repair, including activity scores (Tegner and Knee Injury and Osteoarthritis Outcome Score [KOOS] sports and recreation subscores), return rate, time and level of return, and continuation of sports participation.

The collected data were analyzed using established statistical software. Differences between independent parameters were evaluated using the Kruskal-Wallis test. Differences between variable proportions were measured by χ^2 analysis. Differences were considered significant with $P < 0.05$. Data are presented as mean \pm standard error of the mean (SEM).

Results

Twenty studies describing 1,469 athletes including football players treated for articular cartilage injuries of the knee were included in this study. Only one study exclusively described results in football players. The average postoperative follow-up was 46 ± 3 months (range, 18-84 months). Defect size averaged 3.9 ± 0.5 cm², with the largest average defects in players undergoing autologous chondrocyte transplantation (5.3 ± 1 cm²). Mean duration of symptoms before surgery was 20 ± 3 months (range, 1-48 months). Sixty percent of studies included patients with concomitant procedures. Fourteen studies reported on individual surgical techniques, and 6 studies were comparative studies. Ten studies reported information on microfracture (MF), 9 on autologous chondrocyte transplantation (ACI), 5 on osteochondral autograft transfer (OAT), and 1 on osteochondral allograft transplantation.⁶⁻²⁵

Significant increases in KOOS subscales for sports and recreation were observed after all techniques.^{11,21,24} ACI showed higher KOOS sports and recreation score increases than microfracture at 60 months.²⁴ Tegner activity scores increased after all articular cartilage repair techniques, with highest Tegner activity scores after ACI. Decreasing Tegner scores were observed after the initial increase in 42% after microfracture and 20% after OAT. However, the decreased scores were still significantly improved from preoperative levels. No decline was observed after ACI, while limited information was available on durability after osteochondral allograft transplantation.^{11,12,15,16,19,23-25}

Return to sports including football averaged 79% overall without significant difference between microfracture (68%), ACI (74%), osteochondral allograft transplantation (84%), and osteochondral autograft transplantation (91%). Return to competitive or professional football was observed in 100% after microfracture and 83% after ACI.^{15,18} Time to return to sports ranged between 7 to 17 months depending on the cartilage repair technique and was shortest after osteochondral autograft (7 months) and longest after ACI (17 months). Return to play at the preinjury level averaged 69% without a significant difference between surgical techniques. Sixty-five percent of athletes continued playing sports at the preinjury level after 3 years, with the best durability after ACI (77%) (Table 1). Factors that affected the ability to return to play after cartilage repair included age,^{8,10,14,15,17} duration of symptoms with up to 4-fold increased return rate for surgery within 1 year of the injury,¹⁵⁻¹⁷ defect size,^{8,14,17} chondral defects,^{8,9} and fewer prior surgeries (Table 2).^{15,17} Return rates for competitive athletes (71%-83%) were better than for recreational athletes (16%-29%) ($P < 0.001$), and competitive players returned to play faster than recreational athletes (12 v. 22 months) ($P < 0.001$). Intensive, sports-specific rehabilitation was able to reduce the time to return to play. Della Villa *et al.*²³ confirmed that athletes treated with intensive rehabilitation including isokinetic training and sport-specific on-field rehabilitation (**Fig. 1**) after ACI showed a faster recovery of previous activity level (8.6 ± 1.7 months) and an earlier return to competition (10.6 ± 2.0 months) compared with the controls (10.6 ± 1.7 and 12.4 ± 1.6 , respectively). While better macroscopic repair tissue grade was associated with better rate of return to sport, the effect of histological tissue quality on return to play was inconclusive.^{6-9,18,24}

Discussion

Athletes often consider return to sports the most important outcome measure for successful treatment. Return to high-impact sports like football requires restoration of articular cartilage to the degree that can withstand even the high mechanical forces placed on the restored joint surface during the sport. The observed high activity scores confirm that articular cartilage repair improves activity levels even in the athletic population. Articular cartilage repair was successful in returning players to high-impact sports including football at a rate similar to that reported for other common sports medicine procedures such as anterior cruciate ligament reconstruction or meniscal repair.^{26,27} The best return rates (up to 100%) observed in high-level players are very encouraging considering the complexity of articular cartilage restoration and excessive demands placed on the repair tissue, particularly in professional football players. However, while return to sport at the preinjury level is possible, it is not clear from the available literature if the player can achieve the

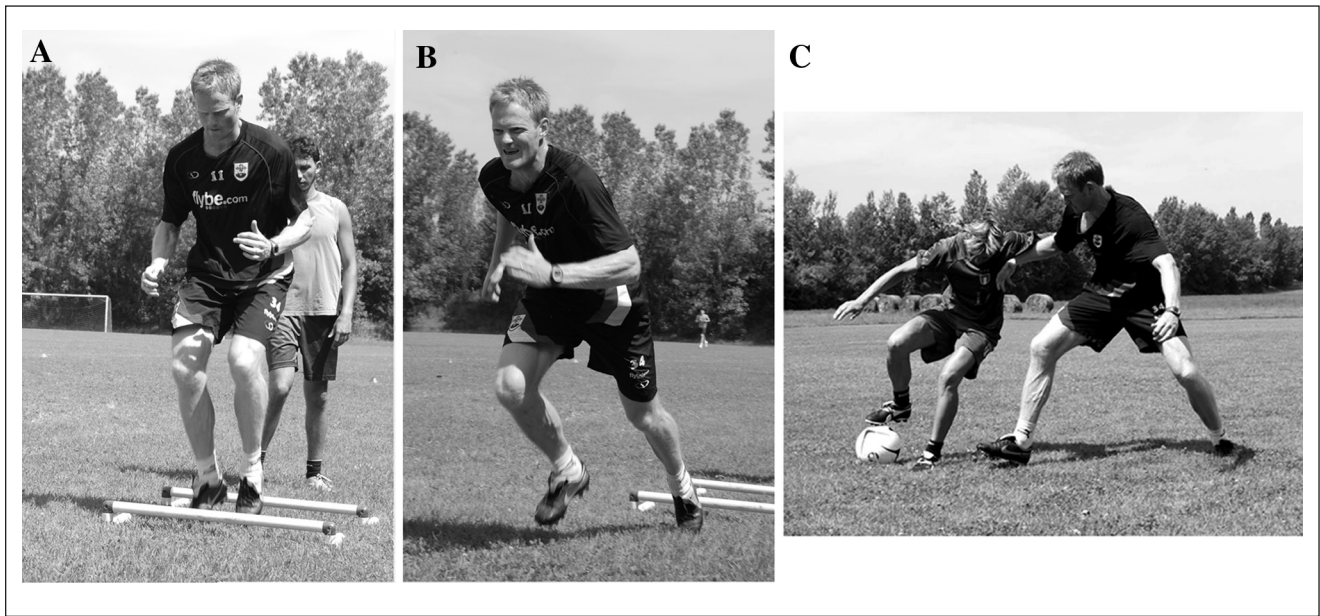


Figure 1. Sport-specific on-field rehabilitation in football players allows for gradual reintegration into sport-specific movement and joint loading patterns (**A, B**) and under simulated match conditions (**C**) and has been demonstrated to accelerate return to play after articular cartilage repair without compromising graft integrity and the ability for continued competition even at the elite football level over time.

Table 1. Return to Play Overview

	MF	ACI	OAT	Allograft
Return rate	68%	74%	91%	84%
Same level return	67%	71%	70%	60%
Time to return, mo	8 (6-18)	17 (10-36)	7 (4-9)	N/A
Durability (>3 y)	56%	77%	72%	N/A
Decreasing function	42%	0%	20%	N/A

Note: MF = microfracture; ACI = autologous chondrocyte implantation; OAT = osteochondral autograft transfer; N/A = no data available.

same performance level as before injury.^{6,28,29} At least temporary postoperative performance limitations have been observed in some cartilage repair studies at the professional level, with similar observations after anterior cruciate ligament reconstruction in professional athletes, and may be related to pain, effusion, stiffness, altered joint proprioception, and deconditioning.^{17,28-31} Intensive, sport-specific rehabilitation programs may offer a possibility to improve safe reintegration into sports like football and to recover full athletic performance.²³

Time to return to sport was longer for ACI than for microfracture, osteochondral autograft transplantation, or osteochondral allograft transplantation. This is not surprising and is based on the larger average lesion size, more invasive nature of ACI, and the need for repair tissue growth for this technique. Less invasive ACI techniques and accelerated

rehabilitation programs have been recently shown to reduce the time to return after ACI.^{11,23,32}

Durability of sports participation after successful return averaged 65% and was best after ACI. The excellent durability of up to 96% after ACI was observed as late as 9 years after surgery even under the high demands of professional football.^{11,12,17} Interestingly, sports participation was found to improve postoperative knee function scores, confirming the benefit of athletic activity and encouraging participation in sports activities including football after cartilage repair.¹² Mild deterioration of activity scores was observed after microfracture or OAT, but athletic activity levels with both techniques remained better than before surgery. The reasons for this functional decline are not completely understood. Several factors such as limited repair tissue quality or volume, limited peripheral integration, or relative thinning of the

Table 2. Factors Affecting Return to Play after Cartilage Repair

	MF	ACI	OAT	Allograft
Age	+	+	+	+
Duration of symptoms	+	+	+	
Lesion size	+		+	
Lesion type	+		+	
No. of previous surgeries	+	+		
Athlete's skill level	+	+		
Concomitant procedures			+	
Repair tissue morphology	+		+	

Note: + = demonstrated effect on return to sport; MF = microfracture; ACI = autologous chondrocyte implantation; OAT = osteochondral autograft transfer.

overlying repair cartilage tissue by subchondral bone overgrowth or osteochondral mismatch have been suggested as factors that may influence the durability of the functional improvement after cartilage repair.^{6,13,24,33,34}

Several athlete- and injury-specific factors can influence the footballer's return to play. Player's age significantly affects sports participation after all cartilage repair techniques and can be explained by the age-dependent metabolic activity and matrix synthesis in the repair cartilage as well as socioeconomic factors.^{10,35,36} The duration between injury and cartilage repair influenced the return rate, with up to 4-fold better return rate when cartilage repair was performed within 12 months after injury.¹⁵⁻¹⁷ Development of a degenerative joint environment and prolonged absence from competition offer a possible explanation for this observation.³⁷ This is consistent with the better results observed also with fewer prior surgical interventions. These results emphasize the critical importance of early surgical treatment of articular cartilage lesions for the successful postoperative return to play in the football player.^{15,16} Better return rates were observed in more competitive athletes after cartilage repair, an effect that has also been reported for elite athletes after anterior cruciate ligament reconstruction.³⁷ Earlier diagnosis, shorter intervals between injury and cartilage repair, better access to rehabilitation, younger age, better defect fill, and socioeconomic factors such as higher motivation to return to professional sport can explain the higher return rates in elite players.^{6,15,37} Defect size <2 cm² was associated with a significantly higher rate of return by high-impact athletics after microfracture and OAT and supports the established indications of these 2 techniques for smaller defects.^{14,15,17,38,39} Treatment of concomitant knee pathology had a beneficial effect on return to sport.^{6,13,15} Simultaneous treatment with articular cartilage repair may support the athlete's return to sport by avoiding repeated rehabilitation and extended absence from competitive play. Accelerated, sport-specific rehabilitation programs that are individually designed and

based on treatment goals rather than fixed timelines can also improve both the rate and time to return to play without compromising graft integrity and clinical outcome at medium-term follow-up.^{23,32}

In conclusion, the results of articular cartilage repair in high-impact athletes like football players are encouraging and comparable to other common sports medicine procedures. Return to sports participation can be successfully achieved by all techniques. Return is frequently at the preinjury level even at the elite level. Younger, competitive players with small defect size, short duration of symptoms, and fewer prior surgical interventions have a higher probability to return to sports. Prospective long-term studies are needed to determine how the incidence of joint degeneration is affected in athletes who return to play football after articular cartilage repair.

Acknowledgments and Funding

The authors received no financial support for the research and/or authorship of this article.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

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