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Review

Correlation between histological outcome and surgical cartilage repair technique in the knee: A meta-analysis☆,☆☆

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ABSTRACT

Background: Compare histological outcomes after microfracture (MF), autologous chondrocyte implantation (ACI), and osteochondral autograft transfer (OATS).
Methods: Literature review using PubMed MEDLINE, SCOPUS, Cumulative Index for Nursing and Allied Health Literature (CINAHL), and Cochrane Collaboration Library. Inclusion criteria limited to English language studies International Cartilage Repair Society (ICRS) grading criteria for cartilage analysis after ACI (autologous chondrocyte implantation), MF (microfracture), or OATS (osteochondral autografting) repair techniques.
Results: Thirty-three studies investigating 1511 patients were identified. Thirty evaluated ACI or one of its subtypes, six evaluated MF, and seven evaluated OATS. There was no evidence of publication bias (Begg's $p = 0.48$). No statistically significant correlation was found between percent change in clinical outcome and percent biopsies showing ICRS Excellent scores ($R^2 = 0.05$, $p = 0.38$). Percent change in clinical outcome and percent of biopsies showing only hyaline cartilage were significantly associated ($R^2 = 0.24$, $p = 0.024$). Mean lesion size and histological outcome were not correlated based either on percent ICRS Excellent ($R^2 = 0.03$, $p = 0.50$) or percent hyaline cartilage only ($R^2 = 0.01$, $p = 0.67$). Most common lesion location and histological outcome were not correlated based either on percent ICRS Excellent ($R^2 = 0.03$, $p = 0.50$) or percent hyaline cartilage only ($R^2 = 0.01$, $p = 0.67$).
Conclusions: Microfracture has poorer histologic outcomes than other cartilage repair techniques. OATS repairs primarily are comprised of hyaline cartilage, followed closely by cell-based techniques, but no significant difference was found cartilage quality using ICRS grading criteria among OATS, ACI-C, MACI, and ACI-P.
Level of evidence: IV, meta-analysis

Contents

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1. Introduction

Cartilage defects in the knee can cause substantial patient morbidity and predispose patients to chronic knee problems such as osteoarthritis (OA) [10,40,48,49]. Unfortunately, full thickness cartilage defects of the knee joint are quite common. Over half of patients in a recent retrospective study of knee arthroscopy were confirmed to have cartilage defects, [53] and athletes may be at greater risk [16,50]. Although the natural history of cartilage lesion progression to osteoarthritis is not fully understood, prompt treatment of symptomatic cartilage defects has been shown to have good results. [17] These defects in the knee range in severity from small changes in knee cartilage to larger full-thickness lesions.

Several methods have been proposed for the treatment of cartilage defects in the knee. Microfracture (MF), osteochondral autograft (OATS), osteochondral allografts (OCA), and autologous chondrocyte implantation (ACI) have all been well-described treatments. Treatment algorithms have been created based on size and location of defects, activity level, and whether one is performing a primary or secondary procedure [4,13]. However, tissue regenerated after different cartilage repair techniques can vary in the amount of hyaline cartilage.

For instance, microfracture is traditionally thought to produce fibrocartilage, whereas other techniques such as OATS and ACI are thought to produce more hyaline like tissue. [54] Thus, the histological outcome of each cartilage repair technique is different, and many studies have been performed that analyze these histological outcomes. Importantly, previous studies have not focused on a comparison of histological outcomes among the different techniques. The objective of this study is to compare the histological outcomes among cartilage repair techniques and to evaluate any correlation between histological outcomes and clinical outcomes. We hypothesized that microfracture would have the worst outcomes based on histological scores.

2. Material and methods

2.1. Methods

Using guidelines outlined in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) and QUORUM (Quality of Reporting of Meta-Analysis) statements for standardized reporting of systematic reviews in the preparation of this manuscript, [33,37] a systematic search of the literature was performed to identify studies that evaluated histological outcomes after surgical cartilage repair in the knee joint (Figure 1). Cartilage repair techniques evaluated were limited to autologous chondrocyte implantation (with a periosteal cover [ACI-P], with a type I/type III collagen-derived cover [ACI-C], or with a matrix-induced cover [MACI]), osteoarticular transfer system (OATS)/mosaicplasty (MO), and microfracture (MF). One study reported on CCI (characterized chondrocyte implantation), in which chondrocytes are grown on a matrix substance (often cartilage or hyaluronan). This CCI was thus included in the MACI analysis group. The PubMed MEDLINE, SCOPUS, Cumulative Index for Nursing and Allied Health Literature (CINAHL), and Cochrane Collaboration Library databases were searched from their earliest entry points to July 27, 2013. The search terms were autologous chondrocyte implantation, ACI, autologous chondrocyte transplantation, microfracture, osteoarticular transfer, osteochondral autograft transfer, OATS, histology, histological, outcome, and knee.

Inclusion criteria

- English-language studies
- Levels 1 to 4 evidence
- Cartilage defects treated with ACI, MACI, ACI-C, OATS, or MF
- Second-look arthroscopy at follow-up
- Use of a biopsy or International Cartilage Repair Society visual grading scale to grade the treated lesion

Exclusion criteria

- Non-English-language studies
- Animal studies
- Level 5 evidence
- Studies investigating joints other than the knee
- Multiple cartilage repair techniques used in combination

In this review, the ICRS visual grading scale (International Cartilage Repair Society) was used to measure outcomes between studies as numerous studies evaluated used this method of assessing cartilage post-operatively [52]. The scale assesses the degree of defect repair, integration to boarder zone, and macroscopic appearance. Each of these three categories is graded on a one to four scale, and then the sum of the three categories is used to grade the repair site. Grades

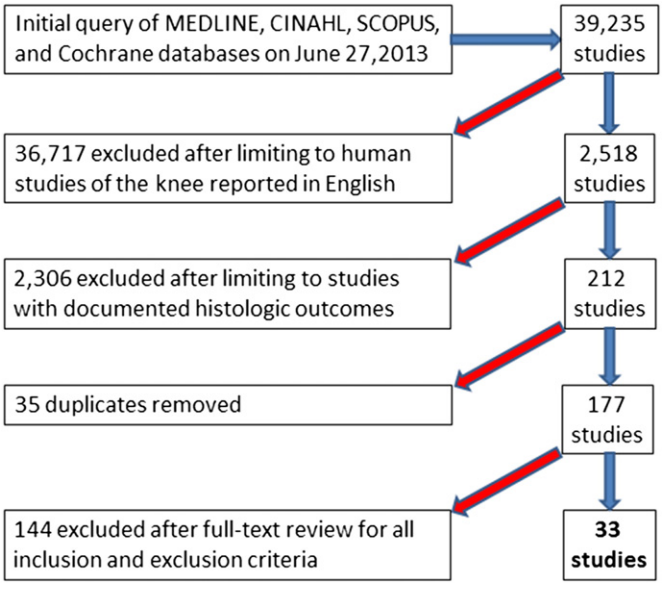

Figure 1. Systematic search process. The initial searches of MEDLINE, CINAHL, SCOPUS, and Cochrane databases identified 39,235 studies. After limiting the searches to human studies reported in English on the knee that included histologic outcomes, duplicates were removed and the full text of the remaining 177 studies was reviewed, resulting in a final total of 33 studies that met all inclusion and exclusion criteria.