Patellofemoral Cartilage Restoration: A Systematic Review and Meta-Analysis of Outcomes

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Focal chondral and osteochondral defects of the knee are common injuries, including in the patellofemoral (PF) joint. Many techniques of cartilage restoration have been described, with short and long-term improvement. 

**Purpose:** To determine and compare outcomes of PF cartilage restoration techniques. 

**Hypothesizes:** Cartilage restoration techniques of the PF joint would lead to favorable clinical outcomes.
Methods – Literature Search & Quality Assessment

- **Literature Search**: PRISMA guidelines were followed. Pubmed, EMBASE, & The Cochrane Library databases were utilized (10/08/18)
  - Inclusion criteria: therapeutic studies with levels I, II, III, IV evidence treatment of full thickness, or nearly full thickness cartilage lesions, and osteochondral lesions; human subjects, English language.
  - Relevant terms of the search were grouped by defect, location, and procedure. Relevant articles were determined to be those which included at least one term from each grouping.

- **Quality Assessment**: Classified by level of evidence and evaluated by the Coleman Methodology Score (CMS).
Methods – Data Extraction & Analysis

- Technique groups:
  - **Osteochondral allografts transplantation** (osteoochondral allograft (OCA))
  - **Osteochondral autografts transfer** (osteoochondral autograft transfer as either a single cylinder transfer (OAT-1) or a mosaicplasty (OAT-M))
  - **Chondrocyte cell-based therapy** (autologous chondrocyte implantation with periosteum (pACI), autologous chondrocyte implantation with membrane, without chondrocytes already in the membrane (mACI), matrix-induced autologous chondrocyte implantation (MACI), and particulated juvenile articular cartilage allograft (PJAC))
  - **Bone marrow-based therapy, with or without orthobiologic augmentation** (autologous matrix-induced chondrogenesis with platelet-rich plasma (AMIC-PRP) or without PRP (AMIC), bone marrow aspirate concentrate (BMAC) implantation, microfracture (MFx))
  - **Scaffolds** (TruFit and three-dimensional osteochondral scaffold (3D-OCS)).

- Associated PF pathology: **Instability** = objective patellar subluxation or dislocation (with or without PF risk factors); **Anatomical risk factors** = maltracking, malalignment or PF risk factors without PF instability

- PF risk factors = increased lateral quadriceps vector, patella alta, increased lateral tilt, and trochlear dysplasia.

- Complications:
  - **Minor** = did not require further surgical intervention;
  - **Major** = required surgical interventions;
  - **Failures** = when the surgical interventions were revisions of the cartilage restoration procedures.
The metafor package as part of RStudio software version 1.0.143 was used for data analysis.

Each article was stratified by procedure.

Forest plots were created for lesion size, major and minor complication, failures, and change in International Knee Documentation Committee (IKDC), Cincinnati, and Lysholm scores.

All outcomes of analysis were reported as the weighted average with a 95% confidence interval.

A funnel chart was used to evaluate publication bias.
Results

Inclusion and exclusion criteria were met by 59 articles and 62 studies (from 1999 and 2018). (Figure).

Study refers to each technique or lesion location within an article that reports a PRO.

Publication bias funnel plot (Figure). Average CMS score was 71.8. No statistical difference between subgroups (p=0.260).
Results – Systematic Review

Lesion location: patella (n=1077, 65.7%), trochlea (n=390, 23.8%), and bipolar lesions (n=172, 10.5%).

- N=298 did not specify the location of the patellofemoral lesion

The frequency of procedures performed were, in decreasing order:

- chondrocyte cell-based therapy (65.7%)
- bone marrow-based therapy, with or without orthobiologic augmentation (17.2%)
- osteochondral autografts transfer (8%)
- osteochondral allografts transplantation (6.6%)
- scaffolds (2.2%)

Associated PF pathology:

- Instability in 167 knees (18.5%) and Anatomical risk factors in 698 knees (43.5%)

Statistically significant improvement was observed on at least one PRO:

- chondrocyte cell-based (30 studies, 83%)
- OAT (7 studies, 78%)
- OCA (5 studies, 71%)
- bone marrow-based (7 studies, 64%)
- and scaffolds (1 study, 50%)
Lesion Size: chondrocyte cell-based (24 studies, 4.7cm²) > overall pooled lesion size (44 studies, 3.9cm²) > scaffold (2 studies, 2.2cm²) and OAT (8 studies, 1.5cm²)

Age: Overall weighted average (67 studies) was 37.5 years (15 – 72)

Follow-up: Overall weighted average (67 studies) was 56.1 months. In comparison to the overall distribution, there was a statistically shorter follow-up in the OCA (36.1 months) and bone-marrow based groups (36.4 months)

Associated PF pathology – The overall pool (29 studies) of instability was 11.9%; and the overall pool (52 studies) of anatomic risk factors was 32.1%

Associated procedures – No significant difference observed between any of the groups and the overall pool (52 studies) rate of trochleoplasty (3.3%), rate of soft tissue procedures (52 studies, 10.6%) rate of non-PF procedures (52 studies, 4.9%). Realignment was most commonly performed in the chondrocyte cell-based (37.0%) and bone marrow-based (42.1%) OCA frequency was 8.4%. From pairwise comparison, there was greater incidence of realignment procedures in the chondrocyte cell-based group than OATS (p=0.027) and OCA (p=0.004). There was also greater incidence of realignment procedures in bone-marrow based group than OCA (p=0.041). There was greater incidence of soft tissue procedures in OCA than bone-marrow based groups (p=0.049)
Patient Reported Outcomes – no significant differences between any of the groups and the overall pooled change in Lysholm scores (25.2, 95% CI: 16.9 – 33.5).

There were no significant differences observed between any of the groups and the overall pooled change in IKDC score (30.2, 95% CI: 27.4 – 32.9).
Complications and failures – No significant differences were observed between any group and the overall (55 studies) pooled rate in minor complication rate (8.3%, 95% CI: 5.3 – 12.8%) and major complication rate (7.6%, 95% CI: 5.2 – 11.0%).

In comparison to the overall pooled failure incidence (6.7%, 95% CI: 4.7 – 9.5%), OCA had a significantly greater incidence of failure (22.7%, 95% CI: 14.6 – 33.4%).
PF cartilage restoration is most commonly reported in the patella (n=1077, 65.7%). Similar to previously reported.

Chondrocyte cell-based was the most common technique utilized (65.7%). Similar to previously reported.

Associate PF pathology was common (Anatomical risk factors, 43.5%, as well as PF instability, 18.5%).

Clinical improvement was more often reported in chondrocyte cell-based (83%) and OAT (78%).

- There was no differences in change in IKDC or Lysholm scores in the meta-analysis.

Complication rates were relatively low (minor = 8.3%, major = 7.6%).

- No significant differences in minor complication rate and major complication rates.

OCA procedures had a significantly greater incidence of failure.
Conclusions

- PF cartilage lesions can be successfully addressed with all the techniques evaluated.
- There is more consistent evidence to support the use of chondrocyte cell-based therapy in large lesions and OAT in small lesions.
- Reporting on the efficacy of the techniques are limited because of the smaller number of reports.
- Going forward, higher quality studies with greater numbers of subjects, universally accepted PROs and standardized treatment of co-morbidities will be essential in creating an algorithm for optimal use of cartilage restoration in the PF compartment.
REFERENCES