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Review

Why do patellofemoral arthroplasties fail today? A systematic review

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ABSTRACT

Background: Historically poor results of patellofemoral arthroplasty (PFA) were reported in the setting of isolated patellofemoral osteoarthritis (OA). In order to lower PFA failure rates, it is important to identify failure modes using a standardized method. In this systematic review, PFA failure modes were assessed and compared in early vs. late failures and older vs. recent studies.
Methods: Databases of PubMed, Embase and Cochrane and annual registries were searched for studies reporting PFA failures. Failure modes in studies with mean follow-up <5 years were classified as early failures while >5 years were classified late failures. Cohorts started before 2000 were classified as older studies and started after 2000 as recent studies.
Results: Thirty-nine cohort studies (10 level II and 29 level III or IV studies) and three registries were included with overall low quality of studies (GRADE criteria). A total of 938 PFA failures were included and were caused by OA progression (38%), pain (16%), aseptic loosening (14%) and patellar maltracking (10%). Pain was responsible for most early failures (31%), while OA progression was most common in late failures (46%). In older studies, OA progression was more commonly reported as failure mode than in more recent studies (53% vs. 39%, $p = 0.005$).
Conclusion: This level IV systematic review with low quality of studies identified OA progression and pain as major failure modes. Reviewing these studies, appropriate patient selection could prevent PFA failures in select cases. Future studies assessing the role of PFA in isolated patellofemoral OA are necessary.

Contents

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1. Introduction

Isolated patellofemoral osteoarthritis (OA) is a common degenerative knee disease. Of all patients with knee pain, approximately 10 to 24% of patients have isolated patellofemoral OA [1–4]. It has been shown that isolated patellofemoral OA is even more common than isolated tibiofemoral OA [3–6]. Patellofemoral OA can cause pain and lower functional outcomes [7,8] and is more prevalent in females [1,9,10], likely due to a higher incidence of malalignment and dysplasia in women [9].

Treatment options for patellofemoral OA include patellofemoral joint debridement, anterior tibial tubercle elevation, lateral retinacular release, patellectomy and eventually either patellofemoral arthroplasty (PFA) or total knee arthroplasty (TKA) [11]. Following the first introduction of PFA in 1979 [12,13], mixed results were reported in the 1980s with satisfaction rates pending between 20% and 72% [14–18]. Due to these suboptimal results, many surgeons preferred TKA to PFA for isolated patellofemoral OA and reported good results with TKA [19–22]. However, advantages of PFA over TKA were reported including less blood loss [23], shorter hospital stay [23], preservation of bone stock and ligaments [24], higher functional outcome scores [25] and better stair climbing abilities [25]. These advantages led to the development of second generation PFA [26–28] and the use of computer-assisted PFA [29–32].

In spite of these advantages and improvements, several studies have reported PFA failure rates up to 20% [33–35,93]. In order to optimize survivorship and clinical outcomes, it is important to clearly identify the reasons for PFA failure. Therefore, a systematic review was performed to assess the failure modes of PFA. In addition, we aimed to assess differences in failure modes (1) between cohort studies and registries, (2) between early (within five years) and late (more than five years) failures and (3) between earlier studies (cohorts starting before 2000) and more recent studies (cohort starting in 2000 or later).

2. Methods

2.1. Search strategy and criteria

A systematic search was performed on September 1, 2015 for studies reporting PFA failure modes. A search of the electronic databases PubMed, Embase and Cochrane Library was performed with the search terms "arthroplasty AND (patellofemoral OR PF OR PFA OR PFR) AND (outcome OR functional outcome OR scores OR results OR revision OR revision rate OR reoperation OR treatment failure OR prosthesis failure OR failure OR failure rate OR survivorship OR survival)". In addition, BASE and OpenGrey were searched for unpublished articles in order to minimize publication bias. Two independent authors (*** and ***) scanned all studies by title and abstract. The full text of the eligible studies was then evaluated against the inclusion and exclusion criteria. References of the evaluated studies were also scanned for any missed studies and annual registries were scanned for reporting PFA failure modes. Disagreements between the two authors were discussed and a third author (***) was consulted if no agreement was reached. All authors reached final consensus on the inclusion and exclusion of all articles. The systematic review was conducted in accordance with PRISMA guidelines.

2.2. Inclusion and exclusion criteria

Inclusion criteria included studies (I) published since 1995, (II) minimum level IV case series, (III) reporting PFA failure modes and (IV) OA as the primary surgical indication. Exclusion criteria consisted of studies (I) treating patellar subluxation as the primary surgical indication, (II) acute concurrent knee diagnoses (e.g., anterior cruciate ligament rupture, patella tendon rupture), (III) case reports, (IV) studies that used the same database (with the likelihood that patients were present in both studies), and (V) studies only presenting a specific failure mode (e.g., only infections). Studies in a language other than English were considered in order to prevent selection bias.

2.3. Data collection

All parameters were recorded in a datasheet using Excel 2011 (Microsoft Corp., Redmond, WA, USA). Data collected included the authors of the study, year of publication, year cohort started, year cohort ended, total number of PFA included, total number of failures, modes of failure and mean follow-up. PFA failure was defined as revision to TKA.

In order to compare early with late failure modes, the mean follow-up was used to divide the studies in two groups. Early failures consisted of studies with a mean follow-up less than five years and late failures consisted of studies with a mean follow-up more than five years. This threshold of five years was chosen since this is often used to define early failures in arthroplasties [36–38]. For comparison of recent studies and earlier studies, the starting year of the cohort was used with a cutoff of the year 2000. In order to ensure that older studies with a long follow-up would be classified as older studies, the starting year of the cohort was chosen.

2.4. Quality of studies

Two authors (JPL and HC) independently assessed the quality of studies using the Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) [39]. Using this method, studies were evaluated for study design, severity of limitations, consistency, directness and other modifying factors. Depending on the scores using the GRADE criteria, the overall quality of studies was determined to be high, moderate, low or very low. In addition, the level of evidence of studies was determined using the adjusted Oxford Centre for Evidence-Based Medicine 2011 Levels of Evidence [40,41].

2.5. Statistical analysis

Statistical analysis was performed with SPSS Statistics 21.0 (SPSS Inc., Armonk, NY, USA) and Excel 2011. A pooled analysis was performed in order to assess the most common failure modes of PFA as is commonly performed to assess failure modes [42,43]. Final failure modes were presented in percentages. Chi square tests were used to compare failure modes (1) between cohort studies and registries, (2) between early and late failures and (3) between older studies and more recent studies. A difference was considered significant when $p < 0.05$.

3. Results

3.1. Search results

The initial search identified 1084 studies with a total of six additional studies were located by reviewing the references and annual registries. After removing duplicates and reviewing the title, abstract and full-text of the articles, 39 cohort studies [11,27,30,33–35,44–76] and three registries [10,77,78] were found eligible for this study (Fig. 1). Thirty-six of these 39 cohort studies reported follow-up [11,27,30,33–35,44–73] and could therefore used for the analysis of early failures (20 studies) [27,30,33,34,44–59] and late failures (16 studies) [11,35,60–73]. Two registries reported early failures [77,78] whereas one reported late failures [10]. The cohorts of twenty studies [11,27,35,44,48,54,56,60,62–65,67–73,75] were started before 2000 and the cohorts of 19 studies [30,33,34,45–47,49–53,55,57–59,61,66,74,76] were started in 2000 or later.

3.2. Quality of studies

No level I studies, blinded or randomized studies were identified. Ten studies were level II prospective cohort studies [34,45,50,59,61,62,67,68,72,75] and 29 studies were level III or level IV observational studies [11,27,30,33,35,44,46–49,51–58,60,63–66,69–71,73,74,76]. Using the GRADE criteria, it was noted that heterogeneity in prosthesis type existed (Table 1), while no major limitations, important inconsistencies or high probability of reporting bias could be identified. The overall quality of studies was therefore determined to be low [39].

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