Should we recommend patellofemoral arthroplasties to patients?

a systematic review

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Aims

With up to 40% of patients having patellofemoral joint osteoarthritis (PFJ OA), the two arthroplasty options are to replace solely the patellofemoral joint via patellofemoral arthroplasty (PFA), or the entire knee via total knee arthroplasty (TKA). The aim of this study was to assess postoperative success of second-generation PFAs compared to TKAs for patients treated for PFJ OA using patient-reported outcome measures (PROMs) and domains deemed important by patients following a patient and public involvement meeting.

Methods

MEDLINE, EMBASE via OVID, CINAHL, and EBSCO were searched from inception to January 2022. Any study addressing surgical treatment of primary patellofemoral joint OA using second generation PFA and TKA in patients aged above 18 years with follow-up data of 30 days were included. Studies relating to OA secondary to trauma were excluded. ROB-2 and ROBINS-I bias tools were used.

Results

A total of nine studies were included, made up of four randomized controlled trials (domain 1) and five cohort studies (domain 2). PROMs and knee function specific scores developed for reporting TKA were unable to detect any difference between PFA and TKA. There was no significant difference in complications between PFA and TKA. PFAs were found to have a better postoperative range of motion.

Conclusion

TKA and PFA are both viable options for patients with primary PFJ OA. Over time, we have seen an emphasis on patient satisfaction and better quality of life. Recommending sacrificing healthy medial and lateral compartments to treat patellofemoral joint arthritis should be given further thought.

Take home message

- Patellofemoral joint arthroplasty (PFA) is associated with fewer complications than total knee arthroplasty.
- PFA surgery should be included as an option in the shared decision-making process between clinicians.
- The review gives an insight to the treatment available for those young active patellofemoral joint osteoarthritic patients.

Introduction

Isolated patellofemoral joint osteoarthritis (PFJ OA) is common, with up to 40% of

patients having the disease isolated to the patellofemoral compartment.[1,2] Between 13.5% and 23.6% of patients with PFJ OA present with symptomatic anterior knee pain, which is the most common condition seen in a general knee clinic.[3,4] The knee pain typically occurs on standing from a seated position, stair climbing, or kneeling.[5] Patients presenting with anterior knee pain are typically young and active who have higher demands on their knee than those with generalized disease.[5] Females are twice as likely to develop PFJ OA than males.[6] Once nonoperative treatment is exhausted, the two arthroplasty options are to replace solely the patellofemoral joint via patellofemoral arthroplasty (PFA), or the entire knee with total knee arthroplasty (TKA).[7,8] In PFA, only the patellofemoral joint is resurfaced, preserving the cruciate ligaments, and the unaffected tibiofemoral joint surfaces; it is relatively bone conserving compared to TKA.[7–10] This has the potential advantages of being a safer surgical approach with less blood loss, a faster recovery, and a lower chance of early complications, as well as restoring more normal kinematic and proprioception.[11]

PFAs and TKAs are both effective in alleviating pain in patients with PFJ OA. With a mean of 52 TKA cases per surgeon per annum compared to 3.7 PFA cases per surgeon per annum, surgical outcomes following TKA may be reproducible.[12] The absence of a difference in Oxford Knee Score (OKS)[13] at the first year of surgery between PFAs and TKAs, and the low TKA revision rate of 2.66% compared to a 9.8% risk of PFA revision at five years, may explain why PFA use rate remains at less than 1% within the UK National Joint Registry.[14,15] With partial knee arthroplasty associated with a higher risk of revision compared to TKA, it is reasonable to assume that surgeons prefer to maintain their low revision status by using a procedure that is less likely to require revision than partial arthroplasty, even if the patient's function may be better with the partial arthroplasty.[16,17]

Revisions of PFAs can be early (normally due to patella maltracking, subluxation, dislocation, or instability) or in the mid to long term due to progression of OA.[18] With all these risks and without clear indications, surgeons remain unsure which patients to offer a PFA to.[19] Patients with trochlear dysplasia or patella alta have demonstrated less progression of tibiofemoral OA compared to those without, but have a higher incidence of early complications due to difficulties in restoring normal patella tracking and stability.[20–23] Therefore, careful patient selection and measurement of the right outcome measures, which are patient-important, remains paramount.[19,24–26]

The purpose of this systematic review is to compare the outcome of PFA and TKA using implants in current clinical use to help the patient and clinician make an informed decision on treatment. The outcomes of interest are clinical outcomes (including patient-reported outcome measures (PROMs), range of motion (ROM), and pain levels), complications, implant survival, and length of stay.

Methods

The methods used in this review were specified in advance, in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and is registered on PROSPERO (CRD42020182597).[27] Due to the heterogeneity of the literature on this topic, we have performed the analysis in two sections: studies from randomized controlled trials (RCTs; domain 1), and studies from cohort studies (domain 2).

Data sources and searches

A comprehensive search strategy was created and designed to capture all relevant articles pertaining to surgical treatment for PFJ OA. The search strategy was applied to the following databases from inception until April 2023: MEDLINE, EMBASE via OVID, CINAHL, and EBSCO. The full search strategy is detailed in the Supplementary material.

Inclusion/exclusion criteria

The inclusion and exclusion criteria were defined during the protocol stage. Any prospective RCT, cohort study (retrospective and prospective), or registry-based study addressing surgical treatment of PFJ OA using second-generation PFA and TKA in patients aged above 18 years were included. Studies were only restricted to primary OA and those related to OA secondary to trauma were excluded. Studies defined PFJ OA using radiological or coding methods have been outlined in Supplementary Table i. For studies to be included, a minimum follow-up of 30 days was necessary, and if studies reported PROM scores at a minimum of six months and up to two years following the procedure. Due to the small number of cohort studies that compared PFA and TKA directly, no minimum sample size was set.

Selection of studies

Two authors (MVB, JW) scanned titles and abstracts for relevance, and full texts were evaluated against the eligibility criteria. Reference lists of all the studies identified in the above methods were screened for additional studies of possible relevance. Final consensus on inclusion was reached between the authors. The two reviewers (MVB, JW) independently extracted data using a specifically designed standardized data extracting form and the extracted data afterwards was compared for consistency. All inconsistencies between the two forms were resolved by discussion between the two data extractors. Any disagreement between the data extractors after the initial discussion related to inconsistencies between the two individual data extractions were solved involving a third person (ADL).

Data extraction

The same two authors independently extracted data using a customised data extraction form on Excel (Microsoft, USA) to record intervention, patient characteristics, inclusion criteria, exclusion criteria, outcomes, and results. Patient characteristics included sample size, mean age, and sex. Any discrepancies were resolved by discussion until 100% consensus was reached. If complete data were not available from full text articles, the authors were contacted to provide this information. If the authors did not respond following a subsequent email, the study was excluded from data synthesis.

Outcomes

Outcome measures included:

- PROMs.
- Implant survival measured in terms of all-cause revision rate at five and ten years.

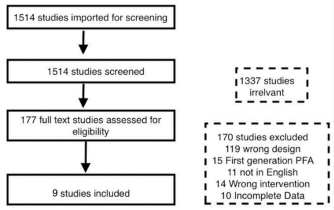

Fig. 1
Flowchart of studies review and included for analysis.

- Complications which (venous thromboembolism, wound infection, or patella issues requiring a reoperations rather than revision).
- ROM.
- Length of stay.

The PROM scores of included studies were recorded at the greatest possible time point. WOMAC scores[28] and articles using the 'old' OKS were transformed so a higher score refected a better outcome.[29]

Risk of bias assessment

We conducted a risk of bias assessment using ROB-2 for RCTs and ROBINS-I for non-randomized interventions (Supplementary Tables ii and iii).[30,31]

Three independent coders (MVB, BS, SC) assessed study quality and any disagreements were resolved via discussion to reach a final decision. The studies were then classified into overall low, medium, and high, based on the scoring protocol of the instruments.

Data analysis

When possible, inverse variance weighted random effects meta-analysis were performed. Individual relative risk estimates and summary data were displayed graphically in forest plots using RevMan 5.4 (The Cochrane Collaboration, UK). Heterogeneity was determined according to Cochrane interpretation (I2 > 75% associate with considerable heterogeneity).

A narrative interpretation was performed if limited data was available. Data from the different research methodologies were presented in their respective sections as outlined previously.

Patient and public involvement

A patient and public involvement (PPI) meeting took place on the 28 October 2020, where patients were engaged by social media to consult the authors on which patient outcomes were most relevant to them as patients, with questions such as, 'What are the most important factors in the recovery process for a patient?'. They expressed a preference to know all surgical treatment options available and all respective risks. This helped us to formulate a research question and determine which outcomes to compare.

According to the patients attending the PPI group, they would rather opt for smaller, safer, and successful operation rather than larger surgeries. Patients were not asked to advise on study methodology and interpretation. Patients were briefed about the results, but were not involved in result dissemination.

Results

As shown in Figure 1, of 1,514 imported, 177 proceeded with full text eligibility. There were four RCTs (domain 1) and five observational studies (domain 2).[11,15,32–38] The remainder were excluded due to study design and therefore did not meet the inclusion criteria. Level 4 evidence was not included due to absence of controls, which introduce a high level of bias.[39]

Patient-reported outcomes

Studies measured outcomes in terms of knee function using different mean or median scores (Knee injury and Osteoarthritis Outcome Score (KOOS),[40] KOOS-Physical Function, University of California, Los Angeles Activity Scale (UCLA),[41] Tegner Activity Scale,[42] OKS, Knee Society Score (KSS),[43] 36-Item Short-Form Health Survey (SF-36) questionnaire,[44] EuroQol five-dimension questionnaire (EQ-5D),[45] and Western Ontario and McMaster Universities osteoarthritis index (WOMAC))[28] made comparisons challenging.

In terms of OKS, from a total of six studies with a population size of 455 individuals, there was a trend to better OKS scores after PFA than TKA, but the OKS was not able to detect any clinically significant difference in knee function in both domains 1 and 2 (Figure 2). Data presented from three RCTs (domain 1) and three cohort studies (domain 2) show a mean difference of 0.34 (95% confidence interval (CI) -1.69 to 2.37) and mean difference of -2.96 (95% CI -7.16 to 1.24), respectively.

Function scores

A total of five studies comparing functional scores between both surgical treatments were pooled into a forest plot (Figure 3).[15,35–38,46]

In this analysis, there was no statistically significant difference in knee function between either surgical treatment in both domains 1 and 2. In domain 1, the data showed a standard mean difference of -0.10 (95% CI -0.15 to 0.35). Studies from domain 2 had a standard mean difference of -0.11 (95% CI -0.43 to 0.22).

Range of motion

Two studies reported ROM following a PFA and TKA procedure.[11,15] From a study of 18 PFAs and 22 TKAs, PFAs were found to have better ROM postoperatively when compared to TKA, with a gain of 4^{0} of flexion. This was further supported by Odgaard et al,[15] where results were PFA patients are more likely to their preoperative ROM unlike their TKA counterparts.

Length of stay

Two studies reported length of stay in their results in domains 1 and 2.[11,15] There was no significant difference in domain 1; however, domain 2 showed that PFAs have shorter postoperative stays with a mean duration of 3.3 days compared to 4.4 days following a TKA procedure (Figure 4).[11,15]

Complications

Five studies reported complications in the postoperative period (Figure 5). Complications included deep vein thrombosis, manipulation under anaesthetic, surgical site infections, steroid injections, and a facetectomy.[11,15,36–38] Overall, there

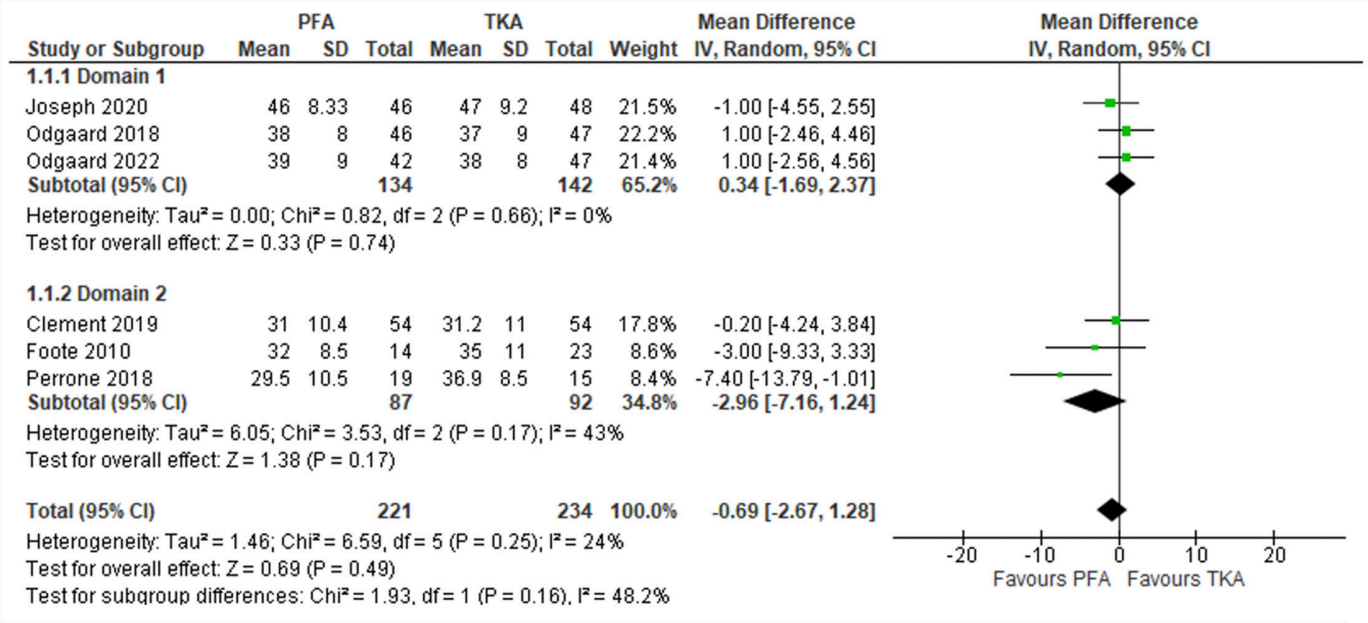

Fig. 2
Forest plot comparing Oxford Knee Score after patellofemoral arthroplasty (PFA) versus total knee arthroplasty (TKA). CI, confidence interval; IV, inverse variance weighting.

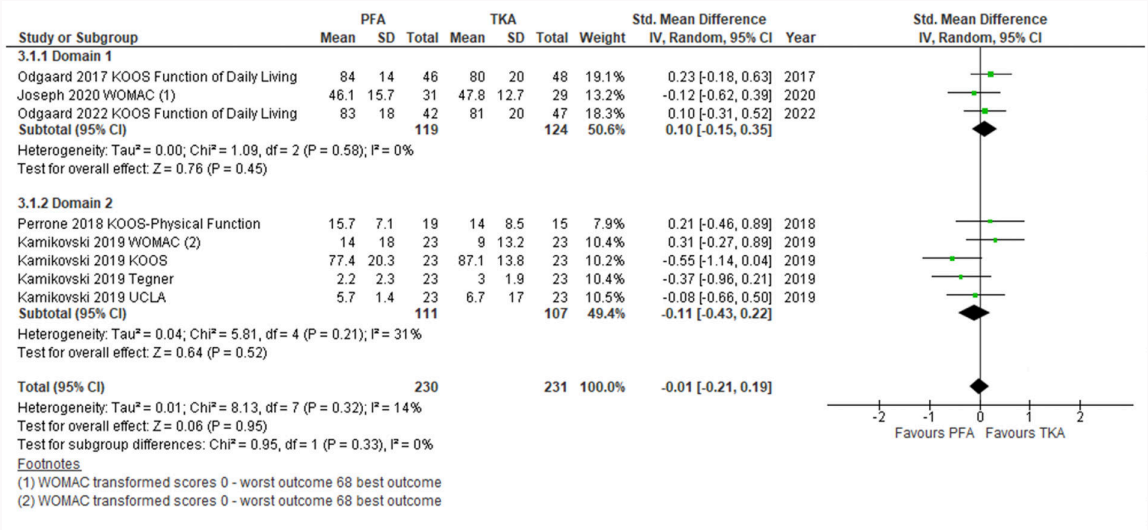

Fig. 3
Forest plot comparing knee function specific scores after patellofemoral arthroplasty (PFA) versus total knee arthroplasty (TKA). CI, confidence interval; IV, inverse variance weighting; KOOS, Knee injury and Osteoarthritis Outcome Score; WOMAC, Western Ontario and McMaster Universities osteoarthritis index.

were less complications following a PFA procedure 0.57 (95% CI 0.30 to 1.08).

Revision at five years

Five studies reported revision rates after five years (Figure 6). Although the results did not reach statistical significance, in domain 1 there was a trend towards a higher revision rate in TKA while in domain 2 the results were opposite. Data from domain 1 showed a risk ratio (RR) of 3.16 (95% CI 0.87 to 11.40). Data from two studies in the domain 2 analysis showed a RR of 0.26 (95% CI 0.03 to 2.28).

Revision at ten years

One study reported revision data comparing 54 PFA and 54 TKA. The revision rate was higher after PFA than after TKA (RR 5.00; 95% CI 0.60 to 41.39). The reasons for revision in the five patients in the PFA group who were reported to have undergone a revision procedure included progression of OA, unexplained pain, and a fracture.

Discussion

This study is aimed at supporting the shared decision-making process between clinicians and patients on outcomes that have been deemed important by the patients themselves

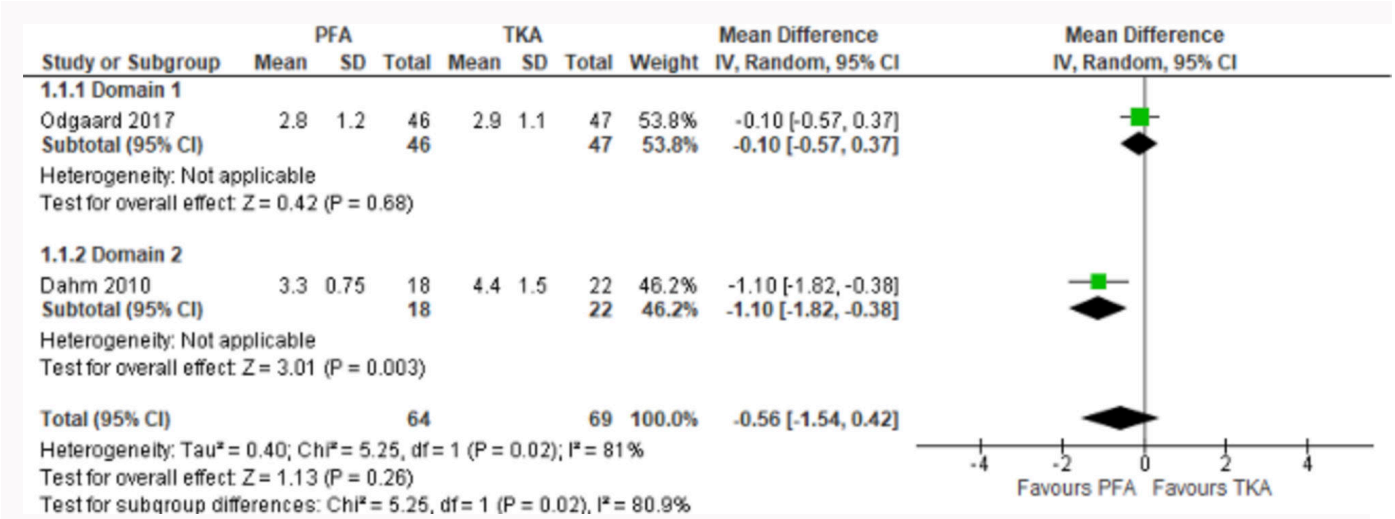

Fig. 4
Forest plot comparing length of stay following patellofemoral arthroplasty (PFA) versus total knee arthroplasty (TKA). CI, confidence interval; IV, inverse variance weighting.

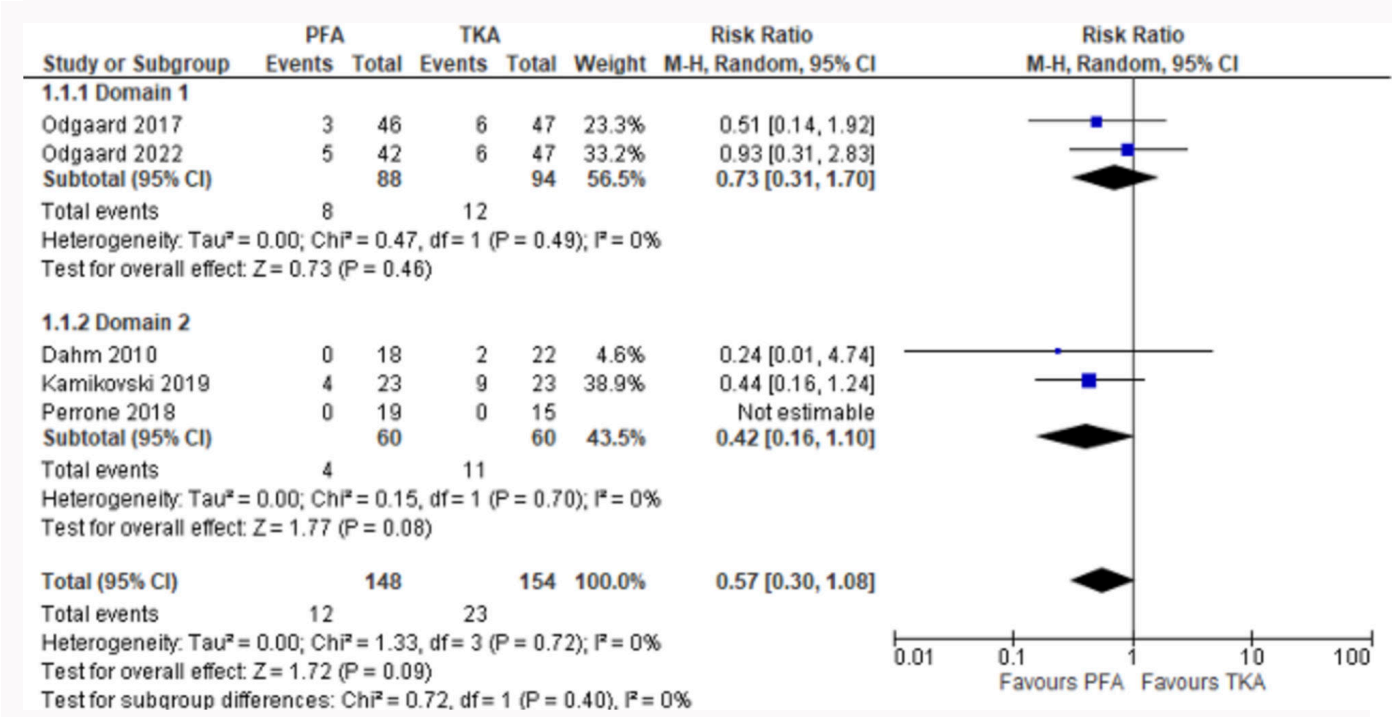

Fig. 5
Forest plot comparing risk of complications after patellofemoral arthroplasty (PFA) versus total knee arthroplasty (TKA). CI, confidence interval; M-H, Mantel-Haenszel test.

following a PPI meeting. However, the quality of the review is dependent on the quality of primary research studies available.[47] From this study, in terms of PROMs, the OKS was not able to detect any significant difference. Previous systematic reviews reached similar conclusions to those of our study, that patient reported outcome measures developed to report on the outcome of PFA are not able to detect any differences in outcome between the two procedures.[48,49]

Quality of life is important as patients with isolated PFJ OA are young and active with normal tibiofemoral compartments. Following a PFA, the tibiofemoral compartment, meniscus, and cruciate ligaments remain preserved, which are important for proprioception, and ultimately patients have better function and biomechanics.[12] This fact is supported by a trial which showed patients who had a PFA had a better quality of life in the first two years compared to their TKA counterparts.[15,37]

PROMs complement objective measurements made by surgeons as they directly measure the patient's evaluation of their treatment and the ability of the health care process to meet patients expectation.[50] In terms of objective measurements, patients with PFAs were found to have a better ROM postoperatively when compared to TKA, with an increase of 4° in one study, a domain which is not detectable using

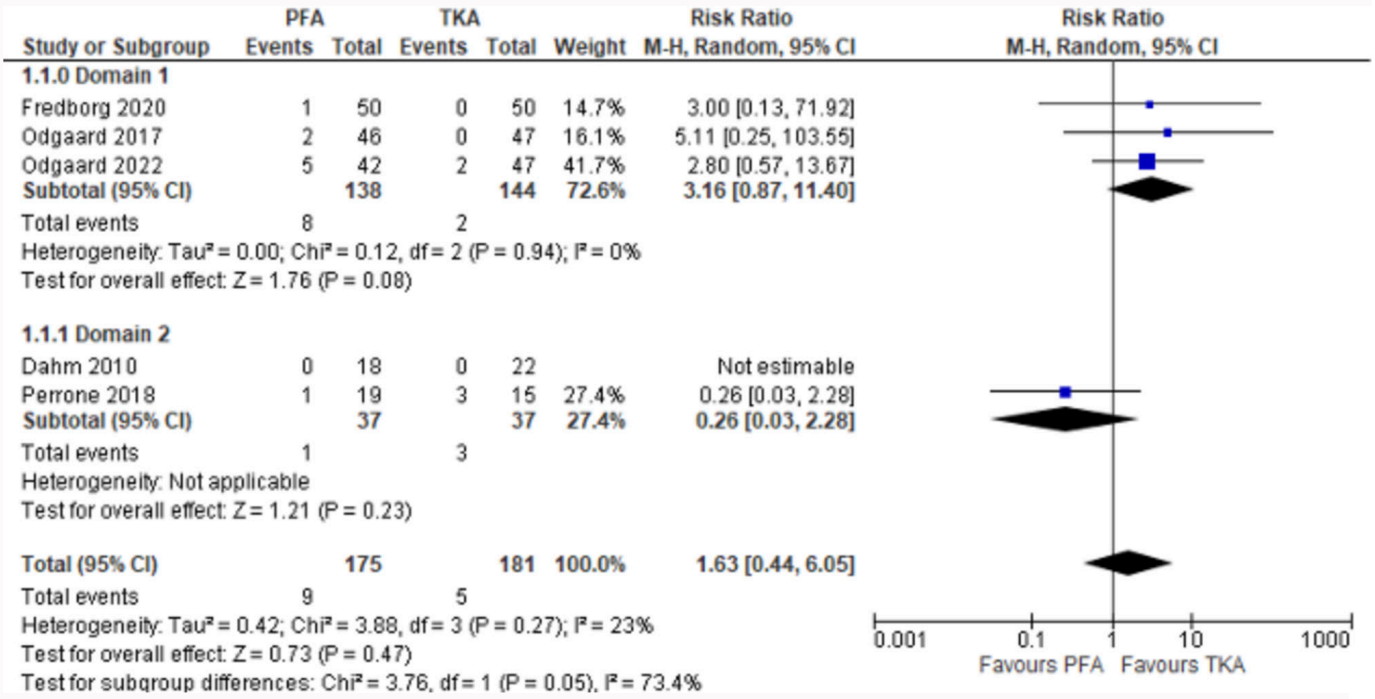

Fig. 6
Forest plot comparing risk of complications after patellofemoral arthroplasty (PFA) versus total knee arthroplasty (TKA). CI, conficence interval; M-H, Mantel-Haenszel test.

conventional PROMs.[15,48] In fact, PFA patients have been found to return to new higher level activities, unlike TKA patients, after which many patients switch to lower impact sports due to loss of normal knee kinematics.[11,51–54]

There was no difference in revision risk and length of stay across included studies. The revision results differ to a registry based published study consisting of a total of 6,785 PFAs.[9] PFAs over five years had a revision risk of 8% in Norway to 18.1% in the Netherlands, three times higher than that of a TKA.[9] Despite having higher cumulative revision rates, the study did not account for patient characteristics such as BMI or activity levels, volume of procedures done by the surgeon, or the type of revision procedure the patient underwent.[9]

The main factor affecting survivorship is failure due to progression of tibiofemoral OA.[55] However, one must understand other patient and surgical factors that may affect revision rate. Obesity is associated with a much higher risk of failure and further surgery after PFA similar to other lower limb arthroplasty studies.[56] The majority of PFA patients have a high rate of return to their preferred activities implying PFA patients are encouraged to remain active.[57] However, activity levels have been linked to higher revision risk in arthroplasty studies.[56] Patellofemoral OA affects the younger age group which is associated with higher revision rates, as highlighted by Roussot et al's[12] study. Patients aged less than 65 years had a revision rate of 30.7% compared to 19.9% for patients aged greater than 65 years.[12]

Surgical factors, such as the surgeon's expertise or operating in high volume units, may contribute to lower revision rates.[58,59] For example, unicompartmental knee arthroplasty (UKA) surgeons report 20% of their arthroplasty practice as UKA achieve lower rates of revision.[60,61] To date, there are no studies looking at the surgical volume required to be associated with better outcomes following PFA surgery. Williams et al[62] have suggested that PFA surgery should be concentrated in specialist centres.

The first generation trochlear resurfacing implants developed in 1970s, such as Richards (Smith & Nephew, UK) and the Lubinus PFA (Link Orthopaedics, UK), were followed by the introduction of second-generation trochlea cutting PFA devices.[63,64] They aimed to reduce the 35% mechanical failure rates associated with the first-generation PFA released in 1979.[3,18,65] Therefore, studies combining results from first- and second-generation implants are less likely to give a clear picture, which makes this study unique as it includes only second generation implants.[49] The most common complications following PFA are lateral releases, arthroscopic debridement, manipulation under anaesthetic, and soft-tissue realignment procedures.[15,36]

Strengths and weaknesses

We are not aware of any other study that has used our approach. It is the first to combine both RCTs (domain 1) and cohort studies (domain 2), analyzing outcomes which are deemed to be important following a PPI meeting. Inclusion of level 1 and level 3 evidence has allowed a larger number of cases available for analysis, particularly as, to date, there are very few RCTs published in this area. With a prevalence of 13% of PFJ OA in our young and active population, we have demonstrated lack of good quality data for patients and surgeons to understand the pros and cons for surgery for isolated PFJ OA.[3]

There are only two other systematic reviews published in this field.[48,49] Elbardesy et al[48] looked at patient satisfaction, UCLA, and WOMAC PROMs. However, the authors combined patient satisfaction from two articles, which measure

satisfaction using different scales. Meanwhile, Bunyoz et al[49] looked at complication rates following PFA and TKA; however, this study has a high degree of heterogeneity. The authors combined first- with second-generation prosthesis, in addition to comparing independent case series of solely TKA for PFJ OA with other separate studies of solely PFA for PFJ OA. Our study has included domains deemed important by the patient, we have only included studies using second-generation prosthesis, separated cohort studies from RCTs, and have included those articles that compared TKA and PFA within the same study increasing the degree of homogeneity.

Limitations

PROMs, such as the OKS and KSS, underestimate pain in PFJ OA patients as the major component of the score is pain on walking on level ground.[66] In these patients, patients have marked pain on standing up from a chair or climbing stairs.[66] Therefore, it is difficult to differentiate between patients with high functional scores.

Using revision as an endpoint in PFA surgery is controversial, as patients with PFJ OA are likely to be younger, with a median age of 58 years, and more active, therefore outlasting their prosthesis.[12,32,49] A PFA revision is thought to be a technically less demanding operation due to the bone preserving nature of the procedure and use of an unconstrained prosthesis.[8,9] Therefore, a PFA can safely provide adequate symptom relief and burns no bridges for a future TKA.[67] Revision of a TKA may result in more bone loss and a more constrained prosthesis.[32] However, in terms of comparing the risk of a TKA revision following PFA surgery, as compared to the risk of a TKA undergoing a first time revision, this has been found to be much higher; however, confounding factors, such as age and patient characteristics, have not been accounted for.[9]

In view of the above limitations, other end points, such as quality of life, ROM, and activity monitoring, would be a better representation of success following PFA surgery rather than revision or knee function specific scores.

This study has included randomized trial data with non-randomized trial data. Similar to the work of Concato et al,[68] the results from RCTs and observational studies were remarkably similar. Results from cohort studies should not be abandoned, particularly for a condition that effects up to 23.6% of patients with knee pain, and to date we can not offer adequate evidence which surgical treatment is best.[3,4]

Future research

There are multiple case series on the optimal surgical treatments for PFJ OA.[69] None of the studies describing revision rates have included any description regarding femoral dysplasia morphology classification. This is important as the commonest reasons for revision is progression of tibiofemoral OA.[70] Patients with dysplasia have the lowest failure rate.[25] Dysplastic femora are less likely to develop tibiofemoral OA progression and have been deemed as the best indication for PFA.[21,62,71,72] Meanwhile, patients with tibiofemoral malalignment, and obesity in addition to isolated PFJ OA, may be precursors for generalized tibiofemoral OA progression.[73] Further level 4 case series evidence will only create more noise and research waste; any future research should focus on identifying which patients will benefit most from this procedure, assessing confounding factors, such as history of patella dislocations, mental health comorbidities, surgical factors contributing to the success of PFA surgery, and identifying suitable objective postoperative outcomes.

With a prevalence of 18%, a large multicentre RCT, consisting of 528 patients addressing the same questions, could easily cost £2.9 million, as evidenced by TOPKAT.[74] Similar to the results from unicompartmental arthroplasties, a well conducted registry-based study can be a helpful addition to the orthopaedic knowledge base and provide a potential solution for young patients.[61]

In conclusion, this review was aimed at providing patients and surgeons the most up-to-date evidence available on surgical treatment choices for 18% of patients affected with PFJ OA.[3] Patients prefer more information when making a final choice for treatment, particularly being able to understand the difference in risks between each option.[75] The review gives an insight to the treatment available for those young active PFJ OA patients who may be 'too young', are commonly female, more willing to accept disability, and less willing to accept the risk of surgery.[76] This review has shown that PFA is associated with a lower risk of complications, but there are no differences in PROMs, revision rate, and length of stay across included studies. PFA surgery should begin to be included as an option in the shared decision-making process between clinicians and patients.

Supplementary material

Tables showing a summary of the studies included, Cochrane risk-of-bias tool for randomized controlled trials (ROB-2); and Cochrane risk-of-bias in non-randomized studies of interventions (ROBINS-I) tool; and details of the search strategy.

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