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EDITORIAL

The evolution and role of patellofemoral joint arthroplasty

THE ROAD LESS TRAVELLED, BUT NOT FORGOTTEN

M. A. Roussot, F. S. Haddad

The Princess Grace Hospital, London, United Kingdom

The patellofemoral joint has posed a challenge for arthroplasty surgeons and implant designers for over 60 years. This is hardly surprising given the complexity of the articulation, with joint reaction forces up to ten times the body weight during activities of daily living,[1-3] frequently encountered congenital and developmental variations,[4-6] and stability that is dependent on the integrity of the extensor mechanism, surrounding soft tissue, and lower limb alignment.[7] Furthermore, patients with end-stage patellofemoral arthrosis may have a prolonged history of patellofemoral pain,[8] and frequently present after numerous surgical procedures such as arthroscopic debridement, soft-tissue reconstruction, lateral release, lateral facetectomy, realignment osteotomies, and even trochleoplasty.[7,9]

Patellofemoral joint arthroplasty (PFJA) had a bold beginning in 1955 when McKeever[10] described the use of a Vitallium prosthesis to resurface the patella as an alternative to patellectomy in advanced, isolated patellofemoral arthrosis. Despite encouraging early- and mid-term results,[11,12] the procedure did not address the trochlea surface and clinical outcomes showed deterioration at five to seven years.[13] The first generation of a complete PFJA was described 24 years later by Lubinus[14] and Blazina et al,[9] using a metallic trochlea with a short anterior flange and a narrow trochlea groove combined with a polyethylene patellar resurfacing. These inherently constrained anatomical designs were implanted with rudimentary instrumentation using an inlay technique, which made it technically challenging to match the surrounding chondral surfaces, and did not address the underlying trochlear dysplasia or maltracking that is evident in the majority of patients with isolated patellofemoral joint osteoarthritis (OA).[15] Hence, they were predisposed to malalignment, maltracking, and subsequent reoperation, with less than half of patients still functioning satisfactorily at 7.5 years.[16]

To address these concerns, the second generation of PFJA designs contained a larger anterior flange, wider trochlea groove with distal modifications to avoid impingement on the anterior cruciate ligament and tibiofemoral articulation, with improved instrumentation.[17,18] The trochlear component was applied using the onlay technique, which allowed greater control of femoral component positioning in flexion, translation, and rotation to assist in addressing underlying bony abnormalities.[19]

With regard to the patellar component, conforming anatomical designs are unforgiving and prone to maltracking, while metal-backed components reduce the available polyethylene thickness and are therefore prone to fatigue failure. The choice of patellar component may be governed more by the compatibility with total knee arthroplasty (TKA) components should the need for revision arise. Therefore, the dome or modified dome polyethylene patella is the design most frequently utilized.[20,21]

PFJA faces many sceptics and registry data are not complimentary. In the National Joint Registry (NJR), the revision rate for PFJA is more than four times higher than that for TKA at 12 years.[20] However, PFJA is performed on a different subgroup of the population, in different volumes, and with implants that are still evolving. The median age for PFJA is 58 years *versus* 70 years for TKA, and for patients > 75 years of age, the ten-year survival rate for PFJA is a competitive 91%.[20] PFJA constitutes only 1.2% of knee joint arthroplasty, with a mean number of 3.7 cases per surgeon per annum in comparison with TKA, with a mean of 52 cases per surgeon per annum.[20] Importantly, not all implants perform the same – at five years, the revision rate ranges from 6.98% to

M. A. Roussot, MBChB, MMed(Ortho), MPhil(SEM), FCOrth(SA), Senior Clinical Fellow in Trauma and Orthopaedics, University College London Hospitals and The Princess Grace Hospital, London, UK and Department of Orthopaedic Surgery, University of Cape Town, South Africa.

F. S. Haddad, BSc (Hons), MBBS, MD(Res), FRCS(Tr&Orth), FFSEM, Editor-in-Chief, The Bone & Joint Journal, Professor of Orthopaedic Surgery, University College London Hospitals, The Princess Grace Hospital, and The NIHR Biomedical Research Centre at UCLH, University College London Hospitals and The Princess Grace Hospital, London, UK.

Correspondence should be sent to M. A. Roussot; email: mark.roussot@nhs.net

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12.85% and only two implants (Avon (Stryker, Mahwah, New Jersey) and Journey Oxinium (Smith & Nephew, London, United Kingdom)) have ten-year results in the NJR.[20] Similarly, the Australian Orthopaedic Association National Joint Replacement Registry (AOANJJR) reports five-year revision rates of PFJA ranging from 7.6% to 30.3% for different prostheses, and ten-year revision rates of 30.7% for patients < 65 years of age *versus* 19.9% for patients > 65 years of age, in contrast to the overall ten-year revision rate of 5% for TKA.[21] This has clearly influenced practice, as the same registry reported a 22% decrease in partial knee arthroplasty alongside a 140% increase in TKA between 2003 and 2016. The Swedish Knee Arthroplasty Registry records PFJA at 0.4% of all knee arthroplasty procedures and provides little other information about PFJA.[22] None of the registries provide detail on the various concomitant procedures that may be performed with PFJA. Recently, improved survival rates have been published for newer designs, for example, 91.8% at nine years for the Avon PFJA,[23] 88% at seven years for the Journey,[24] and 97% at three years for the Femoro Patella Vialla (Wright Medical Technology Inc., Arlington, Tennessee),[25] with a resurgence of inlay components, as well as improved instrumentation and sizing options.[26]

Outcomes are not only about survival statistics. PFJA is a less invasive procedure, with less blood loss, shorter hospital stay, knee mechanics more akin to the native knee, and an improved return to function, and is also more cost-effective in comparison with TKA.[17,27-29] PFJA is, therefore, an attractive solution for young and old patients with advanced, isolated patellofemoral arthrosis. The most common reason for revision by far is progression of disease involving the tibiofemoral articulation,[7,21,30-32] which is not necessarily a representation of the quality of the procedure, surgeon, or patient selection, and is also known to be a factor in unicompartmental knee arthroplasty (UKA) revision.[33] Furthermore, revision from PFJA to TKA does not compromise the results of TKA,[34,35] and the addition of UKA remains an option. By delaying TKA (and TKA revision), potentially severe complications may also be avoided.[7]

Currently, reported metrics such as registry survival do not represent these benefits, most publications are case series with fewer than 100 patients, and there are no published large, high-quality randomized controlled trials comparing PFJA with TKA.[17,18,32] While appropriate selection criteria have not been validated, the presence of underlying trochlea dysplasia is associated with improved outcomes and reduced revision rates in comparison with patients who have no underlying structural cause for patellofemoral OA,[36-38] which may require further consideration.

In order for us to better understand the role of PFJA, efforts should focus on: 1) performing large, high-quality randomized controlled trials comparing PFJA with TKA; 2) conducting survival analyses that accommodate for competing risks (such as death) that will provide more insight into the true implant survival rates;[39,40] 3) including patient-reported and performance-based outcome measures when comparing PFJA with TKA;[41] 4) improving the classification and registry data collection of PFJA with concomitant procedures; and 5) validating criteria to allow for appropriate patient selection.

Modern instrumentation and the growing utilization of technological advancements such as robotic-assisted surgery may improve our accuracy and also influence how implants are designed.[42] In reality, although it is possible to track the patella using computer navigation,[43] these technologies do not yet incorporate the patella into the operative planning and technique and this may be an avenue for further evolution.

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