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ORIGINAL STUDY

Avon patellofemoral arthroplasty. Five year survivorship and functional results from an independent centre

William J.E, REEVE, Paul M. GUYVER, Alexander J.C. VAUGHAN, Kim FARMER, Andrew S. LEE

From the Royal Cornwall Hospital and Duchy Hospital, Cornwall

The aim was to review this series of Avon Patellofemoral Joint Replacements (APFJR) presenting comparable clinical, functional, radiological and survivorship results to published reports.

Retrospective analysis was performed of all consecutive cases of APFJR from October 1999 to January 2010. Each patient had clinical, functional and radiological follow up with post-operative radiological review to check for loosening and progression of disease. Revision to Total Knee Replacement was taken as the endpoint.

83 APFJRs were implanted in 56 patients for established patellofemoral arthritis. Mean follow-up was 5.4 years (0.5-11). The five-year survival rate was 95% (95% CI 88.12%-99.88%) with 5 revisions. Oxford knee score showed significant improvement from 17(IQR 11-21) to 35(IQR 26-41). These results compare closely to the original series.

This study demonstrates satisfactory results in the medium term leading to increased confidence in the use of patellofemoral arthroplasty.

Keywords : Patellofemoral knee arthroplasty.

INTRODUCTION

Knee arthritis confined to the patellofemoral joint is a common variant of knee osteoarthritis. Cadaveric and radiological studies in the 1990's by McAlindon *(16)* and Rogers and Dieppe *(22)* highlighted the prevalence of the condition, which accounts for approximately 10% of all outpatient clinic attendances for knee osteoarthritis in a significantly younger age group when compared to tri-compartmental arthritis *(10,21)*. Patients typically present with anterior knee pain, exacerbated by ascent or descent of stairs or standing from a chair. There may be a history of patella trauma or dislocation, and trochlear dysplasia is a recognised risk factor *(2)*. Conservative treatment of patello-femoral arthritis includes physiotherapy to increase quadriceps strength and aid patella tracking, weight loss, modification of daily activity and oral analgesia.

Surgery is reserved for severe cases and options include arthroscopy, patellectomy, anteriorisation of the tibial tubercle, and chondral grafting ; all which have had limited long-term success *(12,15)*. Both Mont et al. *(19)* and Laskin et al. *(14)* advocate total knee replacement (TKR) as the standard long-term

■ Mr William J.E, Reeve[1],
■ Mr Paul M. Guyver[2],
■ Mr Alexander J.C. Vaughan[3]
■ Dr Kim Farmer[1],
■ Mr Andrew S. Lee[1].

[1]*Royal Cornwall Hospital, Truro, United Kingdom.*
[2]*Derriford Hospital, Plymouth, United Kingdom.*
[3]*Royal Sussex County Hospital, Brighton, United Kingdom.*

Correspondence : William J.E. Reeve, Royal Cornwall Hospital,Truro, Cornwall, United Kingdom, TR1 3LJ.
E-mail : williamreeve@nhs.net

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treatment for isolated patellofemoral replacement. However patellofemoral joint replacement (PFJR) is an acknowledged surgical option. The perceived advantages of a PFJR over a TKR are that it is less invasive, bone preserving, and maintains normal cartilage in other compartments. Ackroyd *(1)* suggested PFJR recovery time may also be faster, and can act as a delaying procedure in younger patients where revision to TKR is less complicated when compared to revision TKR surgery.

McKeever in 1955 *(17)* originally described the PFJR as an option to avoid patellectomy. Initial designs, however, suffered with early to mid-term failure rates as high as of 28% *(5,6,7,25)* from malalignment of the patella, polyethylene wear and disease progression in other knee compartments. This led to development of more anatomically designed implants and more careful patient selection in order to attempt to improve outcomes *(1,12)*. As a result of better designed implants progression of tibio-femoral arthritis is now the most common cause for revision in modern PFJR with midterm revision rates of 4-7% *(1,15,20)*.

This study is the third independent series outside of the designer's study of the Avon PFJR (Stryker Howmedica Osteonics, Allendale, New Jersey, USA) with mean five years follow-up *(2,3,21)*.

MATERIALS AND METHODS

A retrospective analysis of all consecutive Avon patellofemoral replacements performed between October 1999 and January 2010 was undertaken. All surgery was undertaken by the senior author (AL) over 2 sites, the Royal Cornwall Hospital and the Duchy Hospital, Cornwall.

All patients had severe symptomatic osteoarthritis of the patella-femoral articulation with the diagnosis confirmed using anteroposterior (AP), lateral and skyline radiographs and/or arthroscopically. Oxford knee scores (OKS) *(11)* with a range from 0-48 and ROM measurements pre and post-operatively were undertaken in order to be comparable with previous studies. Radiological evaluation of weight bearing AP, lateral and skyline radiographs were undertaken by an independent musculoskeletal radiology consultant (KF) looking at both loosening of the implant and progression of tibio-femoral disease. Revision was taken as the end-point for survivorship. A record of intra-operative data including degree and location of chondral lesions was obtained.

Table I. — Pre-operative procedures / events

Procedure	Number of knees
Arthroscopy (diagnostic)	27
History of trauma	15
Arthroscopy and partial meniscectomy	1
Tibial tubercle transfer	2
Patella stabilisation	1
Lateral release	1
Nil	49
Total	81

83 consecutive PFJR were performed in 56 patients (18 male, 38 female) with an average age at operation of 68 years (34-95). Clinical, functional and radiological follow up was undertaken at an average of 5.4 years (range 0.5 to 10.75 years).

Pre-operatively 27 knees (33%) underwent arthroscopy to confirm diagnosis and 15 knees (18%) had a history of trauma.

A standard technique for the arthroplasty as previously described by Ackroyd *(1)* was used in all cases except where patella bone stock was inadequate. 4 cases had inadequate patella bone stock for standard patella resurfacing and 2 cases had undergone previous patellectomy. In 1 of these cases, where previous patellectomy had been performed for trauma, a Nexgen (Zimmer, Warsaw, USA) trabecular metal shell was sutured into the extensor mechanism and a titanium alloy augment was cemented into this, in the other 5 no patella resurfacing was used.

Statistical analysis was performed using 2 sample T-tests and analysis of survivorship was performed using Kaplan-Meier survivorship methods.

RESULTS

66 consecutive patients underwent surgery (95 knees). 5 patients died (7 PFJR) of causes not attributable to the operation and 5 patients (5 PFJR) were lost to follow-up leaving 83 PFJR performed

Table II. — Intra-operative findings

Findings	Number of knees	percentage
Grade 4 OA at PFJ	81	97.6%
Defect to lateral femoral condyle	2	2.4%
Defect to medial femoral condyle	7	8.4%
Chondrocalcinosis	3	3.6%

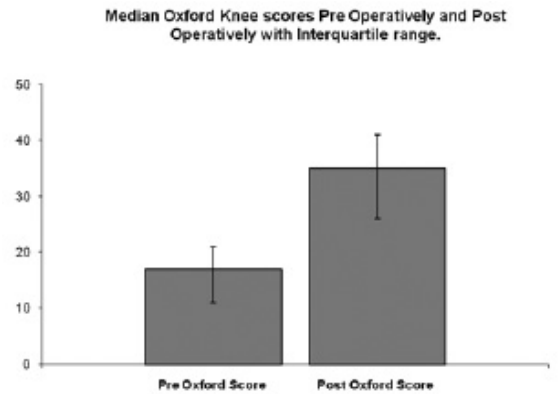


Figure 1. — All knee pre- and post-op OKS including IQ range

in 56 patients. PFJR represents around 2% of all knee arthroplasty performed in the study institutes.

Intra-operative findings are show in table II ; including 1 small grade IV ulcer laterally and 2 small grade IV medial femoral ulcers.

Median OKS for all knees showed significant improvements (P< 0.0001) from 17(IQ range 11-21) to 35 (IQ range 26-41) (figure 1). Of those followed up for a minimum of 5 years (51 knees) the pre-operative OKS was 16/48 (IQ range 10.5-22) and post-operative 37/48 (IQ range 27-42.5) which was also statistically significant (P<0.0001).

Table III. — Early complications

Complication	Number of knees	Post-op procedure
Haemarthrosis	2	Nil
L5/S1 foot drop (transient)	1	Nil
Superficial infection	1	Antibiotics (successful)
Deep infection	0	Nil

Median arc of motion was 120 degrees pre-operative (range 25-140) and 120 degrees' post-op (arc range 40-140 degrees).

Early complications are shown in table III giving an early complication rate of 5% but with all resolving completely. There were no deep infections.

Late complications included non-integration of the patella component into the extensor mechanism, ongoing patella symptoms from absence of patella component due to inadequate bone stock at time of surgery, patella maltracking plus radiological progression of disease in tibio-femoral compartments and ongoing pain (table IV). Radiological progression was seen in 12/83 knees (14%) with 2 being revised to TKR. 3 further knees (2 patients) were revised for persistent pain and reduced function. Of note none of those noted intra-operatively to have chondral lesions in the medial or lateral compartments were revised to TKR in the follow-up period.

Independent radiological review revealed lateral tilt +/- subluxation in 19 (23%), medial tilt in 1 (1%), tibiofemoral disease progression in 12 (14%) and was normal in 41 (50%) (table V).

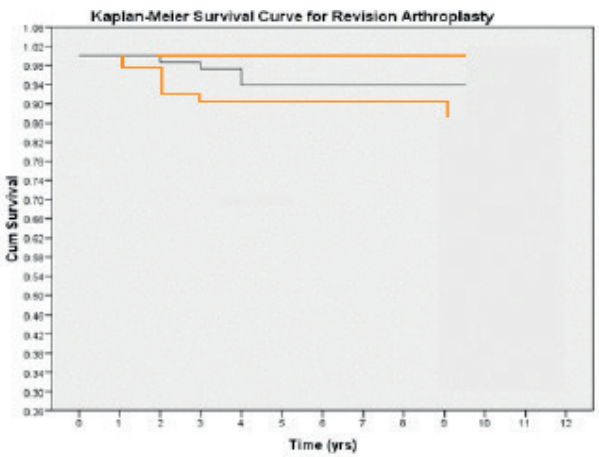
Table IV. — Late complications

Complication	knees	Post-op procedure
Removal of loose patella button *(Nexgen augment used in previous patellectomy)	1	MUA and arthroscopic removal arthroscopic removal
Patella revision	3	Patella resurfacing
Poor patella tracking and pain	3	Lateral release and lateral fascetectomy facetectomy
Radiological evidence of disease progression	12	2 knees revised
Revision	5	TKR

Table V. — Radiological findings post-op

Radiological findings	% knees
X-ray not available	12%
normal	49.4%
Lateral tilt > 5 degrees +/- lateral subluxation	22.9%
Medial tilt	1.2%
Tibiofemoral disease progression	14.5%

Figure 2. — Survivorship curve (endpoint being revision to TKR)



Overall cumulative survival at 9 years was 95.2% (CI 88.12-99.88) (figure 2)

DISCUSSION

Our results correlate well with other medium term published series results of the Avon PFJR *(2,3,21,23)*. 95.2% Survivorship at 5 years is comparable to the three existing series who reported 95.8% in the original Bristol series *(2)*, 100% in the Coventry series *(21)* and 96.3% in the series from Hastings *(3)*. Improvement in OKS from 17 to 35 also mirrors the other case series reported results and represents a significant improvement in functional outcomes especially when the original series considered an OKS of greater than 25 as satisfactory.

Patient selection is clearly important *(9,20)* particularly with regards to pre-existing tibio-femoral OA in order to reduce the need for revision due to progression of disease. Our patient group had pre-existing tibio-femoral OA in 10.8%, with progression in tibiofemoral OA noted radiologically at final follow up in 14%. The overall survivorship of 95.2% at 5 years however does not suggest that this correlates to the need for revision to TKR in the medium term. Of the PFJR revised to TKR only 2 were performed principally for tibiofemoral disease progression at 36 and 43 months respectively, therefore radiological progression alone may not correlate clinically with deteriorating knee function and the need for further surgery.

This cohort contains a small subgroup of 6 knees who had problems with inadequate patella bone stock. This consisted of 3 patients undergoing bilateral PFJR, one of whom had previously had bilateral patellectomy for trauma. These 6 knees represent a small subgroup with relatively poor outcomes compared to the group as a whole with an average OKS rise of only 6.5 (range 2 to 15). None have been revised to TKR in the follow-up period. Poor or absent patella bone stock should be considered as a relative contra-indication for PFJR.

The average range of motion found pre- and post-operatively was unchanged. As this cohort had a good pre-operative range of motion with an average arc of 120 degrees this would support the belief that good surgical technique in combination with maintaining soft tissue balancing means the native kinematics of the knee can be maintained. This also correlates with other studies of not only this implant but other types of knee arthroplasty outcomes. Reinforcing the evidence that pre-operative range of motion is the best predictor of post-operative range of motion in knee arthroplasty *(4,8,24)*.

Seven (12%) case had complications which resulted in re-operation but implant retention, all of which resulted from problems with the patella component or patella tracking. Four of these seven cases had inadequate patella bone stock for patella resurfacing at initial operation. Three cases with maltracking and patella pain required re-operation to improve the patella tracking including lateral release which highlights the importance of soft tissue balancing at time of primary surgery.

The average age of the PFJR patient is younger in this group with an average age of 68 compared to the average age of 72 for standard TKR during the same time period, which reflects a desire where

possible to preserve bone stock in a younger patient population who may require revision surgery in the future.

The Avon PFJ has been shown to have good mid-term survivorship and functional improvement in series from Bristol, Coventry and Hastings. The authors believe with precise patient selection the need for re-operation and symptomatic disease progression can be kept within acceptable limits. The benefits of preservation of bone and soft tissue structures around the knee allows the patient to retain their range of motion and lends itself to less complex revision to TKR if required in the future. Close monitoring of symptomatic, functional and radiological deterioration can select those whose disease progression warrants further surgical intervention. The authors support the use of APFJR for the appropriate subset of patients with isolated PFJ OA over TKR as suggested by other authors *(13,14,18)*, whilst avoiding its use in cases with poor patella bone stock.

REFERENCES

1. **Ackroyd CE, Chir B**. Development and early results of a new patellofemoral arthroplasty. *Clin Orthop Relat Res*. 2005 ; 436 : 7-13.
2. **Ackroyd CE, Newman JH, Evans R, Eldridge JDJ, Joslin CC**. The Avon patellofemoral arthroplasty : five-year survivorship and functional results. *J Bone Joint Surg Br.* 2007 ; 89 : 310-5.
3. **Akhbari P, Malak T, Dawson-Bowling S, East D, Miles K, Butler-Manuel PA**. The Avon Patellofemoral Joint Replacement : Mid-Term Prospective Results from an Independent Centre. *Clin Orthop Surg.* 2015 ; 7 : 171-6.
4. **Anouchi YS, McShane M, Kelly F, Elting J, Stiehl J.** Range of motion in total knee replacement. *Clin Orthop Relat Res*. 1996 ; 87-92.
5. **Arciero RA, Toomey HE**. Patellofemoral arthroplasty. A three- to nine-year follow-up study. *Clin Orthop Relat Res*. 1988 ; 60-71.
6. **Argenson JN, Guillaume JM, Aubaniac JM**. Is there a place for patellofemoral arthroplasty? *Clin Orthop Relat Res*. 1995 ; 321 : 162-7.
7. **Cartier P, Sanouiller J-L, Khefacha A.** Long-term results with the first patellofemoral prosthesis. *Clin Orthop Relat Res*. 2005 ; 47-54.
8. **Chiu KY, Ng TP, Tang WM, Yau WP**. Review article : knee flexion after total knee arthroplasty. *J Orthop Surg* (Hong Kong). 2002 ; 10 : 194-202.
9. **Dahm DL, Kalisvaart MM, Stuart MJ, Slettedahl SW**. Patellofemoral arthroplasty : outcomes and factors associated with early progression of tibiofemoral arthritis. *Knee Surg Sports Traumatol Arthrosc*. 2014 ; 22 : 2554-9.
10. **Davies AP, Vince AS, Shepstone L, Donell ST, Glasgow MM**. The radiologic prevalence of patellofemoral osteoarthritis. *Clin Orthop Relat Res*. 2002 ; 206-12.
11. **Dawson J, Fitzpatrick R, Murray D, Carr A**. Questionnaire on the perceptions of patients about total knee replacement. *J Bone Joint Surg Br*. 1998 ; 80 : 63-9.
12. **Fulkerson JP**. Anteromedialization of the tibial tuberosity for patellofemoral malalignment. *Clin Orthop Relat Res*. 1983 : 176-81.
13. **Hutt J, Dodd M, Bourke H, Bell J**. Outcomes of total knee replacement after patellofemoral arthroplasty. *J Knee Surg*. 2013 ; 26 : 219-23.
14. **Laskin RS, van Steijn M**. Total knee replacement for patients with patellofemoral arthritis. *Clin Orthop Relat Res*. 1999 : 89-95.
15. **Lonner JH.** Patellofemoral arthroplasty : pros, cons, and design considerations. *Clin Orthop Relat Res*. 2004 ; 158–65.
16. **McAlindon TE, Snow S, Cooper C, Dieppe PA**. Radiographic patterns of osteoarthritis of the knee joint in the community : the importance of the patellofemoral joint. *Ann Rheum Dis.* 1992 ; 51 : 844-9.
17. **McKeever DC.** Patellar prosthesis. 1955. *Clin Orthop Relat Res*. 2002 ; (404) : 3-6.
18. **Meding JB, Wing JT, Keating EM, Ritter MA**. Total knee arthroplasty for isolated patellofemoral arthritis in younger patients. *Clin Orthop Relat Res*. 2007 ; 464 : 78-82.
19. **Mont MA, Haas S, Mullick T, Hungerford DS**. Total knee arthroplasty for patellofemoral arthritis. *J Bone Joint Surg Am*. 2002 ; 84 : 1977-81.
20. **Nicol SG, Loveridge JM, Weale AE, Ackroyd CE, Newman JH.** Arthritis progression after patellofemoral joint replacement. *Knee*. 2006 ; 13 : 290-5.
21. **Odumenya M, Costa ML, Parsons N, Achten J, Dhillon M, Krikler SJ**. The Avon patellofemoral joint replacement : Five-year results from an independent centre. *J Bone Joint Surg Br*. 2010 ; 92 : 56-60.
22. **Rogers J, Dieppe P**. Is tibiofemoral osteoarthritis in the knee joint a new disease? *Ann Rheum Dis.* 1994 ; 53 : 612-3.
23. **Sarda PK, Shetty A, Maheswaran SS**. Medium term results of Avon patellofemoral joint replacement. *Indian J Orthop*. 2011 ; 45 : 439-44.
24. **Shi M, Lü H, Guan Z**. [Influence of preoperative range of motion on the early clinical outcome of total knee arthroplasty]. *Zhonghua Wai Ke Za Zhi*. 2006 15 ; 44 : 1101-5.
25. **Tauro B, Ackroyd CE, Newman JH, Shah NA**. The Lubinus patellofemoral arthroplasty. A five- to ten-year prospective study. *J Bone Joint Surg Br*. 2001 ; 83 : 696-701.