Patellar reconstruction following previous patellectomy: a review of the literature and a case series using distal femoral autograft during total knee arthroplasty

DA George¹, A Dosani², R Morgan-Jones²

¹University College Hospital, London, UK

²University Hospital of Wales, Cardiff, UK

ABSTRACT

During total knee arthroplasty, the reconstruction of the patella following a previous patellectomy is challenging, and is undertaken to improve functional outcomes and patient satisfaction. In this case series, we have reconstructed the patella using a femoral condyle resected during total knee arthroplasty. The resected femoral condyle with best available bone stock is selected and secured to the extensor mechanism. We reviewed the preoperative indications and postoperative outcomes of two patients who underwent the above procedure at our Institute, and compared this to the literature.

The cases include a 68-year old male (6 months follow-up) who sustained a multi-fragmentary fracture of his right patella and underwent a patellectomy 30 years previously, and a 45-year old female (4 years follow-up) who underwent a left-sided patellectomy 15 years previously following polytrauma. As a result of progressive osteoarthritis they required total knee arthroplasty, and simultaneous patella reconstruction with a femoral condyle autograft. Compared to their preoperative range of motion, both patients demonstrated an improvement post-operatively with successful pain-free knee function, with no radiological signs of graft resorption.

In this limited, small series we have reported two patients who are clinically and functionally satisfied by the outcome of surgery, with comparable outcomes to alternative methods. We believe the use of a femoral condyle autograft for patellar reconstruction is a safe and simple technique that optimises knee kinematics, without associated donor morbidity.

KEYWORDS

Patellar Reconstruction – Femoral Autograft – Patellectomy – Case Series – Technique

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CORRESPONDENCE TO

R Morgan-Jones, E: rhidianmj@hotmail.com

Introduction

A patella-deficient knee secondary to previous patellectomy is an infrequent but challenging problem when planning total knee arthroplasty. It can lead to poorer functional outcomes and satisfaction than in non-patellectomised knees.^{1,2} These inferior results are mainly due to loss of mechanical advantage of knee extensor mechanism, anteroposterior instability and persistent anterior knee pain.³ Techniques reported to date involve either attempting patellar reconstruction using autograft or allograft, or a prosthetic patella (Table 1).⁴ In this case series, we present our experience of knee arthroplasty with intraoperative patellar reconstruction using a femoral condyle resected during femoral preparation.

Surgical technique

A routine midline incision is used for all our total knee replacements, employing any previous surgical scars that can be incorporated into the incision. We use a medial parapatellar approach to access the knee joint, and the implant is secured following the relevant distal femur and proximal tibial cuts according to the manufacturer's instructions.

The resected femoral condyle ('neopatella') with best available bone stock is selected, having first excised any osteophytes that may be present. Commonly, the medial distal condylar resection is the appropriate dimension.

Following implantation of the prosthesis, the knee is flexed to 30 degrees and the optimal position of the patella is determined. A pocket is fashioned by creating a horizontal

Table 1 Nature of patella reconstruction, graft source and complications

Reconstruction	Knees (n)	Procedure	Graft source	Complications
<i>Autograft</i>				
Tirveilliot ⁹	6	TKA	Tibial cut and polyethylene graft to new patella	Graft migration
Lakshmanan ³	1	TKA	Tibial cut	None
Pang ¹⁰	1	TKA	Femoral condyle	None
Jabbar ¹¹	1	TKA	Femoral condyle (posterior lateral)	None
<i>Allograft</i>				
Kulkarni ¹³	1	After TKA	Fresh-frozen extensor allograft and polyethylene graft to new patella	None
Tirveilliot ⁹	1	TKA	Femoral bone bank	None
Busfield ¹²	6	TKA	Fresh-frozen PtPQt	Infection (2) Amputation (1) Graft resorption (1)
	3	Revision TKA	Fresh-frozen PtPQt	Infection (1)
<i>Prostheses</i>				
Kwong ¹⁵	4	TKA	Tantalum augment (porous trabecular implant) and polyethylene articular surface sewn affixed to flat surface of augment	Implant loosening (3) Anterior knee pain (2) Reduced ROM (1)

TKA = total knee arthroplasty; PFA = patellofemoral arthroplasty; PtPQt = patellar tendon–patella–quadriceps tendon; ROM = range of motion

split in the patellectomy tendon at the appropriate position in relation to the distal femur. The ‘neopatella’ is inserted into the pocket, which acts as a ‘vascular envelope’, with the convex articular side facing the implant. This is referenced from the femoral condyles, trochlear groove and the tibia to prevent patella baja or alta (Fig 1). We attempt to follow the Insall–Salvati ratio⁵ but this may vary depending on the size of the neopatella. Typically, we position the proximal pole of the neopatella to be 10 mm distal to the tip of the implant apex, in the centre of the trochlear groove to optimise patellofemoral mechanics when maximal coverage of the neopatella is desired.⁶ This ensures that the neopatella is engaging the trochlea notch from 30 degrees of flexion and does not disengage in full flexion or extension.

When height and tracking are satisfactory, the pocket is closed with absorbable sutures to enclose the neopatella. No restriction of postoperative mobilisation is necessary.

Cases

Case 1

A 68-year-old man was injured in explosive trauma 30 years previously. He sustained a distal femoral and multi-fragmentary fracture of his right patella and a patellectomy was performed. Post-traumatic osteoarthritis developed and, when conservative management had been exhausted, he underwent a complex primary knee replacement. This included both a distal femoral osteotomy and creation of a neopatella. Preoperatively, his range of movement was 10–70 degrees with posterolateral laxity noted (secondary to the prolonged varus alignment). Patella tracking was lateralised, owing to distal femoral malunion.

During the reconstructive arthroplasty, we used a semi-constrained, mobile bearing prosthesis with uncemented metaphyseal fixation (DePuy Synthes,). The resected medial distal femoral condyle was used as a neopatella using the described technique. Postoperative rehabilitation was uncomplicated, with immediate full weight bearing and movement allowed. At 18 month review, the neopatella was stable and the patient had pain-free range of movement of 0–100 degrees, which was comparable to the non-operated side, no extensor lag and satisfactory patella tracking. Quadriceps bulk had improved but was reduced in comparison with the contralateral limb, with no detectable intra-articular effusion. Radiologically, no signs of graft resorption were seen (Fig 2).

Case 2

A 45-year-old woman sustained a patella fracture and underwent a left-sided patellectomy 15 years previously. Progressive pain and severe mechanical problems resulted in revision of the patellectomy with an Insall tube realignment 10 years prior to the index procedure (proximal realignment of the patella consisting of a lateral release and advancement of the vastus medialis).^{7,8} This gave temporary symptomatic relief but recurrent pain and degenerate changes necessitated a total knee arthroplasty. Preoperatively, her range of motion was 0–90 degrees, with no extensor lag, instability or patella tendon maltracking.

During the complex primary knee replacement we used a cruciate retaining prosthesis (uncemented NexGen femur with monoblock trabecular metal tibia [Zimmer]) to minimise loss, because of the patient’s young age, and the medial distal femoral condyle was used as a neopatella. When last

reviewed, four years post-procedure, she had pain-free knee function and a range of movement of 5–95 degrees, similar to the contralateral knee, with no extensor lag. Clinically, the patella was stable, with symmetrical quadriceps bulk compared with the opposite limb, and no intra-articular effusion. Radiologically, no signs of graft resorption were seen (Fig 3).

Discussion

A key decision in patellectomised knees undergoing arthroplasty revolves around the source of the new patella. Choices may include reconstruction using bone graft or replacement with a prosthesis. The resected juxta-articular bone is a convenient source of autograft, provided that it has adequate bone stock and degenerative changes are not severe enough to cause future problems.

Tirveilliot et al.⁹ and Laksmanan⁵ have described the use of the tibial plateau cuts to fashion patellar substitutes; an additional polyethylene button was cemented on five of the six cases in the former's series (Table 1). There were improvements in both the pain and function components of the International Knee Society (IKS) score;⁹ pain score (range) improved from 41 (35–45) to 78 (55–95) and function score changed from 35 (5–50) to 72 (40–100). Graft migration was a medium-term complication in this series.⁹ To our knowledge, the use of the femoral cuts from patellar reconstruction has been described only twice,^{10,11} with no problems encountered in either case.

Allograft options are varied, ranging from patellar reconstruction with bone bank graft⁹ or fresh-frozen allografts of

the extensor mechanism. Busfield and Ries have described the use of a patellar tendon–patella–quadriceps tendon graft in six primary and three revision arthroplasty cases.¹² Infection was the predominant complication in three of these knees (33%), necessitating one amputation. Kulkarni et al. have, however, reported a successful outcome after their use of extensor allograft with a polyethylene button in a patellectomised patient who had developed progressive extensor lag following knee arthroplasty.¹³

It has been noted that a metal prostheses may be more advantageous in knees with remaining patellar bone stock,¹⁴ compared with those with completely absent patellae. Kwong and Desai reported an 85% complication rate in their series of seven arthroplasties with simultaneous trabecular metal patellar implants.¹⁵

If the patella is not reconstructed, the tradition has been to employ a posterior-stabilised prosthesis to help limit the anterior translation or instability in the coronal plane.¹⁶ The tibial post helps to compensate for the deficient four-bar linkage between the cruciate ligaments and the patellar mechanism, which would normally provide intrinsic antero-posterior stability.¹⁷ However, the advantage of recreating the patella and subsequent extensor mechanism, which improves the quadriceps and hamstring torque and strength,¹⁸ avoids unnecessary additional bone loss needed for a posterior stabilised implant, which is important in younger patients, such as described in case 2.

Other advantages of using a resected femoral condylar autograft harvested at the time of total knee replacement is convenience. It is adequately sized, so as not to impede wound closure, and minimises the risk of postoperative graft

Figure 2 Radiographs of case 1: (a) preoperative; (b) immediately postoperative; (c) at follow-up

rejection and infection. Neither of the patients experienced anterior knee pain and there were no signs of graft resorption in either case. Patellectomy is rarely performed today but we expect a sizable cohort of previously patellectomised patients to seek consultation for consideration of arthroplasty in future. More studies need to be reported to help evolve a consensus on how to tackle these complex cases.

Conclusion

Using the excised a femoral condyle for patellar autograft is a safe and simple technique to reproduce a neopatella and to optimise kinematics, without any donor morbidity. In this limited, small series we have reported two patients who are clinically and functionally satisfied by the outcome of

Figure 3 Radiographs of case 2: (a) preoperative; (b) immediately postoperative; (c) at follow-up

surgery. We recommend its use in post-patellectomy patients undergoing primary total knee arthroplasty.

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