Resection arthroplasty for failed patellar components

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Abstract A total of 1,401 primary total knee arthroplasties (TKA) were reviewed; 44 (3.2%) had at least the patellar component revised. Nine of these knees (eight patients) had insufficient bone stock to allow reimplantation of another patellar component. Clinical data on the nine knees were

obtained with recent follow-up evaluation, review of their medical records and radiographs. Evaluation included Hospital for Special Surgery (HSS) scores. Average follow-up was 4 years and 7 months, 2-year range (2 months to 8 years and 4 months). Common factors found in these nine knees included: thin patella after primary TKR status, osteoarthritis, good range of motion and patella alta. Results were good to excellent in seven knees and fair in two. The untoward associations with patellectomy such as quadriceps lag, extension weakness and anterior knee pain were not experienced. Resection of the patellar component, without reimplantation, is an acceptable alternative in revision TKA lacking adequate remaining bone stock.

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Résumé Objectif: Analyser les reprises des prothèses totales de genou avec ablation de l'insert rotulien. 1401 prothèses totales du genou ont été revues. 44 genoux (3,2%) ont eu une révision du composant rotulien. 9 de ces genoux (8 patients) n'avaient pas un stock osseux suffisant pour permettre une réimplantation d'une prothèse rotulienne. Méthodes: les données cliniques de ces 9 patients ont été analysées ainsi que leur suivi clinique et radiographique et une évaluation selon le score HSS. Résultats: le suivi moyen a été de 4 ans et 7 mois (de 2 mois à 8 ans, 4 mois). Ces malades présentaient en commun une épaisseur patellaire très mince après la prothèse primaire avec une bonne mobilité et une rotule haute. Les résultats ont été excellents et bons dans 7 cas et médiocres dans 2 cas. Nous n'avons pas évalué la force du quadriceps et les douleurs antérieures. En conclusion: l'ablation du composant patellaire sans réimplantation est une alternative acceptable dans les révisions de prothèses totales du genoux qui n'ont pas un stock osseux suffisant.

Fig. 1 **a** Lateral view of typical case with inadequate bone for patellar component revision. **b** Skyline view of typical case with inadequate bone for patellar component revision

Introduction

As modern total knee arthroplasty (TKA) designs and techniques have evolved, the original problems such as infections and tibial/femoral component loosening are decreasing. Part of this evolution has included routine resurfacing of the patella. Reports of increased function and significant reduction of the incidence of post-operative anterior knee pain have been described as similar when compared to non-resurfaced TKA if a specific design of prosthesis is used [1, 25]. However, with current designs allowing increases in range of motion, and implants being placed in more active people, patellofemoral joint problems [21] still occur in TKA.

Patellar complications, such as aseptic loosening and fracture, can occur at rates up to 5 and 12%, respectively [3, 4, 9, 11, 13, 16, 17, 19]. Proposed aetiologies of these complications have been well delineated in the literature, including vascular, technical, biomechanical, thermal and traumatic [5, 22, 23]. Occasionally in the revision situation, the dilemma of inadequate bone stock for reimplantation of the patellar component is encountered. Alternatives to address this problem with specific techniques include patellar resection arthroplasty, the gull-wing osteotomy, structural bone grafting of the patella, morcellised bone grafting of the patella or the use of a porous metal augmentation baseplate [7], but clinical outcomes have not yet been reported.

The purpose of this study is to evaluate the effects of resecting the failed patellar component without reimplantation in revision TKA.

Materials and methods

A total of 1,401 consecutive primary TKA performed by the two senior authors (KAK and DSH) were reviewed. All of the operations were performed using a similar technique

Table 1 Radiographic data

Case	Mechanical axis alignment (°)		Patellar thickness (mm)		Insall-Salvati ratio	Percentage remaining original patellar grade
	Pre-TKA	Post-TKA	Pre-revision	Post-revision		
1	11 Varus	2 Varus	12	8	1.16	3
2	12 Varus	1 Varus	11	11	1.18	2
3	14 Varus	0	16	15	1.22	2
4	8 Varus	2 Valgus	13	0	1.16	4
5	17 Valgus	2 Valgus	10	0	1.61	4
6	8 Varus	1 Varus	15	14	1.20	2
7	12 Valgus	1 Varus	13	10	1.12	2
8	6 Valgus	0	8	6	1.16	3
9	20 Varus	5 Varus	11	10	1.24	2

Table 2 Clinical data

Case	Sex	Age (years)	Original diagnosis	Reason for patellar revision	Date of surgery		Functional category	Procedure	Knee ROM						HSS score	
					Primary TKA	Patellar revision			Pre-revision		Post-revision		Pre-TKA	Post-TKA		
									Passive	Active	Passive	Active				
1	F	70	OA	Aseptic loosening	09/09/82	09/30/86	C	Remove patellar component	0–120°	0–120°	0–120°	0–120°	55	92	92	
2	M	64	OA	Aseptic loosening	01/04/82	08/30/83	B	Remove patellar component	0–135°	0–135°	0–135°	0–135°	58	98	94	
3	M	66	OA	Aseptic loosening	11/02/81	06/14/85	B	Remove patellar component	0–138°	0–138°	0–138°	0–138°	58	98	97	
4	M	73	OA	Patellar fracture	10/04/82	05/23/87	C	Patellectomy/replace tibial PE tray	0–103°	0–103°	0–120°	0–120°	49	92	97	
5	F	76	OA	AVN/aseptic loosening	10/26/82	02/24/88	B	Patellectomy	1–100°	20–100°	5–110°	5°–110°	54	62	79	
6	F	22	SLE/AVN	Aseptic loosening	12/26/85	06/30/88	C	Remove pat. component/replace tibial PE tray	5–90°	5–90°	0–120°	0–120°	49	57	98	
7	F	63	OA	Aseptic loosening	04/11/83	10/16/89	C	Remove patellar component/revise femur & tibia component	0–100°	0–100°	0–90°	0–90°	39	88	65	
8	M	75	OA	Patellar fracture	05/08/84	03/24/89	C	Remove patellar component/partial patellectomy	0–100°	0–100°	0–90°	0–90°	50	NA	88	
9	M	73	OA	Aseptic loosening	04/23/86	02/23/87	C	Remove patellar component	0–105°	0–105°	0–95°	0–95°	44	NA	65	

and the same semi-constrained prosthesis: the Porous-Coated Anatomic™ (PCA, Howmedica, Inc., Rutherford, NJ, USA). Forty-four knees (3.2%) ultimately had at least the patellar component revised. Of these 44 knees, nine (in eight patients) had insufficient bone stock to allow reimplantation of another patellar component. Data were collected on these nine knees in the form of chart review, questionnaire, recent physical examination, and pre- and post-operative radiographs.

Hospital for Special Surgery (HSS) knee scores [10, 24] were obtained at three intervals: pre-TKA, post-TKA and post-patellar revision surgery. These interviews and physical exams included assessment of pain walking and at rest, walking distance, ability to climb stairs, transfer activity, range of motion, muscle strengths, measurement of deformities, instability and the need for ambulatory support. Patients were also categorised in a modification of the Chamley classification [26] as follows: category A, the patient has unilateral arthroplasty with opposite normal knee; category B, unilateral arthroplasty with contralateral knee impaired; and category C, patient with multiple arthritis or medical infirmity.

Radiographic analysis included pre- and post-operative primary TKA mechanical alignment measurements, patellar thickness (measurements on lateral radiographs done pre- and post-patellar revision), Insall-Salvati ratio [15] and a grading system for the percentage of the remaining patella after revision surgery. This grading system was obtained by comparing pre- and post-operative radiographic lateral and sunrise views and is as follows: grade 1 has 75–100% of the original patella remaining, grade 2 has 50–75%, grade 3 has 20–50% and grade 4 has 0–25%. All radiographic measurements were made independently by three of the authors.

The nine knees studied in detail were followed for an average of 4 years and 7 months; the maximum length of follow-up was 8 years and 4 months; and the minimum was 2 years and 2 months.

Results

The average age for patellar revision surgery was 64 years, ranging from 22 to 76 years. There were four women and five men. The original pre-TKA diagnosis was systemic lupus erythematosus (SLE) with secondary avascular necrosis (AVN) after steroid treatment in one patient, and osteoarthritis (OA) was the diagnosis for the remaining eight individuals. The PCA functional category found was B for three of the patients and C for the remaining five knees. The surgical procedure consisted of the removal of the patellar component, débridement and synovectomy (Fig. 1), performed in eight of our patients.

In the remaining knee, all three components were revised.

Two of the knees had such minimal bone remaining after removal of the component and débridement that it became essentially equivalent to patellectomy. The remaining knees had a bony shell that did not provide adequate bone stock for reimplantation of another patellar component (Fig. 1). The average HSS score before primary TKA was 50, after primary TKA (at its best prior to revision) it was 83 and post-patellar revision it was 86 (see Table 2).

Radiographic evaluation showed eight of the nine knees corrected within 1–2° of the normal mechanical axis (see Table 1). Of interest was the consistent finding of patellar thickness after primary TKA and pre-revision moment. Of the nine knees, pre-revision patella bony thickness ranged from 8 to 16 mm with an average of 12 mm.

Although most of the patients had ratios not significantly above 1.2 they averaged 1.2 (4/5 knees were above 1.20). The percentage of remaining patella after débridement was graded from 2 to 4 with a mean of 2.6. At interview, all nine patients stated they were satisfied with the outcome post-patellar revision. Two had intermittent mild anterior knee pain, and the remaining seven knees had no knee pain. All nine patients were able to climb stairs step over step, six required a hand rail support in coming down the stairs, while one required hand rail support both up and down. All patients on physical examination of motor testing had 5/5 quadriceps strength. There were no extension lags and only one flexion contracture of 5°.

After patellar revision, all patients either remained or improved upon their pre-revision baseline range of motion (Table 2). There were no infections or other complications in any of the nine knees after patellar component resection.

Fig. 2 Patellar skyline view of typical case status post-patellar component removal

Discussion

When analysing the nine cases in which the patellar component was excised, good or excellent results were observed in seven of the nine knees. The two fair results with HSS scores of 65 were both category C patients. These good to excellent clinical results persisted despite suboptimal appearing post-operative radiographs (Fig. 2). There was no correlation with an increased incidence of low function to pain scores in those patients who had so much bone “shelled out” that they were essentially left with a patellectomy. Minimal literature is available describing the results of primary TKA performed in patients who subsequently undergo partial or complete patellectomies. There are, however, papers denoting the results of TKA performed in patients after they have had patellectomies, presenting results with encouraging success rates for function and pain relief when using a posterior stabilised device [18]. Other studies show no untoward effects of prior patellectomy and a selected implant [14]. This discrepancy, in part, may be explained by the fact that the results of patellectomy vary depending on surgical technique, as is the direct relation to disruption of the extensor mechanism [6].

Along with the previously mentioned aetiologies and mechanisms of patellar failure in primary TKA, studies have shown that dome shape design of the patellar component is associated with increased patellar strain and increased compression forces due to narrower contact area [1, 25]. Recently the described mechanism of failure with the dome-shaped metal-backed patellar component was defined as polyethylene (PE) wear separating from the metal back rather than shear failure at the baseplate-fixation peg junction [2, 12]. The remaining bony patellar thickness after resection in primary TKA has also been directly correlated with patellar strain [27]. Bony patellar thickness less than 15 mm is associated with mainly significant increase in patellar strain, particularly with increased flexion. A smaller contact area at each flexion angle can also be observed when compared to normal thickness patella, which may be caused by patellofemoral incongruity following abnormal patellar tracking [8]. This appears to be unaffected by PCL retention or sacrifice [20]. In our study, only one patient had a post-primary TKA patellar thickness greater than 15, with the average being 12 mm (Table 1). Of the nine knees, there were two patellar fractures with the remaining modes of failure being aseptic loosening and/or avascular necrosis.

On questioning, all patients were satisfied with their results, with two having intermittent mild knee pain, and no pain reported in the remaining seven knees. There was no trend or direct correlation between the percentage of remaining patella and the clinical outcome. All maintained

or improved upon their good pre-revision ranges of motion, with six to nine knees flexing greater than 100°. A contributing factor to the increased patellar strain and eventual loosening in these patients may have, in fact, been their good to excellent range of motion, as other previously outlined potential causes. The Insall-Salvati ratio indicated that all patients had at least a mild degree of patella alta, considered as another potential cause for this primary osteoarthritic patient population.

Despite the fact that the nine knees in this study were in patient function categories B, and mostly C, a high rate of good to excellent results were obtained. The untoward effects commonly associated with patellectomy type patients, i.e. extension lag, decreased stair climbing ability, etc., were not found in this series. This may, to some extent, be attributed to the maintenance of the soft tissue extensor mechanism.

In summary, the patella is the area of greatest functional load of the knee and will likely remain problematic in TKA. Revision situations will be encountered in which the patella lacks remaining adequate bone stock for a repeat component fixation. This study indicates that resection of the patellar component, without reimplantation, is an acceptable alternative in this patient population.

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