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The influence of the position of the patellar component on tracking in total knee arthroplasty

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Summary. *The position of the patellar component and patellofemoral symptoms were assessed in a series of 72 cemented polyethylene patellar components in total condylar arthroplasties. A small (25 mm) component was used. The minimum follow up was 2 years and maximum 3 years. A lateral retinacular release was carried out in 22 knees. Clinical results were assessed by questionnaire and 86% had no patellofemoral symptoms. The mean postoperative patellar height was not changed compared to the preoperative height. Lateral placement of the patellar component was associated with both increased medial tilt and lateral subluxation. The component should be inserted so that its centre is slightly medial to the centre of the bone.*

Résumé. *Etude de la fonction fémoro-patellaire et de la position de la prothèse rotulienne dans une série de 72 prothèses totales de genou à pièce rotulienne en polyéthylène cimentée (prothèse sans conservation des croisés de Johnson and Johnson). Dans la plupart des cas, un petit composant (25 mm) a été utilisé. Le minimum de suivi est 2 ans. Une section de l'aileron rotulien externe a été faite pour 22 genoux (30%). Les résultats fonctionnels ont été étudiés au moyen d'un questionnaire. 86% des patients ont une articulation fémoropatellaire asymptomatique. L'épaisseur moyenne de la rotule n'a pas été modifiée de façon significative par l'intervention. L'inclinaison frontale moyenne du composant patellaire est de moins 2°, l'inclinaison de la coupe osseuse est de moins de 5° et l'inclinaison de l'ensemble osprothèse est en moyenne de 3°. La position latérale du composant patellaire s'accompagne d'une façon significative d'une augmentation de l'inclinaison patellaire interne et d'un déplacement externe de la rotule. La prothèse patellaire doit donc être placée avec son centre légèrement plus médial que le centre de la rotule. L'utilisation d'une prothèse patellaire de petite taille n'est pas un facteur de douleur fémoro-patellaire.*

Introduction

Symptoms related to the patellofemoral joint are a frequent cause of failure after total knee arthroplasty (TKA) [7, 11], and patellar resurfacing is advocated [3, 7, 13]. The incidence of patellar subluxation, stress fracture and anterior knee pain was high in early series of knee arthroplasties. Fewer of these complications were reported with improved surgical technique, with attention paid to the correct rotation of the femoral and tibial components and the use of a lateral retinacular release.

Unlike the cuts in the femur and tibia, the patellar cut is generally made freehand. As a result of observation made during revision operations and the senior author's (WEMM) experience of 1500 knee arthroplasties carried out over 18 years, a new patellar component and instrumentation was developed. The aim was to allow precise and re-

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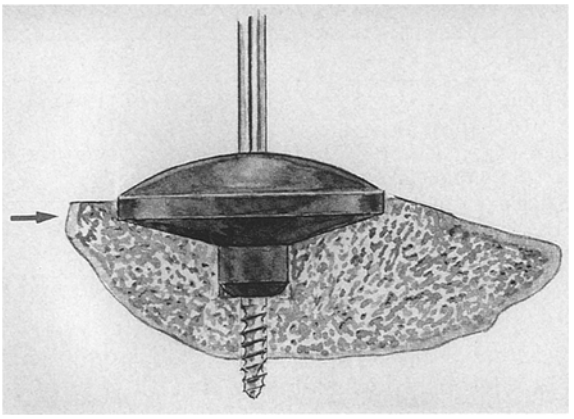

Fig. 1. The inset patellar component has a dome-shaped articular surface with a tapered conical undersurface and a central peg

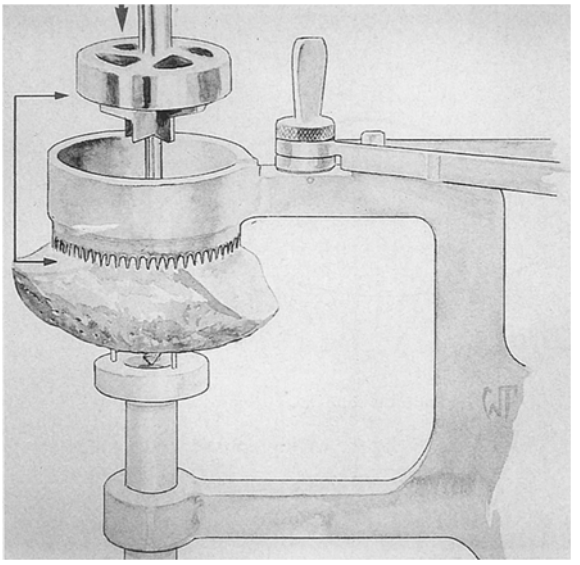

Fig. 2. A cannulated reamer is used over a guide wire

producible implantation and at the same time conserve bone stock and ensure correct tracking.

This paper describes the component and the technique for its insertion. The early clinical and radiographic results are reported.

Material and methods

The patellar component is made of ultra-high density polyethylene (UHMWP) and has a domed articular surface with a conical back and a central peg (Fig. 1). The articular surface is congruent with the trochlear component so that cold flow of the UHMWP is reduced during flexion of the knee [9]. The small patellar component (25 mm, 28 mm, 32 mm) resurfaces the central part of the patella while the periphery of the bone has direct contact with the femoral component. The 25 mm size was used in 58 knees, and the 28 mm and 32 mm each in 6 knees. The symmetry avoids incorrect tilting during insertion and the conical base with its central peg reduces load and shear stresses. The undersurface offers a large area for cement fixation.

Operative technique. The femoral component is slightly lateralised, and both tibial and femoral components are slightly externally rotated to improve patellar tracking [7]. Every patient was operated on by WEMM or under his supervision. A lateral retinacular release was done if lateral subluxation occurred during a "no-thumb" test [7].

The appropriate sizing template is placed over the articular surface of the patella. A threaded guide wire is drilled into the bone after a free hand cut of the median patellar ridge, or after using the patellar holding clamp. A cannulated reamer is used over the guide wire (Fig. 2). Fracture cannot occur during reaming because the mean thickness of the patellar is 23 mm [7] and the maximum depth reached by the reamer is 12.3 mm, 10.4 mm and 9.3 mm for the 25 mm, 28 mm and 32 mm components respectively. Overreaming is prevented by the rim of the reamer. The trial component is seated, and after trial reduction the final component is cemented into place; any remaining osteophytes are resected. The apex of the component has to be the most prominent point.

During the operation, the patella is fully everted and its thickness measured with a calliper at the level of the median ridge both before resection and after cementing the component in position.

Clinical study. Fifty-nine patients (73 TKA) were included. There were 39 men and 20 men (mean age 71 years, SD 7.9) with a minimum follow up of 2 years (mean 2 years, SD 0.5). The diagnosis was osteoarthritis in 57 and rheumatoid arthritis in 2 patients. At follow up, the range of knee movement was recorded. The documents of all the patients were reviewed. A telephone questionnaire concerning specific patellofemoral symptoms was used (Table 1), and a patient-satisfaction score was carried out in 52 patients (65 knees) by the junior authors who were not aware of the radiographic results.

Radiographic study. Standing radiographs of 53 patients (66 knees) were used to measure the femorotibial angle before and after operation. The position of the patellar component, and any tilt or translucency was assessed in an axial view in 45° of flexion [10]. The measurements were made by two researchers. Displacement of the component was measured as the distance C between the centre of the patellar component and a line drawn through the central area of the femoral condyles (Fig. 3) [5]. Its position (medial or lateral) was defined as

Table 1. Patello-femoral joint questionaire

1.	Do you have pain, and where?
2.	Do you have pain in the front of the knee?
3.	Do you have a grinding sensation in your knee?
4.	Do you have pain, grinding and/or clicking sensation when walking stairs up or down?
5.	Are you hindered by your knee during daily activities? If no, what hinders you (hip, other knee, feet, stamina).
6.	Do you have pain rising from a chair?
7.	Do you have weakness in your leg?
8.	Give your satisfaction score (1–10) for the knee 1 2 3 4 5 6 7 8 9 10

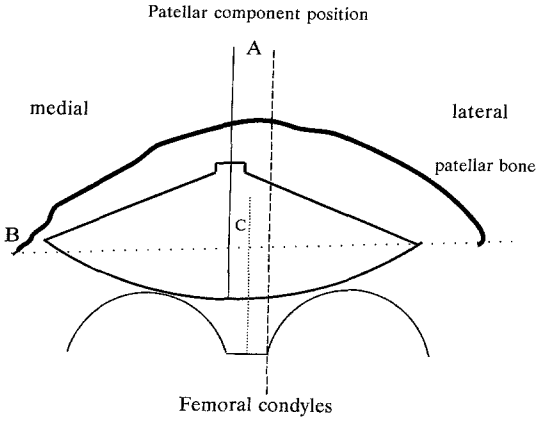

Fig. 3. Diagram showing the radiographic measurements made on a axial view of the patella

the horizontal distance A between its centre to a line drawn through the centre of the patella. Patellar bone tilt was the angle between a line between the anterior limit of the femoral condyles and a line perpendicular to the long axis of the peg. The bone-component tilt B was the difference between these two angles. Values for the patellar tilt within 5° for the angle between the patella and the femur were arbitrarily defined as the neutral range of such angles [5]. Differences of medio-lateral component displacement of 2 mm or less were the neutral range for these measurements.

Statistics. Mean values, standard deviations and the range were calculated. Linear regression analysis was used and the correlation coefficient was calculated for the relation between patellar position position and tilt. The level of significance is given in the text.

Results

Clinical study

Eighty-six per cent of the patients had no patello-femoral symptoms and excellent knee function (Table 2).

The patient satisfaction score ranged from 5 to 10 points: 8 scored 5, 6 of whom expected more flexion of their knee, and one still had symptoms. Forty-nine knees had a score of 8 or higher. Thirty-eight patients were able to carry out their daily activities normally. Others had difficulties due to lack of stamina (5 patients), trouble with the other knee (5), lower back (4) and hip (3). Functional disability was not due to the knee which had been operated on in 42% of cases.

One patient complained of anterior knee pain and a grinding sensation which was worse on climbing stairs and getting up from a chair. His satisfaction score was 5 and radiographs showed a 1° medial tilt of the patellar component and a lateral position of 4 mm.

Table 2. Patellofemoral symptoms (n = 65 knees)

	n (%)
Knee pain	7 (10%)
Anterior knee pain	1 (2%)
Grinding	6 (9%)
Stairs: pain, grinding, clicking	5 (7%)
Knee hinders activity	6 (9%)
Pain rising from chair	5 (7%)
Weakness in leg	8 (12%)

Flexion was 101° (SD 8.2) and extension 9° (SD 5.4) before operation compared to 110° (SD 15.1) and 1° (SD 2.5) respectively after operation.

Radiographic measurements showing the differences in patellar height are given in Table 3.

A lateral release was carried out in 22 knees (30%). There were no fractures of the patella.

Radiographic study

The mean femorotibial angle before operation was 181° (SD 6.2) and after operation 177° (SD 2.3).

Incomplete radiolucent lines of 1 mm were present around the patellar implant in 2 knees.

The measurements of patellar displacement and tilt are given in Table 3. Six patients had a medial tilt of the component of more than 5°, and they all had lateral displacement of more than 2 mm. Six had a lateral tilt of more than 5°, 3 had lateral displacement of more than 2 mm, and one had medial displacement of more than 2 mm.

A correlation was found between a lateral position of the component in the bone and an increased medial tilt ($r = 0.62$, $p < 0.0001$). A medial prosthetic position and tilt showed no significant correlation. Increased medial tilt was associated with increased lateral displacement ($r = 0.51$, $p < 0.0001$). Lateral tilt had no significant correlation with displacement.

A lateral position of the component in the bone was associated with increased lateral displacement ($r = 0.61$, $p < 0.0001$). A medial position had no significant correlation with displacement.

No association was found between the bone-component tilt and the patellar component displacement (Table 3).

Discussion

Attention has been directed to replacement of the patellar surface during TKA [5, 7, 8], but patellar resection is often carried out by eye which might be a reason for the high rate of patellar complications. Incorrect restoration of the patellar height,

Table 3. Intraoperative and radiographic[a] measurements

	Preoperative mean	(SD)	range	Postoperative mean	(SD)	range
Patellar height	23 mm	(2.0)	20–25	23 mm	(1.8)	20–25
Patellar bone tilt						
medial	0.3°	(0.9)	0–4	0.8°	(2.0)	0–11
lateral	5.1°	(6.4)	0–33	4.1°	(4.1)	0–18
Patellar tilt						
medial				1.7°	(2.6)	0–11
lateral				1.5°	(2.7)	0–13
Bone-compon. tilt[c]				–3°	(4.7)	(–19)–10
Displacement						
medial				0.5 mm	(1.1)	0–5
lateral				2.0 mm	(2.2)	0–11
Patellar position[b]						
medial				1.8 mm	(1.6)	0–6
lateral				0.4 mm	(0.8)	0–4

[a] Measurements made on axial patellar view (Merchant 1974)
[b] Patellar position: translation of centre of prosthesis in relation to centre of patella (Gomes 1988)
[c] Bone-prosthesis tilt: "–" denotes medial tilt

making it too thick, may result in loss of flexion due to tightness of the extensor mechanism and lateral subluxation [8]. A thinner than normal patella may permit anteroposterior instability of the knee. No significant increase in patellar height was seen in our series.

We do not recommend maximum cover of the patella by the component, as proposed by Marmor [8], and others have also reported that large UHMWP components have given rise to more problems [7, 12]. We suggest that coverage should be within the superior-inferior dimensions, with down-sizing where there is doubt. A small patellar button allows for slight adjustments in case of an oblique cut between bone and component, or slight tilting. We refer to this as a tumbler effect because of the adjustment of the small dome-shaped patella to a neutral position.

At revision we, and others [4], found a patellar meniscus covering the patellar bone and the peripheral UHMWP. This meniscus cushions the uncovered bony periphery as early as 10 days [Schmitz, personal communication] and provides a protective layer between the periphery of the patella and the flanges of the femoral component when flexion is more than 90° [1, 6]. An inset patella has the additional advantage of allowing a greater thickness of UHMWP which deters cold flow and decreases wear [2].

Tilting of the patellar component was only slight with our technique, and although bone cuts were not always parallel to the articular surface of the patella, there was only a mean angle of 3 ° of the component to the bony remnant. The tumbler effect of a small patellar component in the groove of the femoral component might adjust for this, as suggested by the absence of correlation between tilt and displacement.

The relevance of the position of the patellar component has been discussed theoretically, but has never been established in practice. In our design a lateral position is correlated with a medial tilt which in turn correlates with lateral subluxation and possible maltracking.

Our results are similar to a recently published paper [7] which reported no anterior knee symptoms in 83% of cases, compared to the 86% in our series. The reamed inset patellar component reproduces patellar height with conservation of bone stock, and the early clinical results are promising.

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