Patellar position and lateral approach for total knee arthroplasty in degenerative knees with lateral femoropatellar arthrosis

T. Ammari (1), B. Zniber (1), P. Boisrenoult (1), O. Charrois (1), M. Perreau (1), P. Beaufils (1)

(1) Service d’Orthopédie-Traumatologie, Centre Hospitalier de Versailles, Hôpital André Mignot, 177, rue de Versailles, 78157 Le Chesnay Cedex.

ABSTRACT

Purpose of the study
Patellar malposition is a well-recognized patellar complication after total knee arthroplasty. Such residual malposition is particularly frequent when the knee presents lateral femoropatellar arthrosis. We compared the radiological position of the patella after total knee arthroplasty in degenerative knees with lateral femoropatellar arthrosis performed via a medial or lateral approach with elevation of the anterior tibial tuberosity.

Material and methods
Twenty-six total knee arthroplasties were reviewed retrospectively. Thirteen prostheses had been inserted via a medial approach and thirteen via a lateral approach. A posterior stabilized implant was used with an original technique for insertion of the patellar implant. The only difference between the groups was the approach. In the “lateral” group, the lateral approach was used to raise the tibial tuberosity and perform lateral marginal patellectomy. The tibial tuberosity was reinserted in all cases without transfert. Preoperative and 3-month postoperative radiographs (weight-bearing, AP, lateral, femoropatellar 30° flexion) were reviewed. Preoperative patellar displacement was at least 5 mm. There was no difference between the two groups for age, gender, weight, height, joint motion, pre- and postoperative mechanical alignment (HKA), or preoperative patellar displacement (7.6 mm in the “medial” group and 9.7 mm in the “lateral” group).

Results
Recurrent patellar dislocation occurred in one patient in the “medial” group and one patient in the “lateral” group had an anterior impaction of the tibial plateau following a fall. Patellar gliding was corrected in both groups: 0.7 ± 1.8 mm in the “medial group” and 0.0 ± 0 in the lateral group (p > 0.05). Residual patellar tilt was +4.2 ± 3° in the medial group (lateral tilt) and -3.3 ± 5.4° in the lateral group (medial tilt) (p = 0.003).

Discussion
Patellar gliding was corrected irrespective of the approach. Conversely, the medial approach did not allow effective correction of patellar tilt. The lateral approach with elevation of the anterior tibial tuberosity did not increase morbidity compared with the medial approach. It enabled avoiding residual lateral patellar tilt which can be a source of patellar complications. We prefer this approach for arthroplasty on degenerated knees with lateral femoropatellar arthrosis.

Key words: Knee, total knee prosthesis, complications, patella, tilt, approach.

Reprints: P. BEAUFILS
E-mail: pbeaufils@ch-versailles.fr
INTRODUCTION

Patellar complications are very frequent after total knee arthroplasty [Beaufils art1-bib1 (1, 2), Rand (3)]. Causes, means of prevention, and appropriate treatment remain controversial. Several factors could explain these complications: defective position of the femoral, tibial and patellar implants [Yoshii et al. (4), Petersige et al. (5), Rhoads et al. (6), Grace and Rand (7)], sagittal conflicts, preoperative patellar height, but also the surgical approach. All of these factors must be taken into consideration when searching to achieve the optimal position for the patella on the femoral trochlea.

The presence of lateral femoropatellar arthrosis preoperatively further complicates the risk of malposition, explaining in part the greater frequency of postoperative patellar tilt in this specific group despite possible section of the lateral patellar retinaculum, a lateral approach raising the anterior tibial tuberosity, and lateral marginal vertical patellectomy.

The purpose of this retrospective case-control radiographic study was to examine the influence of the lateral approach with displacement of the tibial tuberosity on patellar position in total knee arthroplasty for degenerative disease with lateral patellar arthrosis. This investigation was limited to radiographic findings.

MATERIAL AND METHODS

Study population

This retrospective study included knees with lateral femoropatellar arthrosis which were operated on between January 1994 and November 1999.

Methods

Radiographic measurements

The same standard x-ray protocol was used preoperatively and three months postoperatively: weight bearing view of the full limb, single stance ap view, strict lateral view with superposition of the posterior condyles in 20° flexion, patellofemoral view with 30° flexion (Merchant view).

The following elements were measured and analyzed:

— frontal deformation of the limb, defined as the angle between the mechanical axis of the femur and tibia on the weight bearing view (HKA),
— patellar gliding, defined on the patellofemoral view in 30° flexion as the distance between the floor of the trochlear groove and the patellar crest. A positive result corresponded to a lateral displacement (fig. 1). Preoperative lateral patellar displacement of at least 5 mm was an inclusion factor.
— patellar tilt was not measured preoperatively as it was difficult to identify a plane of reference subsequent to osteophytic remodeling. Postoperatively, patellar tilt was defined as the angle between the patellar cut and the tangent to the opening plane of the prosthetic trochlea. A positive measure designated an external tilt (fig. 2). The patellar cut plane was retained instead of the commonly used anterior aspect or the greater transversal axis as we were able to demonstrate [Beaufils et al. (8)] that such landmarks lack reliability (a congruent well-centered patella may present a greater transversal axis which is not parallel to the opening plane of the trochlea).
— other measurements were: patellar height (Caton-Deschamps index), sagittal patellofemoral width, and patellar thickness as a ratio of patellar width (e/l).

The series

Inclusion criteria were: presence of lateral patellar displacement of at least 5 mm from the floor of the trochlear groove on the preoperative femoropatellar view at 30° flexion and a lateral surgical approach with displacement of the anterior tibial tuberosity (ATT).

Thirteen knees fulfilled the inclusion criteria (lateral "group"). This group was matched with thirteen other knees which also presented lateral patellar displacement of at least 5 mm preoperatively but which were operated on via a parapatellar approach ("medial" group) during the same period.

FIG. 1. – Patellar gliding is measured as the distance between the floor of the trochlear groove and the patellar crest.

FIG. 2. – Patellar tilt is measured postoperatively as the angle formed between the opening plane of the prosthetic trochlea and the plane of the patellar cut.
The two groups were comparable regarding patient age, gender, body weight, range of motion (table I). They were also comparable for pre-and postoperative HKA, patellar displacement, patellar height, preoperative patellar thickness (table II).

**Operative technique**

A posterior stabilized implant (CEDIOR) with a fixed plateau (CZimmer) was implanted. The same operative technique (excepting approach) was used in both groups (same anteroposterior sizing of the femur in respect of the posterior condyles and same standard 3° external rotation of the femoral piece). The patellar cut was made with a specific instrument fixed on the trial femoral piece allowing determination of the patellar cut parallel to the prosthetic trochlea (fig. 3) and centering the patellar implant on the trochlea and not necessarily on the center of the patellar bony mass. We had previously demonstrated the reliability and reproducibility of this patellar cut instrument [Beaufils et al. (8)].

The following operative steps were performed:

- implantation of the trial femoral piece with standardized 3° external rotation and lateralization;
- implantation of the trial tibial piece checking that its center corresponded to the medial third of the ATT;
- removal of patellar osteophytes;
- repositioning of the patella on the trial femoral and tibial pieces and test of patellofemoral kinematics in flexion to adapt rotation of the tibial piece if necessary.

After checking tension and rotation, the patellar cut was performed. As the patella was placed in the trochlea, the first pin perforated the patella to the center of the trochlea (giving a landmark for centering the patellar implant in relation to the patellar bone), then two pins parallel to the trochlea were inserted into the patella. This gave the plane of the patella cut parallel to the trochlea.

The thickness of the cut was controlled according to the initial wear of the patella.

The only technical difference between the two groups was the approach.

In the lateral group, arthrotomy was performed via a lateral parapatellar approach passing between the tendons of the rectus femoris and the vastus lateralis. An ATT osteotomy was then performed raising a small 7-10 cm tibial splint with a medial pedicle. In order to open the patellar retinaculum laterally a few millimeters from the patella, a 1 cm incision was made in the prepatellar periosteum along the lateral border of the patella followed by medial to lateral removal of the perisoteum, the lateral marginal portion of the patella being exposed and sectioned with an oscillating saw to achieve marginal lateral patellectomy. The lateral retinaculum was closed and the ATT fixed with screw and wire or wire alone without medialization.

**TABLE II. – The series.**

<table>
<thead>
<tr>
<th>Approach</th>
<th>Age</th>
<th>Gender</th>
<th>Weight (kg)</th>
<th>Height (cm)</th>
<th>Range of motion (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medial</td>
<td>75.9</td>
<td>11</td>
<td>2</td>
<td>72.6</td>
<td>161</td>
</tr>
<tr>
<td>Lateral</td>
<td>72.2</td>
<td>13</td>
<td>0</td>
<td>76.3</td>
<td>160.9</td>
</tr>
</tbody>
</table>

HKA: mechanical axis of the limb; Patellar height according to Caton-Deschamps; Sagittal width: distance between the posterior border of the condyles and the anterior aspect of the patella; e/l: ratio between thickness and width of the patella. Preoperative tilt of the patella was not measured.

**TABLE II. – Pre- and post-operative radiographic measurements made in both groups.**

<table>
<thead>
<tr>
<th></th>
<th>Medial group</th>
<th>Lateral group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preop</td>
<td>Postop</td>
</tr>
<tr>
<td>HKA (°)</td>
<td>175.5±7.1</td>
<td>178.8±3.6</td>
</tr>
<tr>
<td>Displacement (mm)</td>
<td>7.6±1.3</td>
<td>0.7±1.8</td>
</tr>
<tr>
<td>Tilt (°)</td>
<td>4.2±3.6</td>
<td>-3.3±5.4</td>
</tr>
<tr>
<td>Patellar height</td>
<td>0.77±0.16</td>
<td>0.81±0.17</td>
</tr>
<tr>
<td>Sagittal space (mm)</td>
<td>89.2±7.8</td>
<td>91.7±10.35</td>
</tr>
<tr>
<td>Patellar thickness</td>
<td>0.49±0.05</td>
<td>0.48±0.04</td>
</tr>
</tbody>
</table>

HKA: mechanical axis of the limb; Patellar height according to Caton-Deschamps; Sagittal width: distance between the posterior border of the condyles and the anterior aspect of the patella; e/l: ratio between thickness and width of the patella.
In the "medial" group, arthrotomy was performed via a medial parapatellar approach passing between the tendons of the vastus medialis and the rectus femoris. In both cases, the lateral patellar retinaculum was sectioned.

Statistical analysis
StatView for Windows (Abacus Concept Inc., copyright© 1992-1996 version 4.57) was used for the statistical analysis.

The normal distribution of the series and correlations between the different groups of measurements were assessed with a parametric test to compare means of paired or unpaired series using Student’s t test.

RESULTS
Complications
Two complications were observed. In the lateral group, one case of anterior impaction of the tibial plateau (slope - 24\(^\circ\)) occurred subsequent to a fall in a patient with Parkinson’s disease. In the medial group, recurrent patellar dislocation was observed in one case despite opening of the lateral retinaculum. Computed tomography demonstrated defective external rotation, essentially involving the tibia, but the two pieces were changed to correct the tibial defect and increase external rotation of the femoral piece.

Mean operative time was 91 ± 19 min in the medial group and 101 ± 17 min in the lateral group (p = 0.18).

Radiographic results are summarized in table II. Patellar displacement was 7.6 ± 1.2 mm preoperatively and 0.7 ± 1.8 mm postoperatively in the medial group and 9.7 ± 5 mm preoperatively and 0.0 ± 0.0 mm postoperatively in the lateral group. The difference was non-significant between the two groups postoperatively. It was however significantly different in both groups between the preoperative and postoperative value (p < 0.0001), irrespective of the operative approach and the degree of patellar dislocation.

The postoperative tilt could not be compared with the preoperative value since the preoperative tilt could not be measured reliably. Postoperative tilt was on average + 4.2 ± 3.6\(^\circ\) in the medial group (fig. 4) and - 3.3 ± 5.3\(^\circ\) (internal tilt) in the lateral group (p = 0003).

Patellar height and sagittal space were not different. Patellar thickness was greater in the lateral group.

DISCUSSION
Patellar complications, with loosening, constitute the most common cause of failure of total knee arthroplasty [Beaufils and Abouchaya (9)] and the leading reason for surgical revision [Berry and Rand (10), Doolittle and Turner (11)]. Depending on the series, the frequency is estimated at 1 to 50\% [Merrill and Ritter (12), Boyd et al. (13)]. Patellar complications are usually seen as more or less patent patellar dislocation with or without instability, fracture, patellar loosening, or pain.

Residual patellar malposition, and its radiographic presentation of patellar tilt and/or gliding, contributes to such
complications [Rand (3), Barrack et al. (14), Bindelglass and Vince (15)]. The proportion of tilted patella varies from 0.8% according to Brick and Scott (16) to 45% reported by Bindelglass and Vince (15). Lateral tilt is more common [Bindelglass and Vince (15), Brick and Scott (16), Ranawat (17), Freeman et al. (18), Firestone et al. (19)] and has a worse effect on prognosis. Laughlin et al. (20) demonstrated that external tilt tends to worsen with time, unlike internal tilt which tends to improve. The degree of tilt increases with more pronounced patellar malposition preoperatively [Chan and Gill (21)].

There are many causes of residual displacement of the patella and patellar tilt. For Chan and Gill (21), an oblique patellar cut and the presence of a preoperative tilt exaggerate the postoperative external tilt. These authors considered that each 2° of lateral tilt observed preoperatively increases the postoperative tile 1°. Bindelglass and Vince (15) came to the same conclusions.

For Kawano et al. (22), the lateral position of the insert on the bony patella and internal rotation of the femoral piece considerably increase the risk of lateral patellar tilt. Bertrand et al. (23) reported a randomized prospective study showing that external rotation of 3° decreases postoperative lateral tilt 7.2% and that this decreases the frequency of sections of the lateral retinaculum. Merrill et al. (24), Worland et al. (25), Berger et al. (26), Matsueda et al. (27) came to the same conclusions.

The frequency of residual tilt has led several authors to propose section of the lateral retinaculum during arthroplasty performed via the medial approach. This considerably increases the risk of patellar fracture [Ritter et al. (28)], even though the effects on patellar blood supply remain a subject of debate [Ritter et al. (29), Scuderi et al. (30), Wetzner et al. (31), McMahon et al. (32)]. The real effect on patellar tilt remains uncertain [Merrill et al. (24)].

Few authors have investigated the effect of the surgical approach on patellar positioning. Matsueda and Gustilo (33), compared the medial parapatellar approach with the medial sub-vastus approach and obtained better centering with the latter (83% versus 63%). Arnold et al. (34) and Burki et al. (35) demonstrated that the lateral parapatellar approach with raising of the ATT enables better restitution of good patellar kinematics without patellar resurfacing. For Vielpeau et al. (36), the stability of the patella is one of the advantages of the lateral approach which enables correction of the preoperative external tilt if a good ligament balance is achieved in flexion. Furthermore, morbidity with this approach is not greater than with the medial parapatellar approach [Vielpeau et al. (36), Mertl et al. (37)].

We made similar observations in our specific series of patients with lateral femoropatellar arthrosis. In the medial group, the medial approach did not allow, despite section of the retinaculum in a few cases, correction of the external tilt which remained clearly positive.

In the lateral group however, not only was external tilt corrected, but we also observed internal patellar tilt which we found to be better tolerated [Laughlin et al. (20)]. It is also noteworthy that correction of the tilt is linked with other factors. We hypothesized two causes:

— a lengthening effect of the lateral retinaculum due to the lateral marginal patellotomy;
— better positioning of the tibial implant in external rotation due to better exposure of the tibial plateau while the mediopatellar approach can induce internal rotation tibial malposition. A computed tomography study could be conducted to verify this hypothesis.

CONCLUSION

The lateral parapatellar approach for total knee arthroplasty for the treatment of lateral femoropatellar arthrosis enabled us to improve the postoperative position of the patella on the trochlea by achieving internal tilt which is better tolerated than external tilt [Laughlin et al. (20)]. Operative time is not significantly longer. Perioperative morbidity is not increased.

We thus propose this approach systematically and raise the ATT in this specific group of patients, irrespective of the frontal varus or valgus.

References


