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ORIGINAL ARTICLE

Total knee arthroplasty in valgus knees: Predictive preoperative parameters influencing a constrained design selection

J. Girard^{a,*}, M. Amzallag^b, G. Pasquier^a, A. Mulliez^a, T. Brosset^a,
F. Gougeon^c, A. Duhamel^d, H. Migaud^a

^a C and D Orthopaedic Units, University Department of Orthopaedics and Traumatology, Lille 2 University Faculty of Medicine, Roger-Salengro Hospital, Lille Regional University Hospital Center, 59037 Lille cedex, France

^b Orthopaedics and Traumatology Department, Dron Hospital, Tourcoing, France

^c Louvière Private Hospital, Lille, France

^d Biostatistics Laboratory, Medical Computer Science Research Center, Faculty of Medicine, Lille, France

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KEYWORDS

Total knee arthroplasty;
Valgus knee;
Laxity;
Instability;
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Summary

Introduction: In valgus knees, ligament balance might remain a challenge at total knee prostheses implantation; this leads some authors to systematically propose the use of constrained devices (constrained condylar knee or hinge types...). It is possible to adapt the selected level of constraints, by reserving higher constraints to cases where it is not possible to obtain final satisfactory balance: less than 5° of residual frontal laxity in extension in each compartment, and a tibiofemoral gap difference not in excess to 3 mm between flexion and extension.

Hypothesis: It is possible to establish preoperative criteria that can predict a constrained design prosthetic implantation at surgery.

Materials and methods: A consecutive series of 93 total knee prostheses, implanted to treat a valgus deformity of more than 5° was retrospectively analysed. Preoperatively, full weight bearing long axis AP views A-P were performed: hip knee angle (HKA) averaged 195° (186° to 226°), 36 knees had more than 15° of valgus, and 19 others more than 20° of valgus. Laxity was measured by stress radiographies with a Telos™ system at 100 N. Fifty-two knees had preoperative laxity in the coronal plane of more than 10°. Fourteen knees had more than 5° laxity on the convex (medial) side, 21 knees had more than 10° laxity on the concave (lateral) side. Statistical assessment, using univariate analysis, identified the factors that led, at surgery, to an elevated constraint selection level; these factors of independence were tested by multivariate analysis. Logistical regression permitted the classification of the said factors by their odds ratios (OR).

* Corresponding author.

E-mail address: j-girard.lille@yahoo.fr (J. Girard).

Results: High-constraints prostheses (CCK type) numbered 26 out of 93 implantations; the other total knee prostheses were regular posterostabilized (PS) prostheses. Statistically, the preoperative factors that led to the choice of a constrained prosthesis were: (1) valgus severity as measured by HKA (PS = 193°, CCK = 198°), (2) increased posterior tibial slope (PS = 4.8°, CCK = 6.5°), (3) low patellar height (using Blackburne and Peel index PS = 0.89, CCK = 0.77), (4) severity of laxity in valgus (PS = 2.3°, CCK = 4.3°). Among all these factors, the only independent one was laxity in valgus (convex side laxity) ($p = 0.0008$). OR analysis showed a two-fold increased probability of implanting an elevated constraints prosthesis for each one degree increment of laxity in valgus.

Discussion: This study demonstrated that it was not the valgus angle severity but rather the convex medial side laxity that increased the frequency of constrained prostheses implantation. Other factors, as a low patellar height or an elevated posterior tibial slope, when associated, potentiate this possible prosthetic switch (to higher constraints) and should make surgeons aware, in these situations, of encountering difficulties when establishing ligament balance.

Level of Evidence IV: Therapeutic retrospective study.

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Introduction

The correction of deformities and establishing ligament balance are priority mechanical objectives in the implantation of total knee prostheses (TKPs) to ensure a good, durable and functional result [1–4]. In cases of frontal deformity in valgus, achieving these two objectives may be difficult [5,6], notably in patients with convex laxity and/or deformity surpassing 20° [7]. Specific management techniques for the soft tissue release have been developed to treat this type of deformity:

- the lateral approach with elevation of Maissiat's band of Gerdy's tubercle [8–10];
- the medial articular approach and the release of lateral structures by the trans-articular approach with partial section of the iliotibial band by "pie-crusting" [11,12];
- lateral condyle osteotomy allowing the displacement of femoral insertions of the lateral collateral ligament and of the popliteal muscle for adjustment of laxity and space in flexion as in extension [13].

Other methods were proposed when the previous techniques reached their limits:

- osteotomy combined with prosthesis implantation when the deformity is extra-articular [14];
- constrained prosthesis (with constrained condylar knee [CCK] type), notably for elderly patients to simplify and shorten the operative procedure [15–17];
- hinge prosthesis to simplify the intervention to the maximum when significant laxity exists [18,19].

Several authors have raised concerns that these high-constraint prosthesis (CCK type) and hinge prostheses represent a higher risk of loosening and exposure to technical difficulties in case of revision [20–22]. Systematic recourse to prostheses implanted with high-level constraint is questionable, and several authors have proposed adjustment of this indication to the ligament balancing problems [19,23–25]. This attitude appears to be reasonable, but it

presumes the availability, in operating room, of different implant types and corresponding ancillary components (or evolutive ancillary items), to adapt to operative difficulties during intervention. Among these operative problems encountered, the adjustment of ligament tension is the most unpredictable, notably, to obtain evenness of spaces in flexion and in extension [26].

To facilitate the management of operating rooms (intervention duration, ancillaries, implants), it seems justified to identify cases where recourse to high-constraint prostheses is the most probable. Our hypothesis is that preoperative data are predictive of the use of constrained prostheses in cases of valgus deformity greater than 5°.

Materials and methods

Patients

This continuous, monocentric, retrospective series comprised 93 TKPs implanted between 1996 and 2004 for the treatment of valgus knees with deformity of more than 5°. During the study period, only two hinge prostheses (excluded from the study) were implanted in first intention for genu valgum. There were 89 patients (four bilateral cases, 80 women and nine men) with an average age of 70.1 years \pm 11.5 (32 to 90 years). Indications for arthroplasty were gonarthrosis in 63 knees (62.4%), rheumatoid arthritis in 14 knees (15.1%), post-traumatic arthrosis in 12 knees (13%), lateral condyle necrosis in two cases (2.1%), one haemophilic arthropathy and one sequella of septic arthritis. Body mass index (BMI) was, on average, 28 \pm 5 (17 to 41), and 27 patients were significantly overweight with BMI greater than 30.

In the 93 knees, 22 already had at least one intervention (12 knees with one intervention, nine knees with two interventions, and another one which underwent three interventions). The preliminary interventions consisted of eight internal fixations, seven osteotomies (four tibial valgus and three femoral varus osteotomies), 10 hardware removal, two debridement arthroscopies for arthrosis, two sections of the lateral patellar retinaculum, one transfer of the anterior

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