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Influence of collateral ligament laxity on patient satisfaction after total knee arthroplasty: a comparative bilateral study

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Abstract *Introduction:* Correct ligamentous balancing is an important determinant of the clinical outcome in total knee arthroplasty (TKA). Many surgeons prefer a tight rather than a lax knee during implantation of a TKA. The hypothesis in this study was that patients with a slightly laxer knee joint might perform better than patients with a tight knee joint after implantation of a TKA. *Patients and methods:* Twenty-two patients with bilateral knee arthroplasties were clinically and radiologically evaluated at a mean follow-up of 4.5 years, ranging from 2 to 7 years. There were 12 women and 10 men with an average age of 68.9 years (range 32–82 years) at the time of surgery. A modified HSS score (excluding laxity), varus and valgus stress X-rays in 30° of knee flexion, and the subjective outcome of both knees were compared. A knee was considered tight when it opened less than 4° and lax if it opened 4° or more on stress X-ray. *Results:* There was a trend towards improved range of motion and HSS score for the laxer knee joints. However, the difference did not achieve statistical significance. Eleven of the 22 patients considered one side subjectively better than the other side. In 10 out of these 11 TKA, the slacker knee joint was the preferred side ($p < 0.05$). *Conclusions:* As the present study compared bilateral knee joints after TKA, the same patient could act as a control group, and subtle subjective differences were revealed which are not quantifiable. The results showed that patients with a preferred side felt significantly more comfortable on the laxer side, indicating that during intraoperative ligamentous tensioning, some varus and valgus laxity at 20–30° of flexion might be preferable to an over-tight knee joint. Further biomechanical and

prospective investigations will be necessary to establish the correct soft-tissue tensioning.

Keywords Collateral ligament laxity · Total knee arthroplasty

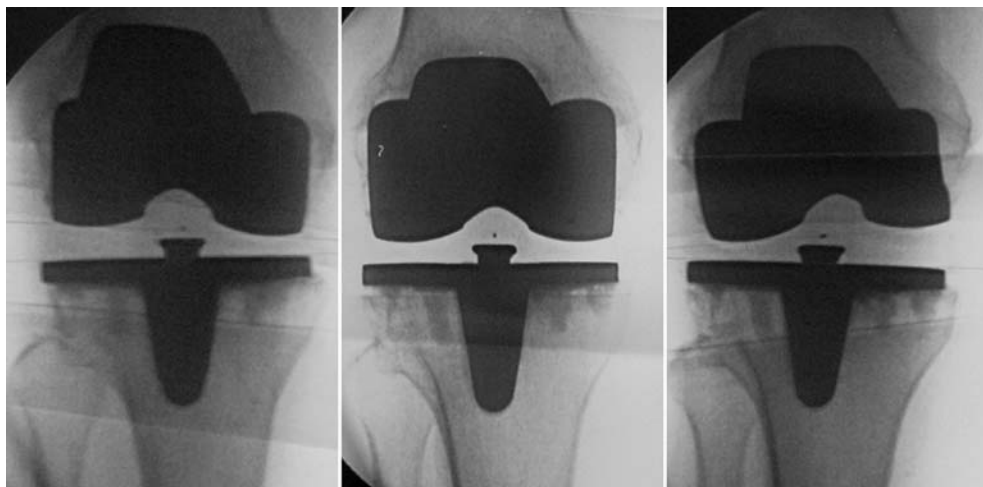
Introduction

Correct ligamentous balancing is an important determinant of the clinical outcome in total knee arthroplasty (TKA). In order to obtain a well-balanced knee, it is believed that good varus and valgus alignment and equal flexion and extension gaps must be achieved [4]. The question arises as to whether the final prosthesis should be tight or slightly lax. Several studies have reported instability as a major cause for revision surgery [1, 3, 6, 10], including spin out of mobile bearing inlays [8]. Also, most clinical rating systems regard increased mediolateral or anteroposterior laxity as a negative point [5]. Hence, most surgeons prefer a tight fit intra-operatively in order to prevent disabling instability or spin out. Other authors, however, have reported a better postoperative range of motion (ROM) with less pain in a loosely balanced knee prosthesis [2, 7, 9], while others did not find any difference in the functional outcome between lax and tight knee joints [11]. A reason for this controversy might be that differences between a lax and tight knee are subtle and not quantifiable with current parameters such as walking distance, range of motion or common knee scores. Indeed, we noticed in our regular follow-up clinics that patients with bilateral TKA often preferred the laxer side. To the best of our knowledge, no study exists comparing bilateral total knee arthroplasties for ligamentous laxity and patient satisfaction. As the same patient acts as the control group, subtle differences might be revealed in such a review. Hence, it was the purpose of the present study to compare patient satisfaction and ligamentous laxity after bilateral total knee replacement.

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Fig. 1 Varus and valgus stress X-rays for one patient taken at 30° of knee flexion



Patients and methods

Twenty-two patients with bilateral primary TKAs were selected. Thirty-seven TKAs were mobile bearing prostheses (LCS, DePuy) and seven fixed bearing prostheses (Natural Knee, Centerpulse). The functional outcome and patient satisfaction were independent of the design. In 13 patients the TKAs were implanted simultaneously. Clinical evaluation showed that the patients were satisfied with the result, were able to walk without aids, and did not have instability. There were 12 women and 10 men with an average age of 68.9 years (range 32–82 years) at the time of surgery. The mean follow-up at the time of examination was 4.5 years (range 2–7 years). A modified HSS (excluding laxity), range of motion (ROM), and the subjective outcome were obtained for each patient before stress X-rays to exclude bias. Standing X-rays in anteroposterior and lateral directions, skyline views as well as varus and valgus stress X-rays at 30° of knee flexion were taken. For the stress X-rays the knee joint was aligned under an image intensifier at 30° of knee flexion in such a way that the tibial plateau was seen as a single line (Fig. 1). The leg was then stressed by hand in varus and valgus while the position of the tibial plateau was maintained. The accuracy and repeatability of these stress X-rays were checked by a second examiner for 4 patients (8 knee joints, 16 measurements), and the results were within 1°. We considered a stress X-ray at 20–30° of knee flexion more appropriate to test the laxity of the collateral ligaments as the posterior structures of the knee joint become important secondary joint stabilisers in full extension. A knee was considered tight when it opened less than 4° and lax if it opened 4° or more on stress X-ray. Informed consent was obtained from each patient before participating in the study.

The statistical evaluation was done with the paired Student's *t*-test and the χ^2 -test. A *p*-value of 0.05 or less was considered to be statistically significant.

Results

The laxity in varus or valgus ranged from 1° to 10° with an average of 4.3±1.9° in varus and 4.0±2.1° in valgus. Sixteen joints were tight (<4 deg) for valgus stress and 23 for varus stress. If the sum of varus and valgus laxity was considered, there were 17 knee joints with a laxity of less than 8° and 27 with a laxity of 8° or more. There was a strong tendency for the lax joints in varus and sum of varus and valgus stress to show increased flexion (*p*=0.06; 108° vs 113° of flexion) and improved modified HSS (*p*=0.06; 78 vs 82). There was no difference with regard to

Table 1 Amount of laxity in patients with a preferred side

Patient no.	Sum of varus-valgus laxity, right side (deg)	Sum of varus-valgus laxity, left side (deg)	Preferred side
1	4	6	Left
2	13	14	Left
3	11	12	Left
4	6	13	Left
5	4	8	Left
6	7	11	Left
7	7	8	Left
8	8	8	Right
9	14	10	Right
10	8	4	Right
11	7	11	Right

extension (one patient had an extension deficit in the lax group and three patients in the tight group).

The subjective results showed that 11 patients did not have a preferred side, while 11 patients did have one (the left side in 7 cases and right side in 4 cases). Six patients out of the group with a favoured side had a tight and a lax knee joint. Five out of the 6 favoured the lax knee. The patient who preferred the tighter side had undergone previous surgery on the medial collateral ligament. But even in the knee joints that were bilaterally lax or tight, it was the laxer knee that was preferred. Hence, only one patient preferred the tighter side, and 10 out of 11 patients preferred the laxer side (Table 1). This difference was significant (*p*<0.05).

Discussion

The present study is to our knowledge the first to compare varus-valgus laxity and functional outcome in bilateral knee joints after TKA. This allows the same patient to act as a control group, thus revealing subtle subjective differences that are not quantifiable. Indeed, all but one patient who had a preferred side did favour the laxer knee joint. Furthermore, the only patient who preferred the tighter side

had undergone surgery on the medial collateral ligament prior to the TKA and was complaining about pain on the medial side where a stapler was inserted. Most patients could not tell why they favoured this side but stated that the knee joint did feel more natural. This finding is supported by the study of Edwards et al. [2] who assessed 47 patients with 63 TKAs after 12–84 months. The varus-valgus laxity was obtained clinically at 20° of knee flexion. In all, 75% of the knees with some laxity had an excellent result on the HSS score, while only 38.5% of the tight knees were graded as excellent. This strongly suggests that increased patient satisfaction can be obtained by implanting a prosthesis with a slight laxity. However, laxity did not seem to influence the range of motion much. Although a strong trend was seen towards an improved function of the laxer knee joint in this study and Edward et al.'s study, this difference did not achieve statistical significance. Also, Yamakado et al. [11] found no correlation between laxity and range of motion. It seems likely that knee flexion can be improved to a certain extent by increased laxity, but this seems to depend more on other factors such as the tightness of the posterior capsule and the PCL in flexion and on the preoperative range of motion.

We would like to stress the fact that the present results do not support a badly balanced knee joint. It is important to bear in mind that too much laxity is a well established complication after TKA [1, 3, 6, 10] that can lead to pain, effusion, increased wear and early failure and must be avoided under all circumstances.

There are some shortcomings of the present study which must be mentioned. First, it is not prospective, and the amount of laxity at surgery is not known. It is impossible to determine whether the ligaments did stretch out over time or not. Hence, the ideal intraoperative tension cannot be obtained from the present data. Second, the measurement of laxity at 30° of knee flexion represents mainly the status of the collateral ligaments near extension and does not describe ligamentous stability over the whole range of knee flexion. Also, the laxity in the sagittal plane was not assessed, which might play an important role. There are studies [7, 9] suggesting that also in this plane an increased laxity between 6 and 11 mm improves the functional outcome.

The present study suggests that a varus and valgus laxity between 4° and 8° on either side in 20° of knee flexion will improve patient satisfaction and to some degree ROM without deleterious short to mid-term effects. However, a longer follow-up period is necessary to rule out negative long-term effects such as increased wear. Also, further research is necessary to establish the optimal degree of intraoperative laxity in the mediolateral and anteroposterior directions. This seems particularly important in the light of computer navigated surgery, and further guidelines must be established in biomechanical and prospective clinical investigations.

References

1. Besson A, Brazier J, Chantelot C, Migaud H, Gougeon F, Duquenois A (1999) Laxity and functional results of Miller-Galante total knee prosthesis with posterior cruciate ligament sparing after a 6-year follow-up (in French). *Rev Chir Orthop* 85:797–802
2. Edwards E, Miller J, Chan K (1988) The effect of postoperative collateral ligament laxity in total knee arthroplasty. *Clin Orthop* 236:44–51
3. Fehring T, Valadie A (1994) Knee instability after total knee arthroplasty. *Clin Orthop* 299:157–162
4. Insall J (1988) Presidential address to The Knee Society. Choices and compromises in total knee arthroplasty. *Clin Orthop* 226:43–48
5. Insall J, Dorr L, Scott R, Scott W (1989) Rationale of the Knee Society clinical rating system. *Clin Orthop* 248:13–14
6. Pagnano M, Hanssen A, Lewallen D, Stuart M (1998) Flexion instability after primary posterior cruciate retaining total knee arthroplasty. *Clin Orthop* 356:39–46
7. Pellengahr C, Jansson V, Durr H, Refior H (1999) Significance of sagittal stability in knee prosthesis implantation—an analysis of 76 cases with unconstrained joint surface replacement (in German). *Z Orthop* 137:330–333
8. Sanchez-Sotelo J, Ordonez J, Prats S (1999) Results and complications of the low contact stress knee prosthesis. *J Arthroplasty* 14:815–821
9. Warren P, Olanlokun T, Cobb A, Walker P, Iverson B (1994) Laxity and function in knee replacements. A comparative study of three prosthetic designs. *Clin Orthop* 305:200–208
10. Waslewski G, Marson B, Benjamin J (1998) Early, incapacitating instability of posterior cruciate ligament-retaining total knee arthroplasty. *J Arthroplasty* 13:763–767
11. Yamakado K, Kitaoka K, Yamada H, Hashiba K, Nakamura R, Tomita K (2003) Influence of stability on range of motion after cruciate-retaining TKA. *Arch Orthop Trauma Surg* 123:1–4