Simultaneous bilateral total knee arthroplasty. A multicenter feasibility study


**Summary**

*Introduction*: The value and risk of simultaneous total knee arthroplasty (TKA) in patients with bilateral knee arthritis is a subject of debate.

*Hypotheses*: The risk of complications following simultaneous bilateral TKA will be increased compared to the rates published in the literature for unilateral TKA, and the clinical and functional outcomes will be poorer in this particular group.

*Materials and methods*: One hundred and twenty-three patients who underwent simultaneous bilateral TKA between 2005 and 2011 in five specialized, high volume centers were evaluated. The files were analyzed retrospectively after a median 33 months of follow-up.

*Results*: The mean hospital stay was 11 days. Mean blood loss was 4.1 g/dL. A postoperative transfusion was performed in 68 patients (55%), with a mean 3.1 units of blood. The mean global IKS score increased from 90 to 150 points. Eighty patients would agree to undergo simultaneous bilateral TKA again (65%), and 70 would recommend this procedure to others (57%).

*Discussion*: The hypothesis was not confirmed: the risk of complications was not increased compared to the generally accepted risk of a unilateral procedure. The risk of complications in this study was very similar to that published in the literature for the same therapeutic strategy. Therefore, there is no solid medical evidence to prevent recommending this strategy.
Introduction

Total knee arthroscopy (TKA) has become a routine procedure. Because osteoarthritis of the knee is often bilateral, both knees are often affected in patients, which supports an indication for bilateral arthroplasty in two procedures staged close together [1]. The interest and risk of performing both arthroplasties simultaneously is still a subject of debate [2]. The theoretical advantages of this treatment strategy include faster, and perhaps less costly patient management [3]. However, opponents of this strategy claim that there is a greater risk of complications because of the increased difficulty and duration of the simultaneous surgical procedure [4]. The frequency of simultaneous bilateral TKA varies in the literature but is always low, between 2 and 7% of all TKA [4–7]. To our knowledge except for one recent study [8], no large studies have been published in France on the subject of TKA, and therefore we felt that it would be interesting to evaluate the feasibility and real risks of this strategy in France. Our hypotheses were therefore the following: the risk of complications following simultaneous bilateral TKA in France would be higher than the risk found in published studies for unilateral TKA, and the clinical and functional results of simultaneous bilateral TKA would be poorer than those published in the literature for unilateral TKA.

Materials and methods

In this retrospective series patients who underwent sequential bilateral total knee arthroscopy in one surgical procedure between 2005 and 2011 in high specialized, high volume centers (CHU Caen, CHU Grenoble, Clinique des Cèdres—Grenoble, CHU Nice, CHU Strasbourg) were evaluated. Patient files were analyzed retrospectively and independently in each center according to a standardized protocol. The series included 43 men and 80 women, mean age 70 ± 10 years old (20–88). The mean initial global International Knee Society (IKS) score [9] was 90 ± 30 points (21–139 points). The American Society of Anesthesiologists (ASA) [10] score was ASA one in 24 cases (19%), ASA two in 81 cases (66%), and ASA three in 18 cases (15%).

Total surgical time, tourniquet time, length of hospital stay, and the development of complications were recorded. Blood loss was evaluated by determining the difference between preoperative and immediate postoperative hemoglobinemia (3 days ± 1 day after surgery) including postoperative transfusions; these results were compared to the Gross formula to calculate allowable blood loss [11]. At the final follow-up, the time since surgery and the clinical and functional IKS scores were noted (in the same manner as above). Patient satisfaction was evaluated with the following questions: "would you have this operation again?" and "would you recommend this operation to others?"

All data were collected on Excel software (Microsoft, Seattle, USA). Measurements were expressed as means and standard deviations for continuous variables and percentages for categorical variables.

Results

The surgical procedure lasted a mean 153 ± 45 minutes (70–230 minutes). Mean tourniquet time was 127 ± 41 minutes (70–230 minutes), including 29 ± 18 minutes with a tourniquet on both legs simultaneously (0–100 minutes). The mean hospital stay was 11.4 ± 4 days (5–35). Mean hemoglobinemia was 13.9 ± 1.2 g/dL (10.0–16.7 g/dL) before surgery and 9.7 ± 1.3 g/dL afterwards (6.6–13.2 g/dL). Mean blood loss was 4.1 ± 1.5 g/dL (0–3.9 g/dL). There were no preoperative transfusions. Sixty-eight patients (55%) received a postoperative transfusion, which was autologous in 25 cases, homologous in 27 cases, and mixed in 16 cases, with a mean 3.1 ± 1.8 units. Thirty patients (24%) developed early complications, and 19 patients (15%) developed late complications (Table 1). There were no deaths. A significant thromboembolic event occurred in 13 patients (10%) and one postoperative infection was diagnosed in two patients (1.6%). The risk of complications was not correlated to the preoperative ASA score.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Complications.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases (n)</td>
</tr>
<tr>
<td><strong>Early complications (30 cases — 24%)</strong></td>
<td></td>
</tr>
<tr>
<td>Cardiac</td>
<td>2</td>
</tr>
<tr>
<td>Deep venous thrombosis</td>
<td>10</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>3</td>
</tr>
<tr>
<td>Hematoma</td>
<td>2</td>
</tr>
<tr>
<td>Confusion syndrome</td>
<td>10</td>
</tr>
<tr>
<td>Incision site incident</td>
<td>2</td>
</tr>
<tr>
<td>Pneumopathy</td>
<td>1</td>
</tr>
<tr>
<td>Hypercapnic coma</td>
<td>1</td>
</tr>
<tr>
<td>Tibial fracture</td>
<td>1</td>
</tr>
<tr>
<td>Occlusion syndrome</td>
<td>1</td>
</tr>
<tr>
<td>Perforated colon</td>
<td>1</td>
</tr>
<tr>
<td><strong>Late complications (19 cases — 15%)</strong></td>
<td></td>
</tr>
<tr>
<td>Flessum</td>
<td>4</td>
</tr>
<tr>
<td>Knee stiffness</td>
<td>8</td>
</tr>
<tr>
<td>Instability</td>
<td>2</td>
</tr>
<tr>
<td>Infection</td>
<td>2</td>
</tr>
<tr>
<td>Tibial loosening</td>
<td>1</td>
</tr>
</tbody>
</table>
The 123 patients were evaluated after a mean follow-up of 33 months ± 19 (3–72 months). The mean global IKS score in the 117 patients who were evaluated after at least 6 months of follow-up was 152 ± 42 points (54–200 points). Eighty patients would accept to undergo the simultaneous bilateral procedure again (65%), and 70 would recommend it to others (57%).

Discussion

Although the rate of complications reported in the literature following unilateral TKA varies depending on the population studied and patient comorbidities, it is reasonable to say that the risk of early mortality is less than 1% [12–14], the risk of developing a significant thromboembolic event is between 0.5 and 10% [13,15,16], and the risk of early infection is 0.5–1.5% [17–19]. The first hypothesis of this study was not validated: the risk of severe complications did not appear to increase compared to the generally observed risk after a unilateral procedure.

The clinical and functional results observed after unilateral TKA have been extensively reported in the literature. The most recent meta-analyses have shown that there is a mean improvement in the global IKS score of 60–65 points for a maximum of 200 points [20], with mean scores of between 140 and 160 points [21–24]. Our second hypothesis was not validated: the clinical and functional results with simultaneous bilateral TKA were not poorer than recently published results for unilateral TKA.

Should we continue with this strategy, or even promote it?

There are very few studies on simultaneous bilateral TKA. In addition, the quality of the methodology in these studies often makes it impossible to draw firm conclusions. Thus, simple retrospective studies such as the present study still have their place, even if the level of evidence is not normally considered to be high.

It is interesting to note that numerous studies in the literature have indirectly treated the subject of simultaneous bilateral TKA. These studies compared two different implants or two different surgical techniques with the patient as his/her own control... [25–27]. The rate of complications was acceptable, even if this was not the main goal.

Cohort studies on the clinical results of simultaneous bilateral TKA are often significantly biased: the control group often includes patients who have undergone unilateral TKA. Moreover, the condition of the opposite knee is necessarily not defined and may be asymptomatic, thus in better condition than the knee that undergoes TKA. Nevertheless, despite this frequent bias, which is impossible to compensate for in a retrospective study, no obvious disadvantages have been identified for simultaneous bilateral TKA. The study by Shetty et al. [28] showed that the outcome of postoperative rehabilitation following bilateral TKA was identical and published clinical results were very similar to those observed after unilateral TKA [29,30].

Cohort studies evaluating the risk of complications usually have the same bias as above. A valid comparison would mean that the risk of complications in the control group would have to be doubled [4]. Despite the difficulty of analyzing results, most studies do not mention an increase in this risk following simultaneous bilateral TKA [29,31,32]. Age over 70 was not shown to negatively influence the risk of developing complications in the study by Severson et al. [33]. Other authors have observed an increase in the risk of certain complications following simultaneous TKA: deep venous thrombosis [34], hypoxia and episodes of confusion [35] and the risk of transfusion [36,37]. However, all these authors agree that although the risk was increased, the rate was still acceptable, and they do not question simultaneous bilateral TKA as a valid therapeutic strategy.

Nevertheless, two studies advise against simultaneous bilateral TKA. Luscombe et al. [38] observed a significant increase in the risk of incision site incidents and infections (6% vs. 1%), cardiac complications (3% vs. 1%) and pulmonary infections (7% vs. 2%). However, they did not find any difference in the risk of mortality or thromboembolic events. Memtsoudis et al. [39] reported a moderate increase in the overall risk of complications (9% vs. 7%), but especially in the mortality rate (0.3% vs. 0.14%), even if this rate remains very marginal. It should be remembered that these two studies compared simultaneous bilateral TKA to unilateral TKA. Thus the risk of complications in the control group must be doubled to obtain a valid comparison.

Although certain biases such as a “center” effect or the management of complications in a center different from that of the original surgical procedure can theoretically be avoided with registry studies, this does not solve the problem of the comparison to unilateral TKA. Three registry studies have been published, all in support of simultaneous bilateral TKA. Barrett et al. [5] analyzed more than 122,000 cases of TKA including more than 96,000 unilateral procedures, more than 8000 simultaneous bilateral procedures and nearly 18,000 sequential procedures separated by several months to 2 years. There was only a slight increase in the risk of thromboembolic events, (1.44% for simultaneous procedures compared to 0.81% for unilateral procedures) with a relative risk of 1.81. If the outcome of treatment after both arthroplasties is included, the results suggest that the risk is not increased. Walsmley et al. [6] analyzed more than 19,000 unilateral TKA and 826 bilateral sequential or simultaneous TKA and did not find any difference in the mortality rate.

Very few studies have posed the more pertinent question of comparing simultaneous bilateral TKA to sequential bilateral TKA. Meehan et al. [40] analyzed more than 11,000 simultaneous TKA and nearly 24,000 sequential TKA. They observed a marked reduction in the risk of infection and poor functional results with simultaneous procedures associated with a moderate increase in the risk of cardiovascular complications. They therefore recommend that the simultaneous procedure be systematically offered to patients who do not have any specific cardiovascular risks. Stefanssdottir et al. [4] compared more than 1000 simultaneous bilateral TKA to more than 3000 sequential bilateral TKA and more than 49,000 unilateral TKA. These authors identified an increase in the risk of mortality following simultaneous bilateral TKA with a relative risk of four compared to unilateral TKA and seven compared to sequential bilateral TKA. However, the absolute risk remained low, less than 1% in all cases. Yoon et al. [41] observed an increase in general complications (5% after simultaneous bilateral TKA vs. 0.8%...
after unilateral TKA), mainly in patients over 70 with an ASA grade of 3 or 4. They recommend that care be taken in elderly patients with a high anesthesia risk.

Even meta-analyses are not especially helpful. Only one meta-analysis has been published, comparing simultaneous bilateral TKA to unilateral TKA with the same bias as described in other studies [42]. This study included more than 16,000 cases of simultaneous bilateral TKA and nearly 11,000 cases of unilateral TKA. Results show an increase in the risk of pulmonary embolism (relative risk 1.8), cardiac complications (relative risk 2.5) and mortality (relative risk 2.2), but paradoxically a slight reduction in the risk of thrombosis (relative risk 0.99). This study recommends taking care in high-risk patients—a recommendation that no one can disagree with.

Finally, the most recent study in the literature by Noble et al. [2] concluded that for the moment there is no valid argument against bilateral implants. Although it is impossible to draw clear unbiased conclusions based on published results, the many studies on simultaneous bilateral procedures reported in the literature support the use of this strategy. The financial cost-clinical benefit ratio of the simultaneous bilateral TKA strategy must still be evaluated in national French studies. Intuitively this strategy, which only requires one hospital stay, should be less expensive for the healthcare system than sequential management, although surgeon’s fees and hospital reimbursement is generally less for one bilateral TKR than for two unilateral TKRs [3]. Even though there is no medical evidence to prevent recommending this strategy to orthopedic surgeons with experience in TKA and with an experienced anesthesiology team, it is perhaps reasonable to limit the use of this approach to specialized, high volume centers where the overall risk of serious complications is probably reduced.

This study has certain weaknesses. It is a retrospective study, with all the limitations associated with this model. The indications for bilateral or unilateral TKA were certainly not applied in the same manner in the different centers and even in each center. Complications were also recorded differently in the different centers. Therefore the results can only be considered a non-validated sample, which cannot be considered representative or be generalized.

Nevertheless, there are also strong points to this study that should not be underestimated. An evaluation of practices, which was performed at the same time as this study, showed that the participating centers are probably representative of a large majority of French orthopedic surgeons who regularly perform simultaneous bilateral TKA, and the group that was studied could therefore be truly representative of national practices. There were a large number of patients included in the study, which could compensate somewhat for any selection or analytical bias. No difference was found among the centers, so that a center effect is improbable. Finally, the results are similar to those in the international literature, suggesting that there was no major bias in this study.

Conclusion

The results of the present study therefore support those in the literature. Even if the level of evidence is low, the clinical results of simultaneous bilateral TKA in this study were not poorer than those with unilateral or sequential procedures. The risk of severe complications was not increased. There is no solid medical evidence to prevent recommending this strategy for selected indications.

Disclosure of interests

None of the authors in this study has any conflict of interest in relation to this article. J.-Y.J receives royalties and be a consultant for B.-Braun Aesculap. C.T. receives royalties from Torrieri and certain expenses are paid by Torrieri and Smith & Nephew. J.-Louis P. receives royalties from Lepine. C.V. has certain expenses paid by Mathys and is a member of the board of Bayer. D.S. receives royalties from B.-Braun Aesculap.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.otsr.2012.12.015.

References

Simultaneous bilateral total knee arthroplasty


