

Simultaneous or Staged?

A Comparison of Bilateral Uncemented Total Knee Arthroplasty.

JRM Hutchinson, MBBS, FRCS (Orth & Tr)

Research Fellow

EN Parish, MHSc

Research Assistant

MJ Cross, OAM, MBBS, MD, FRACS

Consultant Orthopaedics Surgeon

Australian Institute of Musculoskeletal Research, Sydney, Australia

Address for correspondence:

Dr Mervyn Cross

286 Pacific Highway

Crows Nest, 2065 Australia

Phone: +61 2 9437 5999

Fax: +61 2 9906 1060

Email: mervcros@ozemail.com

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Abstract

We analysed the results of both simultaneous and staged total knee replacements (TKR) and compared them to unilateral TKR. The bilateral procedures have significantly higher rates of complications than unilateral cases, almost entirely due to thrombo-embolic problems. This does not however correspond to an increase in mortality rate. If a bilateral procedure is indicated then a simultaneous procedure has no increased risk over a staged procedure. There is no increase in cardiovascular complications, DVT rate, PE rate or mortality. The infection rate is lower with a bilateral procedure and the overall revision rate is less than one percent in all groups. The prosthesis functions as well in both bilateral and unilateral procedures in the medium and long-term periods. There is good evidence to support the position that simultaneous procedures are more cost efficient than a staged bilateral procedure. We feel that simultaneous TKR is a safe, successful and cost-effective procedure for the treatment of bilateral knee arthritis

Introduction

Total knee arthroplasty has proved to be a consistently reliable treatment for knee arthrosis. Its indications and use are now beyond question. However in patients with bilateral knee arthrosis the timing of surgery has stimulated considerable debate. There is strong support for simultaneous bilateral procedures performed under one anaesthetic[1-3]. This approach has been reported as showing similar results as staged procedures with greater patient satisfaction and decreased costs[4].

Critics of simultaneous procedures point to increased perioperative complications, in particular cardio-vascular complications, due to the increase surgical insult[5, 6]. In addition the thrombo-embolic complications of DVT and PE have been reported as being more frequent.

Uncemented knee replacement has the advantage of a shorter tourniquet time without the potential embolic complications due to cement pressurization. However there is increased bleeding from the uncemented bone surfaces and this may increase the stress on the patients cardiovascular system thereby leading to an increase in arrhythmias or MI's.

This study aims to analyse the results of simultaneous and staged bilateral uncemented Total Knee Replacements and compare them with the results of unilateral cases to assess the safety and efficacy of each approach.

Materials and Methods

Between the periods of 1992 and 2003 all TKR's performed by the senior author were prospectively recorded. According to the type of surgery performed, patients were divided into one of three groups; simultaneous bilateral (SIM), staged bilateral (STA) and unilateral (UNI). Staged bilateral patients were allocated to the UNI group until completion of the second operation when they became part of the STA group. The

decision to undertake either a simultaneous or staged bilateral operation was made dependent on disease severity in each joint.

All perioperative complications were recorded prospectively, as were preoperative and postoperative knee scores (Knee Society Clinical Rating Score[7]) at 3 and 6 months, and 1, 2, 5, and 10 years thereafter. All patients undergo a post-op Doppler ultrasound scan prior to discharge to assess deep vein thrombosis.

The prosthesis used was the Active TKR system (ASDM, Sydney, Australia). This is a modular knee prosthesis that is cementless, hydroxyapatite coated, PCL retaining and stemless in design. The femoral component is cobalt chrome (CoCrMo) with the beads recessed into the proximal end of the prosthesis. The tibial component is titanium alloy (Ti6Al4V) using 4 cortical and cancellous bone screws to achieve a secure fixation and a beaded distal surface. A hydroxyapatite coating on the beaded surface ensures secure long-term fixation. A fixed bearing polyethylene insert was used in all cases with a cemented polyethylene patella component used when required. A standard surgical procedure was followed in all cases. Tourniquet was used in all cases except where there was a vascular contra-indication. A drainage system was used in all cases (Bellovac, Astra Tech, Molndal, Sweden)

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS, version 10.0, Chicago, Illinois). For the purpose of the analysis the data was assumed to be nonparametric. The data was analysed comparing the 3 groups (SIM, STA

and UNI) and also comparing the 2 bilateral groups (SIM and STA). An analysis of variance (ANOVA) was used in the groups with interval data (age, knee score and range of movement). A χ^2 test was used for categorical data. This significance was assumed if $p < 0.05$.

Results

Patient demographics can be found in Table 1. There were 1304 patients in total (1867 knees) included in the study. The majority of patients were female in the STA and UNI groups and males in the SIM group ($p < 0.01$). Average patient age varied from 65 years (STA) to 68 years (UNI) which was significantly different between the 3 groups ($p < 0.05$). The primary diagnosis was OA in each of the groups ($p = 0.907$). Average tourniquet time was 43 minutes.

The mean patient follow up was similar in the SIM and UNI groups (76 and 75 months respectively) and varied slightly in the STA group (90 months for the first knee and 57 months for the second knee). The total range of follow-up for the three groups was a minimum 13 months post surgery to 148 months. The mean time between first and second surgeries for the STA group was 34 months (range 2-120 months) with 8 of the 125 patients (6.4 percent) having their second procedure within 6 months.

Complication data was recorded and is presented in Tables 2-4. Total postoperative complications were significantly higher ($p < 0.001$) in both SIM and STA groups when

compared to the UNI group. However, when the two bilateral groups were compared for total complications there was no difference ($p=0.611$). There were 77 (17.6%) and 21 (15.2%) cases of thrombi in the SIM and STA groups respectively compared to 82 (11.1%) cases in the UNI group ($p<0.01$). Pulmonary emboli were also higher in the bilateral groups compared to the unilateral group ($p=0.078$). Again, there was no difference in PE rates between the two bilateral groups ($p=0.902$). Cardiac complications showed a comparable incidence between the 3 groups ($p=0.467$).

The rate of deep infection was also similar when the 3 groups were compared ($p=0.428$) but revealed an increased trend towards the STA group when the 2 bilateral groups were compared ($p=0.186$). There have been 13 cases of revision (6 SIM, 1 STA, and 6 UNI, $p=0.838$) and 2 cases of perioperative death (1 in both the bilateral groups) both due to MI ($p=0.095$).

Preoperative and postoperative scores and range of movement is presented in Table 5. There was a significant improvement between the pre-operation values and the scores at 1 year ($p<0.001$). The average score values between the 3 groups revealed varying levels of significance between the groups. Mean scores ranged from 93 to 98 preoperatively and increased to a range of 181 to 186 at 5-years.

Discussion

The suitability of total knee replacement as a simultaneous procedure has been debated for many years. Good results have been available in the literature for some time [2, 3]. Some centres have published high rates of simultaneous procedures [1] whilst others have questioned the indications for simultaneous operations [8, 9]. In our centre all patients with symptoms severe enough to warrant arthroplasty are offered simultaneous procedures. This has resulted in 33 percent of our patients undergoing simultaneous TKR. Some patients who had a single TKR that did not warrant a bilateral procedure at the time of primary surgery went on to develop worsening symptoms in the un-operated knee at a later date.

As all patients were followed up for a range of 13-148 months, if a patient with a unilateral TKR were to develop worsening symptoms then a staged bilateral procedure would have occurred. Because of the adequacy of the follow-up on all patients, few were lost. Subsequently it was rare for a patient to decline a second operation. Co-morbidity was almost never used as a deciding factor in the decision to stage the procedure. In patients where a concern was present a physician was asked to assess the patients suitability for surgery. In our series fewer than 10 percent of patients required a staged TKR, again indicating the suitability of the selection criteria at the initial operation. In all 43 percent of our patient series required bilateral procedures.

An increased complication rate from simultaneous procedures has been a potential concern [6, 10]. There have been several studies showing acceptable complication rates in cemented TKR but none using an uncemented prosthesis [1, 5]. It has been shown the

there is increased blood loss with bilateral TKR [11]. While there is an increased blood loss with an uncemented TKR, there has been shown to be no increase in transfusion requirements if a low suction re-transfusion drain is used [12]. There was concern that this may have an effect on post-op complications.

After analysis of our results there was no difference between the groups regarding cardiovascular complications. There was a higher asymptomatic DVT rate in the bilateral groups versus the unilateral group but no difference between the simultaneous or staged groups. This is a consistent finding in published series [1, 10, 13]. This was also seen with the PE rate with no difference between the bilateral groups. There was no difference in peri-operative mortality between the groups. There was no difference in the mortality rates during the follow-up period.

There appears to be no difference in complication rates between a simultaneous and a staged bilateral TKR but both strategies have a significantly higher overall complication rate than a unilateral.

There was a significantly lower infection rate in the bilateral groups when compared to the unilateral group. There were two revisions for infection in the bilateral groups and three in the unilateral (overall incidence of revision for infection 0.38 percent). There was no difference between the groups when looking at the overall revision rate. A bilateral procedure does not have a detrimental effect on the survival of an implant. This is consistent with the findings of Ritter et al in a study of 6200 TKR's [1].

Patient satisfaction following the bilateral procedure was high. All groups had a significant improvement in scores. At one year the Knee Society Scores was significantly higher in the bilateral groups. This finding has been reported in other studies with significantly better WOMAC and SF-36 scores up to one year post-op [4]. This difference was not seen at five and ten years but the overall improvement of all groups was maintained. The range of movement of the prosthesis is unaffected by the implantation strategy. Our average post-op range of movement in the whole cohort is 115 degrees at five years.

There are potential economic and logistical benefits in having a simultaneous rather than a staged procedure [4]. Only one anaesthetic is required and hence a reduced operating time. Length of hospital stay has been consistently shown to be the same for uni and bilateral procedures. Physiotherapy and discharge co-ordination are required only once. It has been shown in the Australian health care system that the out of pocket expenses for the patient are lower than compared with a staged procedure. The cost savings has been questioned however when rehabilitation costs are taken into account [14]. The exact savings in time and money remain debated.

We have found that a bilateral procedure has a significantly higher rate of complications than a unilateral case. This increase in complication rate is almost entirely due to thrombo-embolic problems. This does not however correspond to an increase in mortality rate. If a bilateral procedure is indicated then a simultaneous procedure has no increased

risk over a staged procedure. There is no increase in cardiovascular complications, DVT rate, PE rate or mortality. The infection rate is lower with a bilateral procedure and the overall revision rate is less than one percent in all groups. The prosthesis functions as well in both bilateral and unilateral procedures in the medium and long-term periods. The Knee Society Scores are not significantly different. There is good evidence to support the position that simultaneous procedures are more cost efficient.

We have no hesitation in supporting the practise of simultaneous bilateral Total Knee Arthroplasty using an uncemented design and feel it is a safe, successful and cost-effective strategy for the treatment of bilateral knee arthritis.

Table 1. Patient demographics

| | Simultaneous Bilateral | Staged Bilateral | Unilateral | P value (3-way) | P value (2-way) |
|------------------------------------|-----------------------------------|--|-------------------|----------------------------|----------------------------|
| Patients (knees) | 438 (876) | 125 (250) | 741 | - | - |
| Mean Age (years) | 67 | 65 | 68 | <0.05 | 0.288 |
| % Female | 44 | 63 | 53 | <0.001 | <0.001 |
| Deceased | 35 (8%) | 8 (6.4%) | 49 (6.6%) | 0.642 | 0.355 |
| Mean Follow Up (months) | 76 | 1 st knee: 90 2 nd knee: 57 | 75 | - | - |
| Diagnosis OA (%) | 93 | 96 | 95 | 0.907 | 0.797 |
| Previous HTO | 23 (5.3%) | 10 (8%) | 25 (3.4%) | <0.05 | 0.249 |

Table 2. Post TKR Complications

| | Simultaneous Bilateral | Staged Bilateral | Unilateral | P value (3-way) | P value (2-way) |
|-------------------------------------|-----------------------------------|-----------------------------|-------------------|----------------------------|----------------------------|
| Asymptomatic DVT | 77 (17.6) | 21 (15.2) | 82 (11.1) | <0.01 | 0.707 |
| Pulmonary Emboli | 15 (3.4) | 4 (3.2) | 11 (1.5) | 0.078 | 0.902 |
| Death | 1 (0.2) | 1 (0.8) | 0 | 0.095 | 0.343 |
| Cardiac (arrhythmia, MI) | 10 (2.3) | 5 (4.0) | 17 (2.3) | 0.467 | 0.377 |
| Supracondylar Fracture | 7 (1.6) | 1 (0.8) | 11 (1.5) | 0.792 | 0.506 |
| All Complications* | 115 (26.3) | 30 (24.0) | 125 (16.9) | <0.001 | 0.611 |

* All complications include those listed above (excluding fractures) and renal, neurological, confusion, circulatory, gastrointestinal and others.

** All figures in brackets are expressed as percentages

Table 3. Deep infection

| | Simultaneous Bilateral | Staged Bilateral | Unilateral | P value (3-way) | P value (2-way) |
|---------------------------------------|-----------------------------------|-----------------------------|-------------------|----------------------------|----------------------------|
| Deep Infection | 4 (0.5)* | 3 (1.2) | 10 (1.3) | 0.428 | 0.186 |
| <i>- Revision</i> | 1 | 1 | 3 | - | - |
| <i>- Arthroscopic synovectomy</i> | 1 | 1 | 5 | - | - |
| <i>- Open Synovectomy</i> | 1 | 1 | - | - | - |
| <i>- Washout</i> | - | - | 2 | - | - |

* NB: one infection in this group was treated with long-term antibiotics.

** All figures in brackets are expressed as percentages

Table 4. Complications requiring surgery

| | Simultaneous Bilateral | Staged Bilateral | Unilateral | P value (3-way) | P value (2-way) |
|----------------------------------|-----------------------------------|-----------------------------|-------------------|----------------------------|----------------------------|
| Revision | 6 (0.7) | 1 (0.4) | 6 (0.8) | 0.838 | 0.743 |
| Poly revision | 1 (0.1) | 1 (0.4) | 2 (0.1) | 0.572 | 0.343 |
| Patella Replacement | 5 (0.6) | 4 (1.6) | 10 (1.3) | 0.222 | 0.106 |
| Arthrolysis | 6 (0.7) | 1 (0.4) | 7 (0.9) | 0.754 | 0.612 |
| ORIF | 1 (0.1) | 0 | 5 (0.7) | 0.399 | 0.593 |
| MUA | 7 (0.8) | 0 | 5 (0.7) | 0.296 | 0.506 |
| Patella tendon repair | 1 (0.1) | 0 | 1 (0.1) | 0.832 | 0.593 |
| Synovectomy | 4 (0.5) | 2 (0.8) | 11 (1.5) | 0.792 | 0.510 |
| Wound debridement | 0 | 0 | 2 (0.1) | 0.467 | - |

* All figures in brackets are expressed as percentages

Table 5. Patient average Knee Society Scores and range of movement pre- and post-operatively

| | Simultaneous Bilateral | Staged Bilateral | Unilateral | P value (3-way) |
|-----------------------|-----------------------------------|-------------------------|-------------------|----------------------------|
| Pre Op -Score | 96 | 93 | 98 | 0.134 |
| -ROM* | 6-115 | 7-113 | 7-114 | |
| 1 year -Score | 183 | 184 | 179 | 0.005 |
| -ROM* | 1-113 | 1-113 | 2-111 | |
| 5 year -Score | 184 | 186 | 181 | 0.103 |
| -ROM* | 1-115 | 1-116 | 1-114 | |
| 10 year -Score | 175 | 177 | 171 | 0.511 |
| -ROM* | 0-112 | 0-113 | 0-111 | |

* ROM values reported in degrees

** All figures in brackets are expressed as percentages

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