Hydroxyapatite-coated Cementless Total Knee Replacement in Patients older than 75 years of age

B Chan, J Chitnavis, EN Parish, MJ Cross

Abstract
A single surgeon performed 373 total knee replacements (TKR) with a hydroxyapatite-coated cementless prosthesis on 277 patients aged over 75 years from 1992 to 2001. Most patients had osteoarthritis of the knee. The combined Knee Society and functional score improved from 95 to 170 at 5 years. Average postoperative flexion range was 114 degrees at 5 years. The flexion contracture was corrected. Complication rates were low and there was no case of early loosening. This study indicates a favourable result from hydroxyapatite-coated knee replacements in the elderly.

Introduction
Total knee replacement is a safe operation with good success rates even when performed on the elderly (1,2). So far, cemented fixation has represented the gold standard for TKR. Cementless prostheses were designed to provide greater durability. Medium- and long-term (3-5) results from cementless TKR have been satisfactory if patellar component failure is excluded. However, the presence of osteoporotic bone in the elderly has caused concern about the use of cementless designs. In a retrospective study by Bassett (6) comparing cemented and cementless fixation, the average age of patients receiving cementless prostheses were younger than those receiving the cemented design. The choice of fixation was determined by tibial bone density.

The effectiveness of hydroxyapatite (HA) in augmenting TKR fixation has been proven (7,8). The presence of HA encourages bone growth onto the porous coated prostheses (Figure 1). It is suggested that the use of HA-coated implants could overcome the problem of reduced bone stock in elderly patients. This study presents the early results of HA coated TKR in patients over 75 years of age.

Materials and Methods
The senior surgeon performed all operations. The MOTUS knee system posterior cruciate-retaining design was used. Hydroxyapatite coating was present on the distal femoral surface and on the underlying surface of the tibial tray. The tibial tray was fixed to the tibia by 4 screws. Patella replacement was performed in 43% of cases. A 3-peg patellar button design was cemented when the patella was replaced.

Certain points are emphasized by the surgeon in the operation technique. Cortical support of the tibial tray is important. Each tibial tray size has a choice of narrow and wide plates. Four 15mm diameter buttonholes are drilled on the tibial cut surface to receive the four pegs from the undersurface of the tibial tray. Holes were drilled in a reverse manner to impact cancellous bone. Any surface bone defects were filled using autologous bone graft.

Patients were reviewed at 3 months, 6 months, 1 year, 2 years and 5 years post operatively. At each review, evaluation was undertaken using a clinical knee score based
on the Knee Society Score and the Hospital for Special Surgery score. The clinical score and functional score both have a maximum of 100 points and produce a total score of 200 (9).

Results
From 1992 to 2001, 373 total knee replacements were performed on 277 patients aged more than 75 years. 130 patients were male and 147 were female. The average age was 79 years (range 75 - 93yrs). Out of 373 replacements, 8 were revision (Table 1). 180 replacements were performed on the left knee and 193 were on the right. 84 patients had simultaneous bilateral TKR’s and 12 patients had staged knee replacements. 2 patients were lost to the follow up, 1 patient has dementia and 20 have since died. The average time of follow up was 4 years (3 months – 9yrs).

The average knee score has improved from 95 before surgery to 170 at 5 years (Figure 2.). The flexion range has decreased slightly in the initial post-operative period but has gradually returned to the preoperative value of 115 degrees (Figure 3.). The mean flexion contracture improved from 6 degrees pre-operatively to 1 degree postoperatively. A summary of the pre-operative and post-operative knee scores and knee movement range is shown in Table 2.

Complications were comparable with previously published data (Table 3). While there were 13 cases of superficial infection (3.5%), there was only 1 case of deep infection requiring arthroscopic synovectomy (0.3%). No cases required implant removal. Other complications requiring further surgery included 1 case of ankylosis warranting arthrolysis and 2 cases of patella wear requiring patella replacement.

Discussion
Cementless total knee replacement prostheses have been available for many years but the early results were compromised by poor design. At present, concern regarding tibial tray fixation to osteoporotic bone has restricted use of the cementless TKR to older patients. Tibial cortical cover is essential to prevent tray sinkage (10,11). Metal backed patellae associated with titanium femoral components also undermine confidence with uncemented designs (4,12). This study confirms adequate design prevents this problem of fixation.

Radiolucent lines at the bone-prosthesis interface following cementless TKR have diminished with time in the presence of hydroxyapatite coating (7) (Figure 4). We suggest that HA will encourage osseointegration in porotic bone present in the elderly. It was the opinion of the senior author that the HA-coating would allow the use of cementless prosthesis on the more osteoporotic bone of older patients.

Results of this study confirm that the use of a HA-coated cementless TKR produces good results in the group of patients more than 75 years old. Complication rates were comparable to cemented designs. More significantly, there were no cases of loosening despite the presence of osteoporotic bone.
Table 1: Diagnosis of Surgery

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osteoarthritis</td>
<td>341</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>9</td>
</tr>
<tr>
<td>Osteonecrosis</td>
<td>9</td>
</tr>
<tr>
<td>Infection*</td>
<td>3</td>
</tr>
<tr>
<td>Chondrocalcinosis</td>
<td>3</td>
</tr>
<tr>
<td>Loose Prosthesis*</td>
<td>2</td>
</tr>
<tr>
<td>Patella wear*</td>
<td>1</td>
</tr>
<tr>
<td>Ankylosis</td>
<td>1</td>
</tr>
<tr>
<td>Paget’s Disease</td>
<td>1</td>
</tr>
<tr>
<td>Fracture Prosthesis*</td>
<td>1</td>
</tr>
<tr>
<td>Poly Wear*</td>
<td>1</td>
</tr>
<tr>
<td>Trauma</td>
<td>1</td>
</tr>
</tbody>
</table>

*Indications for revision operation

Table 2: Summary of Average Preoperative and Postoperative Results

<table>
<thead>
<tr>
<th></th>
<th>Pre-op</th>
<th>3 months</th>
<th>6 months</th>
<th>1 year</th>
<th>2 years</th>
<th>5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>95</td>
<td>166</td>
<td>176</td>
<td>178</td>
<td>175</td>
<td>170</td>
</tr>
<tr>
<td>Flexion (deg)</td>
<td>115</td>
<td>108</td>
<td>112</td>
<td>113</td>
<td>111</td>
<td>114</td>
</tr>
<tr>
<td>FFD (deg)*</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

*FFD = Fixed Flexion Deformity

Table 3: Summary of Complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>Number of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial infection</td>
<td>13</td>
</tr>
<tr>
<td>Asymptomatic DVT</td>
<td>29</td>
</tr>
<tr>
<td>Symptomatic DVT</td>
<td>4</td>
</tr>
<tr>
<td>Pulmonary Embolism</td>
<td>7</td>
</tr>
<tr>
<td>Atrial Fibrillation</td>
<td>6</td>
</tr>
<tr>
<td>Haemarthrosis</td>
<td>2</td>
</tr>
<tr>
<td>Haematoma</td>
<td>1</td>
</tr>
<tr>
<td>Others (UTI, nausea, bowel obstruction, confusion, pressure sores)</td>
<td>21</td>
</tr>
<tr>
<td>Deep Infection*</td>
<td>1</td>
</tr>
<tr>
<td>Ankylosis*</td>
<td>1</td>
</tr>
<tr>
<td>Patella Wear*</td>
<td>2</td>
</tr>
</tbody>
</table>

*Complications required surgery
Figure 1. Osseointegration of host-bone onto the porous hydroxyapatite coated prosthesis

Figure 2. Clinical knee score values at pre-operatively and follow-up
Figure 3. Clinical Range of movement values at pre-operatively and follow-up

Figure 4. Bone-prosthesis interface views at 2 year.
References