



Hydroxyapatite-coated, cementless total knee replacement in patients aged 75 years and over

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We have carried out a prospective study comparing the results at five years in patients older than 75 years of age undergoing hydroxyapatite-coated, cementless total knee replacement (TKR) with those who were younger. The Knee Society clinical rating scores were recorded before and after operation. Of 559 patients undergoing TKR, 135 were in the elderly age group. The knee scores at five years or more showed comparable results, with patients under 75 years of age reaching a score of 183 and those aged 75 years or over reaching 174. These differences were predominantly due to the functional component of the score. We conclude that elderly patients do just as well as the younger group using this prosthesis.

Total knee replacement (TKR) is an effective procedure even when undertaken in the elderly.¹⁻⁵ In general, survival of uncemented prostheses is comparable with their cemented counterparts at ten years.⁶ Most data available on TKR in the elderly relate to cemented prostheses. The use of uncemented TKR in these patients has been controversial because of concerns regarding the initial fixation of the tibial component, the ability of osteoporotic bone to withstand direct prosthesis-bone load transmission and osseointegration of the prosthesis.⁷ Hydroxyapatite (HA) has been shown to enhance tibial fixation in a number of studies.⁸⁻¹¹ We have compared the outcomes in patients over the age of 75 years with a younger group using an uncemented HA-coated TKR over the same period.

Patients and Methods

All patients undergoing primary TKR, carried out by the senior author (MJC) between August 1992 and October 1997, were reviewed. An HA-coated, posterior cruciate ligament retaining, stemless prosthesis was implanted using a standard technique. We recorded the Knee Society clinical rating scores before and at one and five years after operation. The clinical rating score is divided into knee and function components, each worth a total of 100 points, giving a total score of 200.¹² Independent examiners, either an orthopaedic surgeon completing a fellowship programme or a qualified researcher, conducted the clinical examinations for the study. Weight-bearing anteroposterior, lateral and

skyline patella radiographs were taken routinely at five years and examined by a radiologist to determine evidence of loosening.

The prosthesis used was the uncemented Active (DJ Ortho, Sydney, Australia). The femoral component (CoCrMo) features recessed heat sintered beads on the deep surface. The tibial component (Ti6Al4V) is designed with four press fit lugs on its under surface, through which screws are inserted. The lugs provide initial rotational stability and the screws prevent lift off. The under surface of the tibial component is also recessed and coated with heat sintered beads (pore size 250 to 500 μm). The surfaces of both components are coated with HA. This is applied using a plasma spray technique to a thickness of 70 μm (crystallinity 75%, porosity 20%), which facilitates penetration of osteoblast into the porous beads without blocking the pores.

The senior author (MJC) emphasises certain points regarding the surgical technique, especially in the elderly patient. Cortical support of the tibial tray is essential and the tibial base plate was sized to maximise this. Holes to accept the lugs on the under surface of the tibial tray were drilled in a reverse manner in order to impact cancellous bone. Any surface defects of the bone were filled using autologous cancellous graft salvaged from previous bone cuts. The decision on whether to replace the patella, using a cemented all polyethylene component, was taken during the operation.

For statistical analysis we used the Statistical Package for the Social Sciences (SPSS, version 10.0, Chicago, Illinois) with data assumed to

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Table I. Details of the 559 patients who underwent a TKR

| Age (years) | Younger group (aged < 75 years) | Older group (aged ≥ 75 years) | p value |
|--|------------------------------------|----------------------------------|---------|
| Mean | 66 | 79 | |
| Range | 33 to 74 | 75 to 83 | |
| Gender | | | |
| Male (%) | 207 (49) | 55 (41) | 0.101 |
| Female (%) | 217 (51) | 80 (59) | |
| Number of simultaneous, bilateral procedures (%) | 143 (34) | 42 (31.0) | 0.574 |
| Number of staged bilateral procedures (%) | 56 (13) | 11 (8) | |
| Number of previous high tibial osteotomies (%) | 26 (6.1) | 3 (2.2) | 0.063 |
| Number of deaths since surgery (%) | 25 (5.9) | 23 (17.0) | 0.001 |

Table II. The number and percentage of patients, and their diagnosis

| Diagnosis | Younger group (aged < 75 years) | | Older group (aged ≥ 75 years) | |
|----------------------|------------------------------------|------------|----------------------------------|------------|
| | Number | Percentage | Number | Percentage |
| Osteoarthritis | 398 | 94 | 123 | 91 |
| Rheumatoid arthritis | 14 | 3 | 6 | 4.5 |
| Psoriatic arthritis | 6 | 1.5 | 0 | 0 |
| Other* | 6 | 1.5 | 6 | 4.5 |

* including Paget's disease, trauma, acromegaly, haemachromatosis, osteonecrosis, and osteomyelitis

be non-parametric. Significance was recorded at $p < 0.05$. Differences between patient complications, diagnosis and descriptive data were analysed using Pearson chi-squared analysis. The Knee Society clinical rating scores were analysed using an independent Student's *t*-test.

Results

Between August 1992 and October 1997, 811 TKRs were undertaken on 559 patients. We divided the patients into

two groups according to age, those aged 75 years or more and those aged less than 75 years. Details of the 135 patients in the older group and the 424 in the younger group are shown in Table I. Osteoarthritis was the principal diagnosis (Table II) but with a greater number of inflammatory arthropathies in the younger group ($p = 0.107$). There were 67 staged bilateral TKRs, 56 in the younger group and 11 in the older group (Table I). Follow-up ranged from five to ten years. The mean follow-up was for 7.1 years in the older group and 6.9 years in the younger.

The mean knee score improved from 96 before surgery to 183 at five years in the younger group and from 94 before surgery to 174 at five years in the older (Table III). The mean range of knee flexion was the same in both groups and reached 113° at five years. Only one patient (0.7%) developed a deep infection in the older group compared with 13 (3.1%) in the younger group. Further surgery was required in 37 patients in the younger group and five in the older respectively (Table IV). Medical complications are documented in Table V and Figure 1. There were no differences between the groups in regard to the rate of complica-

Table III. Mean pre-operative and post-operative knee scores and range of flexion for the 559 patients who underwent TKR

| | Younger group (aged < 75 years) | | | Older group (aged ≥ 75 years) | | |
|----------------------|------------------------------------|--------------------------|---------------------------|----------------------------------|--------------------------|---------------------------|
| | Pre-operatively | At one-year follow-up | At five-year follow-up | Pre-operatively | At one-year follow-up | At five-year follow-up |
| Knee score | | | | | | |
| Mean | 96 | 183 | 183 | 94 | 178 | 174 |
| Clinical | 41 | 91 | 94 | 35 | 91 | 92 |
| Functional | 57 | 89 | 90 | 59 | 86 | 83 |
| Range of flexion (°) | 6 to 113 | 1 to 112 | 1 to 113 | 6 to 113 | 1 to 112 | 1 to 113 |

Table IV. Complications requiring surgery in the two age groups following TKR ($p = 0.486$)

| Complication | Younger group (aged < 75 years) | Older group (aged ≥ 75 years) |
|--------------------------------|------------------------------------|----------------------------------|
| Revision | 6 | 0 |
| Change of polythene liner | 2 | 0 |
| Deep infection | 13 | 1 |
| Subsequent patella replacement | 11 | 3 |
| Arthrolysis | 4 | 1 |
| Periprosthetic fracture | 1 | 0 |

Table V. Medical complications seen in the two age groups following TKR ($p = 0.233$)

| Complication | | Younger group (aged < 75 years) | Older group (aged \geq 75 years) |
|----------------|-----------------------------------|------------------------------------|---------------------------------------|
| Cardiac | Peri-operative death | 0 (0) | 1 (0.7) |
| | Myocard Infarct | 3 (0.7) | 1 (0.7) |
| | Arrhythmia | 13 (3.1) | 3 (2.2) |
| Thromboembolic | Pulmonary embolism | 13 (3.1) | 4 (3.0) |
| | Symptomatic deep vein thrombosis | 2 (0.5) | 2 (1.5) |
| | Asymptomatic deep vein thrombosis | 27 (6.4) | 12 (8.9) |
| Other* | | 24 (5.7) | 13 (9.6) |

* oedema, bowel obstruction, confusion, urinary tract infection, nausea, hiccoughs, and pressure sores

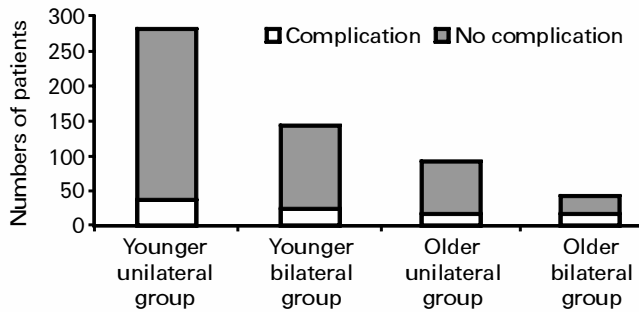


Fig. 1

Risk of complication when undertaking simultaneous bilateral TKRs in younger and older groups. Complication rates were 13.9% in the younger unilateral group, 18.2% in the younger bilateral group, 20.4% in the older unilateral group and 35.7% in the older bilateral group.

tions requiring surgery or medical complications ($p = 0.486$ and $p = 0.233$ respectively).

Discussion

The use of uncemented components for TKR in the elderly has been questioned due to concerns about fixation to osteoporotic bone and the ability of the bone to withstand direct transmission of force.

The theoretical advantages of the uncemented design are preservation of bone stock, ease of revision, decreased operative time and potentially fewer complications. Cementless prostheses for TKR have been available for many years, but the early results were compromised by poor design which was related principally to the use of femoral components made from titanium alloy and metal backed patellar prostheses.^{3,13,14} The results of uncemented and cemented TKRs, using a prosthesis of proven design, have shown no difference in clinical outcome at ten years.⁶

Li and Nilsson⁷ demonstrated that decreased bone mineral density led to increased subsidence and lift-off of the tibial base plate. Concerns regarding the fixation of the tibial prosthesis in osteoporotic bone are the basis of reluctance to use uncemented tibial fixation in the elderly. Tibial cortical cover is essential in order to prevent subsidence of the tray.^{10,13} Attention to detail in this part of the operation does decrease this risk. We also believe that the technique of reverse drilling the tibial lugholes, compressing the under-

lying cancellous bone, is important in order to enhance screw fixation and improve resistance to lift-off.

Hydroxyapatite has been shown to reduce micromovement in the tibial component in a number of studies^{8,9} and to compare favourably with that achieved when using a cemented technique.¹⁰ Although we did not compare the results with those using a non-HA coated prosthesis, we believe that our findings demonstrate that HA coating combined with a meticulous operative technique does produce good results in the elderly (Fig. 2). This is comparable with those reported previously described using cemented prostheses.¹⁻³

The Knee Society clinical rating score combines clinical and functional results. Previous studies have shown that elderly patients, although improving significantly in both components, do not do as well regarding function.^{1,2} Interestingly, our study demonstrates a significant difference in both knee and function score in the older group (Table III; $p < 0.05$). The difference in knee scores, a mean of nine points, is probably due to factors of co-morbidity relating to reduced mobility, and has been noted before.^{1,15} The slightly lower scores at five years in the older group points to them having increasing co-existent conditions, limiting mobility. The difference in the clinical score is only a mean of two points, which is of little clinical significance, although it reaches statistical significance. It should also be observed that the pre-operative scores for the older group were less than those for the younger group.

As could be expected, our study demonstrates a significant difference in mortality between the groups (Table I), but we do not feel this impacts on other results as numbers in both groups remain high. Some authors have reported an increased rate of medical complications after TKR in the elderly population, principally in the form of post-operative confusion.^{4,5} Although our study reveals no statistical difference between the two groups as far as medical complications are concerned ($p = 0.233$), it does demonstrate a trend towards more complications in the elderly group. However, this trend is mainly limited to the less serious, self-limiting complications (Table V). The specialist nature of the centre at which this study was carried out, with the majority of patients being assessed by a consultant physician prior to surgery, may not be reproduced in other places. The fact that cement was not used, and the

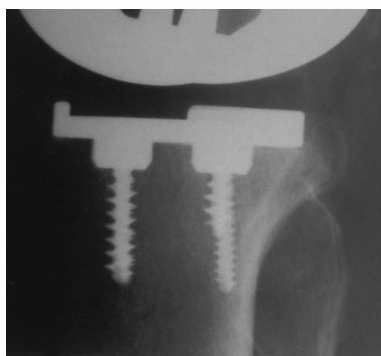


Fig. 2a

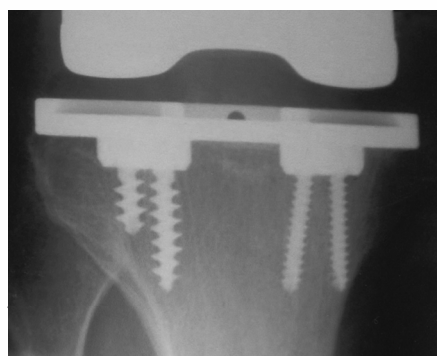


Fig. 2b

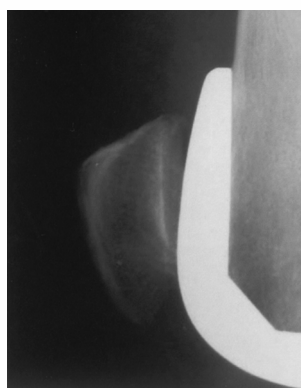


Fig. 2c



Fig. 2d

Radiographs showing interface views at five years after TKR in a patient aged over 75 years.

decreased tourniquet time associated with this, may also contribute. Complications requiring further surgery revealed no significant difference between the groups, but there is a trend towards more frequent deep infection and revision in the younger age group. The reason why these rates may be higher in the younger age group is unclear. Previous studies have demonstrated an increased risk of complications when undertaking simultaneous bilateral TKR.¹⁶⁻¹⁸ Our study demonstrates this in both groups (Fig. 2). It is interesting that although the risk of complications in each group is increased for simultaneous, bilateral TKR, it is not double the risk. To assess the risks accurately, comparison should be made between a group undergoing staged, bilateral TKR, rather than with a group undergoing unilateral TKR.

The results of HA-coated, uncemented TKR in the elderly are clinically comparable with those in a younger group giving a reliable, effective outcome at five years. The rate of complications in the older group are greater, but they do not reach statistical significance. These are mainly minor, self-limiting, medical conditions which do not impact on the final outcome.

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