# Minimum 5-year Follow up of a Hydroxyapatite Coated, Cementless, Total Knee Replacement in Patients aged 75 years and over

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Abstract

The use of uncemented total knee replacement (TKR) in the elderly is controversial due to concerns about fixation to osteoporotic bone and the ability of the bone to withstand direct prosthesis-bone force transmission. We present a prospective study of minimum 5-year results in patients aged 75 years and over undergoing hydroxyapatite (HA) coated, cementless TKR compared with a younger group. Knee Society clinical rating scores were recorded preoperatively and postoperatively. There were 559 patients eligible for analysis of which 135 were 75 years of age or over. Knee scores at 5-years elicited comparable results with patients under 75 years old reaching a score of 183 and patients aged 75 or over reaching 174. The differences in the scores were predominantly due to the functional component of the score. Results at a minimum 5-year follow-up of patients aged 75 or over receiving uncemented, HA coated TKR compares favourably with a group of younger patients receiving the same prosthesis during the same period.

*Key Words*: total knee replacement, hydroxyapatite, uncemented, elderly.

## Introduction

Total Knee Replacement (TKR) is known to be an effective procedure even when performed in the elderly[1-5]. The vast majority of data available on TKR in the elderly relates to cemented TKR. Only one study[1] used uncemented prostheses in the elderly but this is in conjunction with hybrid and cemented fixations and no comparisons between different groups were made.

Survival of uncemented prostheses has been shown to be comparable to their cemented counterpart at 10 years[6]. However the use of uncemented TKR in the elderly is controversial due to concerns regarding initial fixation of the tibial component, ability of osteoporotic bone to withstand direct prosthesis-bone force transmission and osseointegration of the prosthesis[7].

Hydroxyapatite (HA) has been shown to enhance tibial fixation in a number of studies[8-11]. This study was performed to compare outcomes in the over 75 age group with a younger group using an uncemented HA coated TKR over the same period.

## Materials and Methods

All patients undergoing primary TKR performed by the senior author between August 1992 and October 1997 were assessed. Patients received a HA coated, PCL retaining, stemless TKR implanted using a standard technique. Knee Society clinical rating scores were recorded preoperatively and at 1 and 5 years postoperatively. The clinical rating score is divided into knee and function components each worth a total of 100 point giving a total score out of 200[12]. Clinical examination was conducted by independent examiners for the duration of the study,

either by an orthopaedic surgeon completing a fellowship program or by a qualified researcher. Weight-bearing anteroposterior, lateral and patella view radiographs were taken routinely at 5 years and examined by a radiologist to determine any loosening.

The prosthesis used was the Active ™ (DJ Ortho, Australia) uncemented total knee replacement. The femoral component (CoCrMo) features recessed heat sintered beads on the distal surface. The tibial component (Ti6Al4V) is designed with four press fit lugs on the 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 250-500 microns). The beads on both components are designed to enhance bony ingrowth onto the prosthesis.

The surfaces of both components are coated with HA. This is applied using a plasma spray technique to a thickness of 70 microns (crystallinity 75%, porosity 20%), which facilitates osteoblast penetration of the porous beads without blocking the pores.

The senior author has emphasized certain points regarding the operation technique that he believes to be important especially in the elderly patient. Cortical support of the tibial tray is essential and the tibial base plate is sized to maximise this. Holes to accept the lugs on the under surface tibial tray were drilled in a reverse manner to impact cancellous bone. Any surface bone defects were filled using autologous bone graft salvaged from previous bone cuts. The decision to replace the patella using a cemented, all polyethylene component, was taken per-operatively.

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS, version 10.0, Chicago, Illinois) with the data assumed to be nonparametric and significance recorded at $P<0.05$. Differences between patient complications, diagnosis and descriptive data were analysed using Pearson Chi-square analysis. Knee Society clinical rating scores were analysed using an Independent t-test.

## Results

From August 1992 to October 1997, 811 total knee replacements were performed on 559 patients (135 patients were aged 75 years or more). Patients were divided into two groups (Table 1), either under 75 years old (UN75) or 75 years and over (OV75). There were 217 (51%) female patients in the UN75 and 80 (59%) in the OV75 ($p=0.101$). The average age was 66 years (range 33-74 years) in the UN75 and 79 years (range 75-83 years) in the OV75. There were 143 (34%) simultaneous bilateral TKR's in UN75 and 42 (31%) in OV75. Osteoarthritis was the chief diagnosis (94% UN75, 91% OV75) with greater numbers of inflammatory arthropathies in the UN75 group (Table 2) ($p=0.107$). Twenty-five (5.9%) patients in the UN75 compared to 23 (17.0%) in OV75 have died since surgery ($p<0.001$). The average time of follow up was 6.9 years and 7.1 years (range 5-10 years) in the UN75 and OV75 groups respectively.

The average knee score improved from 96 before surgery to 183 at 5 years in the UN75 and from 94 before surgery to 174 at 5 years in the OV75 (Table 3). Knee flexion was unchanged in both groups with flexion reaching 113 degrees at 5 years. Thirteen patients (3.1%) developed a deep infection in the UN75 group compared to 1 patient (0.7%) in the OV75 group. Further surgery was required in 32 and 5 cases in the UN75 and OV75 groups respectively (Table 4). Medical

complications are documented in Table 5. There was no difference between the groups in complications requiring surgery or medical complications (p=0.233 and p=0.486 respectively).

## Discussion

Theoretical advantages of uncemented design are preservation of bone stock, ease of revision, decreased operative time and potentially fewer complications. Cementless TKR prostheses have been available for many years but the early results were compromised by poor design. Principally this related to the use of titanium alloy femoral components and metal backed patellae[3,13,14]. Comparison of uncemented with cemented knees using a proven prosthesis has shown no difference in clinical outcome at 10 years[6].

Li and Nilsson[1] demonstrated that decreased bone mineral density led to increased subsidence and lift-off of the tibial base plate and 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 has been demonstrated to be essential to prevent tray sinkage[10,13] and attention to detail in this part of the operative technique does decrease the risk of subsistence. We also feel that the technique of reverse drilling the tibial lugholes, therefore compressing the underlying cancellous bone is important to enhance screw fixation and improve resistance to lift-off. This technique has not previously been reported.

Hydroxyapatite has been shown to reduce micromotion in the tibial component in a number of studies[8,9] and indeed to compare favourably with micromotion achieved when using a cemented prosthesis[10]. Although this study does not compare the results of a non-HA coated prosthesis we

believe the encouraging results demonstrate that HA coating along with meticulous operative technique do produce good results in the elderly (Fig. 1) comparable with those reported previously using cemented prostheses[1-3].

The Knee Society clinical rating score is comprised of a clinical knee score and a functional score. Previous studies[1,2] have demonstrated that elderly patients although improving significantly in both components do not do as well with regards to function. Interestingly, this study demonstrates a significant difference in both knee and functional score in the OV75 group (Table 3). The difference in functional scores, a mean of 9 points, is most likely due to co-morbidity factors relating to decreased mobility and has been noted previously[1,15]. The slight drop off in scores at 5 years in the OV75 group also points to the elderly group having increasing coexistent conditions limiting mobility as they age. The difference in knee score is only a mean of 2 points, which is of little clinical significance although reaching statistical significance. It should also be observed that the preoperative scores for the OV75 group were less than the UN75 group

As would be expected this study demonstrates a significant difference in mortality between both groups (Table 1) but we do not feel this impacts to greatly on other results as numbers in both groups remain high. Other authors[4,5] have reported an increased medical complication rate when performing TKR in the elderly population but this is principally in the form of postoperative confusion. This is understandable considering that the elderly population tend to have greater premorbid pathology. Our study demonstrates no statistical difference between the two groups as far as medical complications were concerned ($p=0.233$) but does demonstrate a trend towards increased complications in the elderly group. However, this trend is mainly limited to the less

serious, self-limiting complications (Table 5). The specialist nature of the centre where this study was performed, with the vast majority of patients being assessed by a consultant physician prior to surgery may mean that this is not reproduced in other centres. However the fact that cement was not used and the decreased tourniquet time associated with this may also contribute. Complications requiring further surgery also revealed no significant difference seen between either groups but there is a definite trend towards a significant increase in deep infections and revision rate in the younger age group. Obviously these surgical interventions are related but the reason why the rate may be higher in the younger age group is unclear.

Previous studies have demonstrated an increased risk of complications when performing simultaneous bilateral TKR[16-18]. Our study demonstrates this in both UN75 and OV75 group (Fig. 2). It is interesting that although risk of complications in each group is increased for simultaneous bilateral TKR it is not double the risk. To accurately compare risks, comparison should be made between a group undergoing staged bilateral TKR rather than unilateral TKR. This then raises questions of the optimum timing of the second procedure.

The results of HA coated uncemented TKR in the elderly are shown to be clinically comparable to those in a younger group representing a reliable, effective outcome at 5 years follow up. Complication rates in the older age group are increased but not significantly. These are mainly minor, self-limiting, medical conditions that do not impact on the final outcome.

Table 1. Patient descriptive data

| **Demographics** | **UN75** | **OV75** | **P value** |
|---|---|---|---|
| Mean age (range) | 66 years (33-74) | 79 years (75-83) | - |
| M:F (% female) | 207:217 (51) | 55:80 (59) | =0.101 |
| Mean follow up (years) | 6.9 | 7.1 | - |
| Simultaneous bilateral procedure | 143 | 42 | =0.574 |
| Previous high tibial osteotomy | 26 (6.1%) | 3 (2.2%) | =0.063 |
| Deaths | 25 (5.9%) | 23 (17.0%) | <0.001 |

Table 2: Diagnosis of surgery (p=0.107)

| Diagnosis | UN75 | OV75 |
|---|---|---|
| Osteoarthritis | 398 | 123 |
| Rheumatoid arthritis | 14 | 6 |
| Psoriatic arthritis | 6 | 0 |
| Other ** | 6 | 6 |

**Other diagnosis includes: Paget's disease, trauma, acromegaly, haemachromatosis, osteonecrosis, and osteomyelitis.

Table 3: Summary of average preoperative and postoperative knee scores

| | | Pre-op | | 1 year | | 5 years | |
|---|---|---|---|---|---|---|---|
| | | **UN75** | **OV75** | **UN75** | **OV75** | **UN75** | **OV75** |
| **Score** | | 96 | 94 | 183 | 178 | 183 | 174 |
| | **Clinical Score** | 41 | 35 | 91 | 91 | 94 | 92 |
| | **Functional Score** | 57 | 59 | 89 | 86 | 90 | 83 |
| **Flexion (deg)** | | 113 | 113 | 112 | 112 | 113 | 113 |
| **FFD (deg)*** | | 6 | 6 | 1 | 1 | 1 | 1 |

*FFD = Fixed Flexion Deformity

Table 4. Complications requiring surgery (p=0.486)

| Complication | UN75 | OV75 |
|---|---|---|
| Revision | 6 | 0 |
| Poly change | 2 | 0 |
| Deep infection | 13 | 1 |
| Subsequent Patella Replacement | 11 | 3 |
| Arthrolysis | 4 | 1 |
| Peri-prosthetic Fracture | 1 | 0 |

Table 5. Medical Complications (p=0.233)

| Complication | | UN75 (19.3) | OV75 (26.7) |
|---|---|---|---|
| Cardiac | Peri-operative death | 0 (0) | 1 (0.8) |
| | MI | 3 (0.7) | 1 (0.8) |
| | Arrhythmia | 13 (3.1) | 3 (2.2) |
| Thromboembolic | PE | 13 (3.1) | 4 (3.0) |
| | Symptomatic DVT | 2 (0.5) | 2 (1.5) |
| | Asymptomatic DVT | 27 (6.4) | 12 (8.9) |
| Other * | | 24 (5.7) | 13 (9.6) |

Values in brackets are percentage values of group

* Other complications include: oedema, bowel obstruction, confusion, UTI, nausea, hiccoughs, and pressure sores.

**Figure Legends**

Figure 1. Radiographic interface face views at 5 years post total knee replacement in a patient over 75 years old.

Figure 2. Risk of complication when performing simultaneous bilateral TKR in UN75 and OV75 groups. Complication rates were 13.9% (UN75 unilateral TKR), 18.2% (UN75 bilateral TKR), 20.4% (OV75 unilateral TKR), 35.7% (OV75 bilateral TKR).

Figure 1

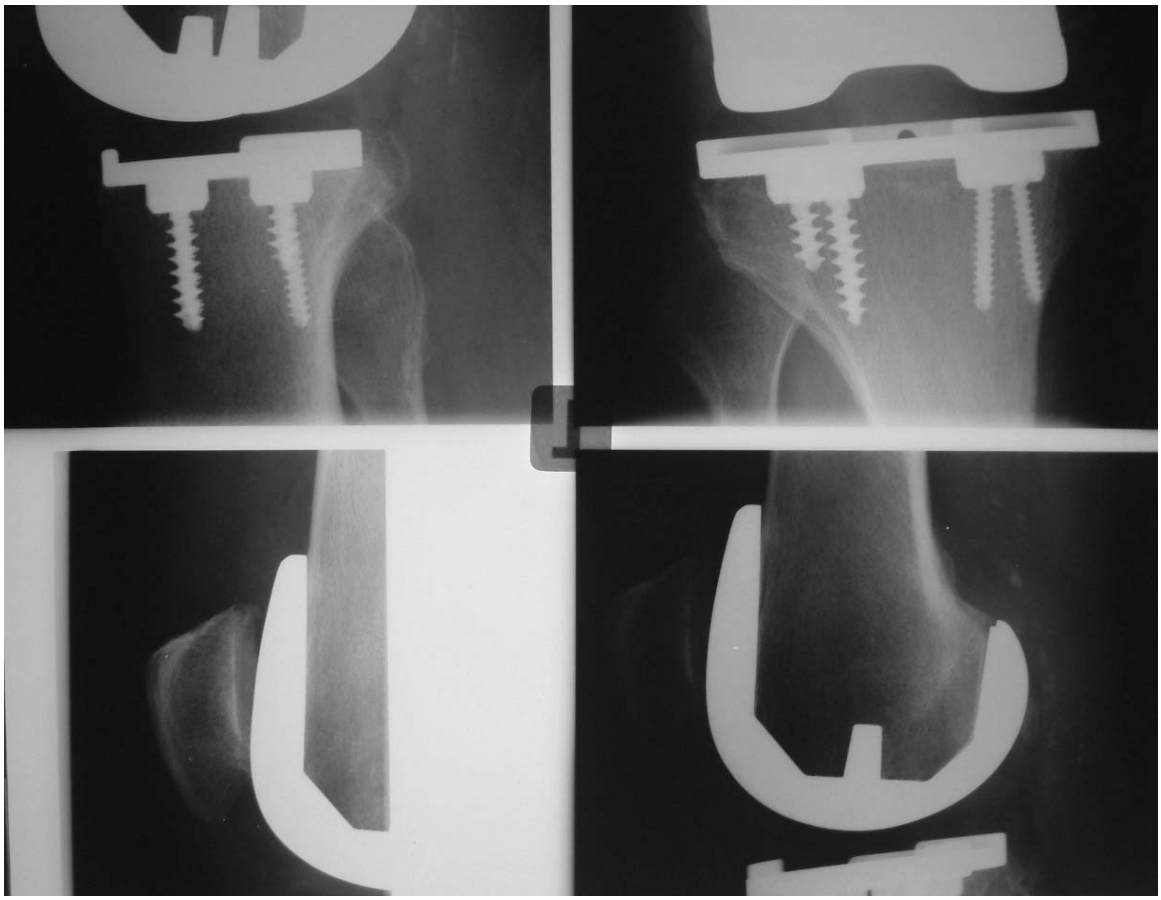
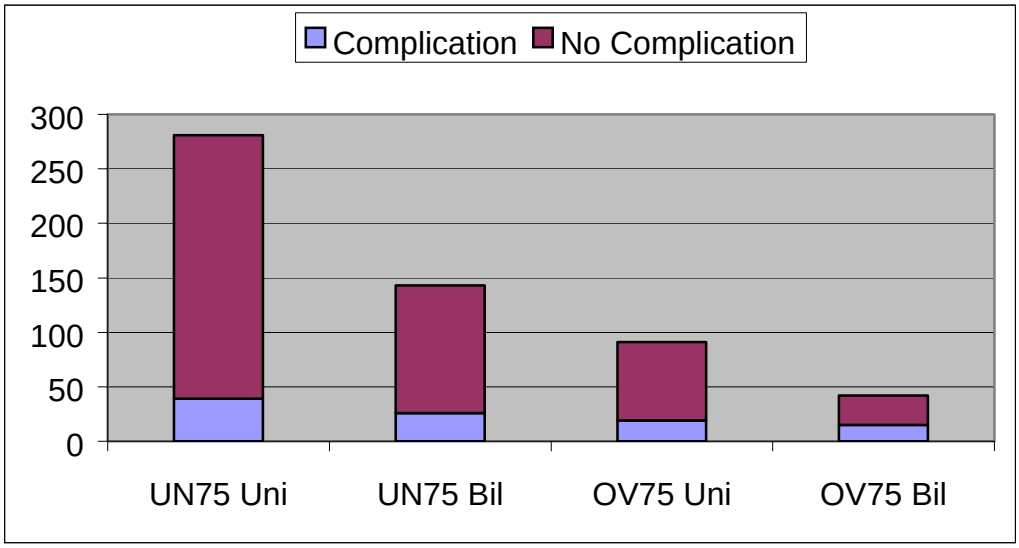


Figure 2.


Complication
No Complication
300
250
200
150
100
50
0
UN75 Uni
UN75 Bil
OV75 Uni
OV75 Bil

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