Unnecessary contraindications for mobile-bearing unicompartmental knee replacement

The contraindications for unicompartmental knee replacement (UKR) remain controversial. The views of many surgeons are based on Kozinn and Scott’s 1989 publication which stated that patients who weighed more than 82 kg, were younger than 60 years, undertook heavy labour, had exposed bone in the patellofemoral joint or chondrocalcinosis, were not ideal candidates for UKR. Our aim was to determine whether these potential contraindications should apply to patients with a mobile-bearing UKR. In order to do this the outcome of patients with these potential contraindications was compared with that of patients without the contraindications in a prospective series of 1000 UKRs. The outcome was assessed using the Oxford knee score, the American Knee Society score, the Tegner activity score, revision rate and survival.

The clinical outcome of patients with each of the potential contraindications was similar to or better than those without each contraindication. Overall, 678 UKRs (68%) were performed in patients who had at least one potential contraindication and only 322 (32%) in patients deemed to be ideal. The survival at ten years was 97.0% (95% confidence interval 93.4 to 100.0) for those with potential contraindications and 93.6% (95% confidence interval 87.2 to 100.0) in the ideal patients.

We conclude that the thresholds proposed by Kozinn and Scott using weight, age, activity, the state of the patellofemoral joint and chondrocalcinosis should not be considered to be contraindications for the use of the Oxford UKR.

Unicompartmental knee replacement (UKR) is being used increasingly for the treatment of end-stage arthritis affecting one compartment in the knee.1 If appropriate indications and techniques are used, UKR has a faster recovery, fewer and less severe complications and better function than total knee replacement (TKR), although the revision rate tends to be higher.1,2 There is, however, debate about the indications and contraindications for UKR. Kozinn and Scott3 suggested that patients who weighed more than 82 kg, were younger than 60 years, were “extremely physically active or performed heavy labour”, had chondrocalcinosis “as seen on pre-operative radiographs or at arthrotomy” or “exposed bone in the patellofemoral joint”, should ideally not be offered UKR because of the fear of early failure. By contrast, Goodfellow et al4 recommended that these so-called contraindications could be ignored for mobile-bearing UKR and that the decision to perform UKR should depend on the pathoanatomy. They recommended UKR for patients with significant symptoms and anteromedial osteoarthritis (OA) or spontaneous medial osteonecrosis of the knee. In anteromedial OA, there should be bone on bone in the medial compartment, the anterior cruciate and medial collateral ligaments should be functionally intact and there should be full-thickness cartilage in the lateral compartment.4

Our aim was to determine if the contraindications proposed by Kozinn and Scott3 should be applied to mobile-bearing UKR. We therefore compared the outcome of patients with and without these potential contraindications in a large series of patients who had undergone UKR.

Patients and Methods

Between June 1998 and July 2009, 1000 cemented phase 3 medial Oxford UKRs (Biomet, Swindon, United Kingdom) were implanted by two surgeons (CAF, DWM) in 818 patients for anteromedial OA and medial spontaneous osteonecrosis as recommended by Goodfellow et al,4 and the potential contraindications proposed by Kozinn and Scott3 were ignored. There were 636 unilateral procedures and 182 bilateral procedures, of which...
22 were simultaneous and 160 were staged. The operation was performed in 425 women (52.0%). The mean age of the patients at the time of operation was 66 years (32 to 88). In 977 knees the UKR was undertaken for primary anteromedial OA and for spontaneous osteonecrosis in the remainder, which occurred in the femur in 20 knees and the tibia in three. The overall outcome of this series has been described previously. This prospective study described the outcome of the first 1000 phase 3 Oxford medial UKRs implanted using a minimally invasive surgical approach for the recommended indications by two surgeons and followed up independently. The mean follow-up was 5.6 years (1 to 10) with 547 knees having a minimum follow-up of five years. At five years the mean Oxford knee score was 41.3 (SD 7.2), the mean American Knee Society objective score 86.4 (SD 13.4), mean American Knee Society functional score 86.1 (SD 16.6), and the mean Tegner activity score 2.8 (SD 1.1). The incidence of implant-related re-operations was 2.9%.

All operations were performed using the standard minimally invasive surgical technique. The patients were assessed clinically by an independent physiotherapist (CJ) using a standard protocol pre-operatively and at one, five, seven and ten years after surgery. The assessment included the Oxford knee score (OKS), the objective and functional American Knee Society scores (AKSS-O and AKSS-F) and the Tegner activity score. If for any reason (social, geographical or medical) patients were unable to attend for clinical follow-up they were sent questionnaires. If they did not return the questionnaires they were contacted by telephone and the relevant information was obtained in regard to the OKS, the Tegner activity score, the AKSS-F and whether the knee had been revised or not. For those who had died, information was gathered from hospital notes, general practitioner records and relatives to establish whether the patient had undergone any further surgery on the knee under investigation before their death. Operative data, surgical findings and details of components were recorded using a standard form. Data on complications occurring either peri-operatively or later were also recorded. Four patients (four knees) were lost to follow-up, all in the first year. The outcome of the remaining 996 knees (99.6%) in the remaining 814 patients was known, and questionnaire data (OKS, Tegner activity score, and AKSS-F) were collected at all post-operative time points. An average questionnaire data (OKS, Tegner activity score, and AKSS-F) were collected at all post-operative time points. An average of 61% of knees had AKSS-O at each post-operative time point. The scores are quoted as the mean (SD).

The patients were classified into subgroups according to whether they were ideal for UKR or not using the five criteria proposed by Kozinn and Scott. These were considered to be not ideal if the following criteria were met: a) aged < 60 years at surgery; b) weight > 82 kg at the time of surgery; c) a Tegner activity score of 5 or above at any stage after surgery when a score of 5 was defined as heavy labour (e.g., building, forestry) and/or competitive sports (cycling/cross-country skiing) and/or recreational sports (jogging on uneven ground at least twice a week); d) chondrocalcinosis diagnosed on a pre-operative radiograph and/or histologically; and e) there was exposed bone in the patellofemoral joint.

Based on each perceived contraindication, the patients were divided into two groups for each variable as follows: group N - variable (non-ideal - variable name) and group I - variable (ideal - variable name). In addition, two overall groups were identified: a non-ideal group in which at least one of the potential contraindications was present and an ideal group in which there were no potential contraindications. The outcome in patients who were both < 60 years of age and over 82 kg at the time of surgery was also analysed.

The outcome data of the ideal and non-ideal groups were compared to assess the effect of each potential contraindication. A revision was defined as an operation in which a component was changed, a new component was added or a bearing dislocation had occurred.

Statistical analysis. Survival analysis was undertaken using the life-table method, and the 95% confidence interval (CI) was calculated using the method of Peto et al. The outcome scores were compared using the Kruskal-Wallis test, the revision rates by the chi-squared test and the survival rates by the log-rank test. Statistical significance was defined as a p-value < 0.05.

Results

The mean follow-up was 5.6 years (1 to 10) with 86 knees having a ten-year follow-up. There were 29 re-operations which were classified as revision, nine for progression of OA in the lateral compartment, six for bearing dislocations, six for unexplained pain, five for infection and one each for traumatic rupture of the anterior cruciate ligament, loosening of the tibial component and avascular necrosis of the lateral femoral condyle.

Effect of age. A total of 245 (24.5%) of the UKRs were implanted in patients younger than 60 years (group N-age). Their mean age was 54 years (33 to 60). The remaining 755 (75.5%) were in patients aged 60 years or older (group I-age) with a mean age of 71 years (60 to 88, Table I). The mean body weight of the group N-age was 86 kg (44 to 146), and that of the group I-age 79 kg (44 to 185) (p < 0.001). Apart from age and weight the two groups were matched for all other confounding variables, including gender, pre-operative diagnosis, intra-operative findings and time to follow-up. At the time of their last follow-up, the mean OKS was 40.9 (SD 8.4) and 4.1 (SD 7.6), the mean AKSS-O 83.8 (SD 8.8) and 85.0 (SD 18.1), the mean AKSS-F 87.8 (SD 20.2) and 82.1 (SD 18.8) and the mean Tegner activity score 3.2 (SD 1.4) and 2.7 (SD 1.1) for group N-age and group I-age, respectively.

There were six revisions (2.5%) in the group N-age and 23 revisions (3.0%) in the group I-age. The mean time to revision was 1.8 years (0.2 to 3.5) in the group N-age and the most common reason for revision was bearing dislocation (three of six). The mean time to revision was 3.5 years (0.4 to 10.0) in the group I-age and the most common...
reason for revision was progression of OA in the retained lateral compartment in seven of the 23 knees. There was no statistically significant difference in the mean OKS or the mean AKSS-O scores or the failure rate or in the survival between these two groups (Table II). The mean AKSS-F and mean Tegner activity score were significantly better in the group N-age (p < 0.001).

Effect of weight. The mean weight of the patients in 449 (44.9%) of the UKRs was 95 kg (82 to 185, group N-weight) and in 551 (55.1%) the mean weight was 69 kg (44 to 82, group I-weight). Except for age at surgery (mean age for group N-weight 64 years, mean age for group I-weight 69 years, p < 0.001) and gender distribution (p < 0.001), the two groups were matched for other confounding variables, including the pre-operative diagnosis, intra-operative findings and the time to follow-up. At the time of their last follow-up, the mean OKS was 40.7 (SD 8.0) and 41.4 (SD 7.6), the mean AKSS-O 86.4 (SD 9.7) and 83.4 (SD 12.7), the mean AKSS-F 83.9 (SD 20.9) and 82.8 (SD 19.3) and the mean Tegner activity score 3.0 (SD 1.1) and 2.7 (SD 1.1) in the group N-weight and the group I-weight, respectively. There were 15 (3.3%) revisions in the group N-weight and 14 (2.5%) in group I-weight. The mean time to revision was 2.6 years (0.2 to 6.3) in the group N-weight and the most common reasons for revision were bearing dislocation (n = 4), progression of OA in the lateral compartment (n = 4) or unexplained pain (n = 4). The mean time to revision was 3.9 years (0.4 to 10.0) in the group I-weight and the most common reason for revision was infection (n = 5).

There was no statistically significant difference in the clinical or functional outcome, failure rate or survival between the groups, except for the Tegner activity score, (Table II). The mean Tegner score was significantly higher in patients over 82 kg in weight (p < 0.001).

Chondrocalcinosis. In 126 (12.6%) of the knees chondrocalcinosis (CCK) was either present (group N-CCK) on the pre-operative radiographs only (n = 60), on histology only (n = 37) or both (n = 29). The remaining 874 (87.4%) did not have evidence of CCK (group I-non-CCK). Except for age at surgery (mean age for group N-CCK 69 years, mean age for group I-CCK 66 years, p < 0.001), the two groups were matched for other confounding variables, including gender distribution, weight, pre-operative diagnosis, intra-operative findings and the time to follow-up. At the time of their last follow-up, the mean OKS was 42.4 (SD 7.0) and 40.9 (SD 7.8), the mean AKSS-O 87.1 (SD 11.0) and 84.7 (SD 11.6), the mean AKSS-F 83.0 (SD 17.7) and 81.8 (SD 20.4) and the mean Tegner activity score 2.9 (SD 1.3) and 2.6 (SD 0.9). There were 4 (3.2%) revisions in the group N-CCK and 25 (2.9%) in the group I-non-CCK. The mean time to revision was 2.0 years (0.8 to 5.6) in the group N-CCK and the most common

<p>| Table I. Mean (SD) clinical outcome scores, revision rate and survival for the different subgroups |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Group</th>
<th>Number</th>
<th>Follow-up (yrs)</th>
<th>OKS*</th>
<th>AKSS† (O)</th>
<th>AKSS (F)</th>
<th>Tegner</th>
<th>Revision rate (%)</th>
<th>Survival at 10 yrs (%) (95 % CI‡)</th>
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<tbody>
<tr>
<td>Age (yrs)</td>
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<tr>
<td>&lt; 60</td>
<td>245</td>
<td>5.6 (2.8)</td>
<td>40.9 (8.4)</td>
<td>83.8 (8.8)</td>
<td>878 (20.2)</td>
<td>3.2 (1.4)</td>
<td>2.4</td>
<td>97.3 (91.3 to 100.0)</td>
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<tr>
<td>≥ 60</td>
<td>755</td>
<td>5.6 (2.9)</td>
<td>41.1 (7.6)</td>
<td>85.0 (18.1)</td>
<td>821 (18.8)</td>
<td>2.7 (1.1)</td>
<td>2.0</td>
<td>95.7 (90.8 to 99.3)</td>
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<tr>
<td>Weight (kg)</td>
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<tr>
<td>≥ 82</td>
<td>449</td>
<td>5.7 (2.7)</td>
<td>40.7 (8.0)</td>
<td>86.4 (9.7)</td>
<td>83.9 (20.9)</td>
<td>3.0 (1.1)</td>
<td>2.3</td>
<td>95.8 (90.5 to 100.0)</td>
</tr>
<tr>
<td>&lt; 82</td>
<td>551</td>
<td>5.6 (2.9)</td>
<td>41.4 (7.6)</td>
<td>83.4 (12.7)</td>
<td>82.8 (19.3)</td>
<td>2.7 (1.1)</td>
<td>2.6</td>
<td>95.6 (90.9 to 100.0)</td>
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<td>Chondrocalcinosis</td>
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<tr>
<td>Present</td>
<td>126</td>
<td>6.4 (2.9)</td>
<td>42.4 (7.0)</td>
<td>87.1 (11.0)</td>
<td>83.0 (17.7)</td>
<td>2.9 (1.3)</td>
<td>2.2</td>
<td>96.4 (89.0 to 100.0)</td>
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<tr>
<td>Absent</td>
<td>874</td>
<td>5.5 (2.8)</td>
<td>40.9 (7.8)</td>
<td>84.5 (11.5)</td>
<td>83.5 (20.1)</td>
<td>2.8 (1.2)</td>
<td>2.9</td>
<td>95.4 (91.4 to 99.4)</td>
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<tr>
<td>Patellofemoral joint</td>
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<tr>
<td>Bone exposed</td>
<td>158</td>
<td>5.6 (2.7)</td>
<td>42.2 (7.9)</td>
<td>83.4 (9.8)</td>
<td>84.1 (18.1)</td>
<td>3.0 (1.3)</td>
<td>0.6</td>
<td>98.8 (93.2 to 100.0)</td>
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<tr>
<td>No bone exposed</td>
<td>842</td>
<td>5.6 (2.9)</td>
<td>41.0 (7.9)</td>
<td>85.1 (12.8)</td>
<td>83.2 (20.6)</td>
<td>2.8 (1.2)</td>
<td>3.3</td>
<td>95.0 (91.1 to 99.0)</td>
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<tr>
<td>Activity score</td>
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<tr>
<td>High (Tegner ≥ 5)</td>
<td>96</td>
<td>6.0 (2.7)</td>
<td>45.6 (4.4)</td>
<td>87.0 (9.3)</td>
<td>96.8 (9.4)</td>
<td>5.4 (0.7)</td>
<td>0.7</td>
<td>97.8 (90.3 to 100.0)</td>
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<tr>
<td>Normal (Tegner ≤ 4)</td>
<td>904</td>
<td>5.6 (2.8)</td>
<td>40.6 (8.0)</td>
<td>84.7 (11.6)</td>
<td>81.8 (20.4)</td>
<td>2.6 (0.9)</td>
<td>2.1</td>
<td>95.3 (91.4 to 99.2)</td>
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<tr>
<td>Kozinn and Scott² group</td>
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<tr>
<td>Non-ideal</td>
<td>678</td>
<td>5.7 (2.7)</td>
<td>41.2 (7.9)</td>
<td>85.4 (10.0)</td>
<td>84.4 (20.0)</td>
<td>3.0 (1.3)</td>
<td>2.4</td>
<td>97.0 (93.4 to 100.0)</td>
</tr>
<tr>
<td>Ideal</td>
<td>322</td>
<td>5.5 (3.0)</td>
<td>40.7 (7.7)</td>
<td>83.1 (14.1)</td>
<td>80.7 (20.3)</td>
<td>2.4 (0.9)</td>
<td>4.0</td>
<td>93.6 (87.2 to 100.0)</td>
</tr>
</tbody>
</table>

* OKS, Oxford knee score
† AKSS, American Knee Society score
‡ CI, confidence interval
§ statistically significant (see Table II)
reason for revision was bearing dislocation (n = 3). The mean time to revision was 3.4 years (0.2 to 10.0) in the group I-non CCK and the most common reason for revision was progression of OA in the lateral compartment (n = 9).

There was no statistically significant difference in the clinical or functional outcome, failure rate or survival between the two groups (Table II).

**Patellofemoral arthritis.** In 158 (15.8%) of the UKRs there was exposed bone on either the patella or trochlea at the time of surgery (group N-PFJ). The remaining 842 (84.2%) did not have any exposed bone (group I-PFJ). Except for age at surgery (mean age for group N-PFJ 68 years and group I-PFJ 66 years, p = 0.038), the two groups were matched for other confounding variables including gender distribution, weight, pre-operative diagnosis, intra-operative findings and the time to follow-up. At the time of their last follow-up, the mean OKS was 42.2 (SD 7.9) and 41.0 (SD 7.9), the mean AKSS-O 83.4 (SD 9.8) and 85.1 (SD 12.8), the mean AKSS-F 84.1 (SD 18.1) and 83.2 (SD 20.6), and the mean Tegner activity score 3.0 (SD 1.3) and 2.8 (SD 1.2) in the group N-PFJ and the group I-PFJ, respectively. There was one revision in the group N-PFJ for a bearing dislocation at 5.6 years and 28 (3.3%) in the group I-PFJ. The mean time to revision was 3.1 years (0.2 to 10.0) in the group I-PFJ and the most common reason for revision was progression of OA in the lateral compartment (n = 9).

There was no statistically significant difference in the clinical or functional outcome, failure rate or survival between the two groups (Table II). **High activity participation.** In 96 (9.6%) of the UKRs the patients reported a Tegner score of ≥ 5 at some stage post-operatively (group N-activity) with a mean Tegner score of 5.4 (5.0 to 8.0) while the remaining 904 (90.4%) did not participate in high-level activities (group I-activity) with a mean Tegner score of 2.6 (0.0 to 10.0). As expected, the patients in the high activity group were younger than those with normal activity levels (group N-activity mean age 60 years, group I-activity mean age 67 years, p < 0.001). Except for age and gender distribution (both p < 0.001), the two groups were matched for other confounding variables including weight, pre-operative diagnosis, intra-operative findings and the time to follow-up. At the time of their last follow-up the mean OKS was 45.6 (SD 4.4) and 40.6 (SD 8.0), the mean AKSS-O 87.0 (SD 9.3) and 84.7 (SD 11.6), the mean AKSS-F 96.8 (SD 9.4) and 81.8 (SD 20.4) in the group N-activity and group I-activity, respectively. There were two revisions in the group N-activity at 2.1 years (2.1%) and 27 in the group I-activity (3.0%). The mean time to revision was 2.6 years (0.2 to 6.3) in the group I-activity and the most common reason for revision was progression of OA in the retained lateral compartment (n = 9) for which revision was undertaken at a mean of 3.2 years (0.2 to 10).

The mean OKS and AKSS-F were significantly better in the group N-activity compared with a group I-activity.
(p < 0.001). Otherwise, no significant differences were noticed either in the outcome, failure rate or survival between the two groups (Table II).

**Non-ideal versus ideal.** Of the 1000 knees, 678 (67.8%) should not ideally have been considered for a UKR according to the criteria of Kozinn and Scott3 (group N) while the remaining 322 (32.2%) were ideal (group I) (Table I).

At the time of their last follow-up the mean OKS was 41.2 (SD 7.9) and 40.7 (SD 7.7), the mean AKSS-O 85.4 (SD 10.0) and 83.1 (SD 14.1), the mean AKSS-F 84.4 (SD 20.0) and 80.7 (SD 20.3) and the mean Tegner activity score 3.0 (SD 1.3) and 2.4 (SD 0.9) in group N and group I, respectively. There were 16 (2.4%) revisions in group N and 13 (4.0%) in group I. In group N the mean time to revision was 2.5 years (0.2 to 6.3) and most common reason for revision was bearing dislocation (n = 6). In group I the mean time to revision was 4.0 years (0.4 to 10.0) and the most common reason for revision was progression of OA in the retained lateral compartment (n = 6). The survival rate at ten years for the ideal patients was 93.6% (95% CI 87.2 to 100.0) and for the non-ideal 97.0% (95% CI 93.4 to 100.0).

The mean AKSS-F (p = 0.02) and mean Tegner score (p < 0.001) were significantly better in group-N compared with group-I (Table II). Although the revision rate was lower and the survival higher for group-N patients, the differences were not statistically significant (p = 0.17 and p = 0.18, respectively). Some authors would consider that a dislocation treated by a bearing replacement was not a revision. Under these circumstances both the revision rate and the survival rate of the non-ideal patients (1.5% and 98.1%, respectively) were significantly (p = 0.016 and p = 0.019) better than those of the ideal patients (3.9% and 93.6%), respectively.

Of the 1000 knees, 144 were in patients who were both young (age < 60 years) and heavy (weight > 82 kg) at the time of surgery (group-N-young and heavy). In this group at the last follow-up the mean OKS was 41.0 (SD 7.8), mean AKSS-O 85.0 (SD 7.9) the mean AKSS-F 89.0 (SD 20.3) and mean Tegner score 3.2 (SD 1.2). There were six (4.2%) revisions with a mean time to revision of 1.8 years (0.2 to 3.5) and the reason for revision was either bearing dislocation (n = 3) or unexplained pain (n = 3). The survival at ten years in this group was 95.5% (95% CI 84.6 to 100.0). There were no statistically significant differences between this subgroup and the overall ideal group for the mean OKS, the mean Tegner score and the mean AKSS-O. The AKSS-F was significantly better in this young and heavy group as compared with the ideal group (p < 0.001).

**Discussion**

The achievement of good results after UKR requires adherence to appropriate indications and contraindications. The criteria of Kozinn and Scott,3 dividing patients into those deemed ideal and non-ideal for UKR, are now generally accepted to be indications and contraindications for UKR. However, our study has shown that the use of a mobile-bearing UKR in patients with these generally accepted contraindications gives results which are no worse than in those considered to be ideal for UKR. In fact, they did better. Therefore, we can conclude that these contraindications should not apply to mobile-bearing UKR. This has important implications for the use of the UKR. If the accepted contraindications are strictly applied then only about 5% of knees are appropriate for UKR.10,11 This would result in most surgeons undertaking relatively few UKRs, possibly less than ten per year, which is the minimum number required to obtain reliably good results.1 Conversely if the contraindications can be ignored, most surgeons would be able to perform a sufficient number of UKRs to obtain good results.

The main reason why UKR is thought to be contraindicated in the young is that it is required to function well for many years. Our study has shown that mobile-bearing UKR in patients under 60 years not only has a similar rate of failure as in those over 60 years, but also has a survival of 97% at ten years. Other studies, with smaller numbers, have confirmed that good results can be achieved in young patients with the Oxford UKR at ten years.12,13 The implant has a mobile bearing which is fully congruent and therefore has minimal wear even at 20 years.14-16 The bearing is unconstrained so there are minimal shear forces at the interfaces and little chance of loosening. Therefore in the long term the failure rate will probably be low. Despite this, in the long term some UKRs would fail as would some TKRs if they were used in this group of patients. It is, however, relatively straightforward to convert a failed UKR to a primary TKR and the outcome of such conversions is likely to be better than that of a revision of a TKR.17,18 It would therefore seem that mobile-bearing UKR, far from being contraindicated in young patients, may actually be advantageous compared with TKR.

Kozinn and Scott3 suggested that UKR should, ideally, not be offered to patients whose weight exceeded 82 kg. There is concern that in the heavier patients the implant may subside and have early loosening. There is some evidence that early loosening does occur in overweight patients with fixed-bearing devices,19 but our findings and those of others20 have shown that the results of mobile-bearing UKR are no worse in the heavier patient than in the ideal patient. Presumably this is because the mobile bearing reduces the shear stresses at the joint interfaces and the tibial base plate distributes load over a large area.4

The very active patients have higher clinical scores than those who are not so active, which reflects the inclusion of elements related to activity within the scores. The very active patients display a trend towards a lower failure rate which is surprising as the very active patients would be expected to have a higher failure rate. A possible explanation is that the very active patients have a higher quality of retained cartilage and bone, lowering the risk of loosening or progression of disease. In addition, the risk of wear remains low because of the mobile bearing. In general, our patients have been advised to avoid high-impact activities, but it is clear from the Tegner scores that many do have...
high levels of activity, including those with impact loading. This suggests that they ignore the advice of their surgeons because their knees function so well. At ten years, at least, it seems that high levels of activity do not compromise the outcome.

Chondrocalcinosis is considered by some to have elements of an inflammatory arthropathy, which would be expected to lead to progression of the arthritis in the other compartments in the knee. This does not seem to be the case in our patients with the condition. Other smaller studies have confirmed this. Therefore it would seem that such patients can be treated safely by UKR.

The most contentious potential contraindication relates to the state of the patellofemoral joint. Although revisions for problems in this area are relatively common in the second decade after fixed-bearing UKR, there is no evidence to suggest that these revisions are the consequence of damage to the patellofemoral joint which was present at the initial operation. Previous studies on mobile-bearing UKR, which were smaller and shorter than our study, showed that the state of the joint at operation did not compromise the outcome. Our study shows that the clinical scores and failure rates are the same after mobile-bearing UKR irrespective of whether there is bone exposed in the patellofemoral joint or not. It would therefore seem that exposed bone should not be considered as a contraindication.

Our study of 1000 patients with results up to ten years gives a relatively accurate insight into the clinical outcome in patients with or without the various contraindications proposed by Kozinn and Scott. Other studies have similar conclusions although the numbers and follow-up were shorter. However, despite the large numbers in our study there were only 29 failures. This is a weakness of our study since with a small number of failures it is impossible to determine if contraindications cause a small increase in the rate of failure. However, if a complication had caused a substantial increase in the failure rate then the number of failures would have been higher and it would have been possible to detect such a difference. The best way to study large numbers of failures is to use data from national registers, but these collect little information on the indications and techniques and therefore conclusions may be erroneous. For example, all registers report higher revision rates in younger patients. A factor which may contribute to this and cannot be adjusted for, is that many of the younger patients may have a UKR for early disease without complete loss of cartilage. This is a contraindication and these patients will have a higher failure rate.

A further limitation is that we have only analysed the thresholds proposed by Kozinn and Scott. It may be that some factors, particularly age, activity and weight are important but only at a higher level, for example a body mass index over 40 or age under 50 years. In order to analyse a series of different thresholds for different factors we would have needed to include larger numbers of patients because of multiple testing. Further studies, ideally multicentre, are required to focus on different factors and thresholds. Another limitation is that, in order to avoid multiple testing, we have not studied interactions between factors. We did examine one interaction. It is accepted that young heavy individuals have a high risk of failure, but we found no difference in the clinical scores or failure rate between those patients who were both less than 60 years of age and more than 82 kg in weight and those deemed to be ideal. This suggests that interactions may not be important.

In conclusion, our study has shown that for mobile-bearing UKR the generally accepted contraindications and thresholds for UKR, as proposed by Kozinn and Scott, can be ignored provided that patients have significant symptoms and anteromedial osteoarthritis or medial spontaneous osteonecrosis. The data only relate to mobile-bearing UKR and further studies are required to determine if our conclusions should also apply to fixed-bearing UKR.

Further opinion

A further opinion by Mr M. Glasgow is available with the electronic version of this article on our website at www.jbjs.org.uk/education/further-opinions

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