A study of the factors in hip replacement dislocation part 1

This is the first of two articles which describe a clinical and radiographic review of the reasons for dislocation in patients who have received customised total hip replacements. The researchers compared the alignment of 19 arthroplasties which had dislocated with 347 which had not. A number of factors were considered including pre- and post-operative factors, femoral component placement, component head size, and acetabular position and orientation. It was found that the femoral head size had the greatest influence on dislocation. However, the researchers point out that dislocation on these patients is a multifactoral problem and that prevention, through effective pre-operative and post-operative patient education in relation to care of the hip and mobilising, should be encouraged. They also advocate a multidisciplinary approach to improve patient outcomes. The second article will appear next week.

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Dislocation of the femoral head from the acetabular component is one of the most dramatic, distressing and common early complications of total hip replacement. Although they can occur at any time following surgery, most dislocations happen during the first six weeks post-operatively. It is evident from the literature that the incidence of this complication has fallen steadily with increasing surgical experience. Consequently, every effort should be made to limit its occurrence by the use of a correct operative technique.

Pre-operative education, particularly from nursing and physiotherapy staff, is given to each patient warning against extreme flexion and adduction of the new joint. If a posterior approach is used then internal rotation should be added to the above caution.

Dislocations are classified as early or late depending on the time interval from surgery – dislocation before six weeks is early and after six weeks is late. Early dislocation is associated with the relative instability of the joint in the first few weeks following surgery. Stability increases as soft tissue healing takes place and full muscle control is restored.

The incidence of anterior or posterior dislocation varies with the operative approach, the type of prosthesis used and the alignment of the components. Anterior dislocation usually occurs from external rotation and abduction when the patient is lying with the hip extended. Posterior dislocation is more common when the hip is in full flexion, adduction and internal rotation and may occur as the patient gets up from a low chair, turns around in a low chair, or bends to pick up objects from the floor, particularly where there is bending and rotation.

In both types of dislocation the patient develops acute pain with limitation of movement and a characteristic deformity. When the hip is dislocated posteriorly the lower limb is internally rotated, adducted and flexed. In anterior dislocation the leg appears externally rotated, similar to a fractured neck of femur (Fig. 1).

Predisposing factors The major factors thought to contribute to instability and dislocation are the design of the implant and its manufacture, the modular head size, the technique of insertion and the stability of the soft tissues.

Previous authors have stated that technical errors, such as malalignment of the components, have caused the majority of dislocations (Dorr et al 1983, Hamblen 1984). It has also been stated that the 'commonest error was a badly placed acetabular cup' (Ali...
Fig. 1. Dislocation of a total hip replacement

Kahn et al (1981), although published figures fail to show any significant effect of the differences in design of hip prostheses on their dislocation rates.

AIM OF STUDY AND METHODS
The aim was to determine if malposition of the components was the major factor determining dislocation in this group of patients. A total of 1,023 Custom X-Press total hip replacements have been implanted in Musgrave Park Hospital over the last three years. The dislocations in this group were compared with a subset (chosen at random from the Custom Hip database) of 347 arthroplasies which did not dislocate, taking into account the factors in Box 1.

The researchers reviewed retrospectively the notes and X-rays of 19 custom total hip arthroplasties which had dislocated (16 posteriorly, 3 anteriorly) and compared the alignment of the prosthetic components with those of the 347 arthroplasties that did not dislocate. Surgeons use a standard surgical technique and all operations are performed using the posterior approach to the hip (Fig. 2). The posterior approach used in Belfast is a modified approach and includes just the Kocher part of the Kocher-Langenbeck incision.

RESULTS
In this study (n=1,023), 19 replacement hips dislocated, a rate of 1.85 per cent. In the group of hips having a small head size (22.225mm) (n=259) there were 12 (4.63 per cent) dislocations. In the group having a large head size (28mm) (n=764) there were 7 (0.9 per cent) dislocations. Surgeon A carried out 517 (50.54 per cent) of the replacements in the sample group, surgeon B, 316 (30.9 per cent) and surgeon C, 190 (18.6 per cent) (Table 1). The overall dislocation rate is presented in Table 2.

OPERATIVE VARIABLES AFFECTING DISLOCATION
Surgeon Each surgeon’s dislocation rate for 22.225mm and 28mm head size was calculated (Table 2). Surgeon A had a high overall dislocation rate so this required further investigation. Interestingly, in reviewing surgeon A’s dislocation rate it was found that he had implanted eight small heads and five large heads in his series of dislocations.

Age and sex The age range in the dislocated hips group was 35-84 years (mean 66.5 years). The age range in the control group was 29-91 years (mean 68 years). There were 447 males in the total sample and in six patients (1.3 per cent) dislocation occurred. There were 576 females in the sample and dislocation occurred in 13 patients (2.25 per cent). Overall, 0.6 per cent of the dislocations occurred in males and 1.3 per cent in females.

Other authors, for example Woo and Morrey (1982), have also found a higher rate of dislocation among female patients than male patients (p<0.001). The authors believed that muscle tone or muscle mass...
Box 1. Factors compared between dislocation and non-dislocation groups

OPERATIVE FACTORS
The surgeon who operated
Position on the operation list
Primary diagnosis
Age
Weight
Sex
Side of operation
Approach
Medical condition of the patients at the time of their dislocation
Previous operations on the hip

POST-OPERATIVE FACTORS
Surgeon's comments on operation note
Contributing factors in relation to dislocation
Range of hip motion post-operatively
Anterior or posterior dislocation
Reduction of dislocation - easy/difficult open/closed, early/late
Surgeon's post-dislocation management and the success rate of this
Revision surgery for dislocation

FEMORAL COMPONENT PLACEMENT
Vertical height in the proximal femur
Varus/valgus alignment of the femoral component in degrees
Anatomical offset
Hip factory planned offset
Component offset post-operatively (to assess offset mismatch)

COMPONENT HEAD SIZE
Head-neck ratio
Patients' post-operative range of motion

ACETABULAR POSITION AND ORIENTATION
Socket placement
Socket wire configuration
Cup inclination
Socket version - anteverted, retroverted, neutral

may play a role in this observed difference'. In the study reported here, the fact that ten of the 13 female patients received implants with small heads probably affected the level of incidence. Only two of the six males received implants with small heads.

Side In terms of the side that dislocated, 13 were left and six were right hips. From the total sample of 1,023 patients, 511 were right hips and 512 were left hips. Of the 576 women, 301 (52.3 per cent) were right and 275 (47.7 per cent) were left. Of the 447 males, 210 (47 per cent) were right and 237 (53 per cent) were left. Interestingly, ten of the 13 females whose hip dislocated had had their left hip replaced and three had had their right hip replaced. Females were significantly more likely to dislocate their left hip. The proportion who dislocated their left or right hip in the male group was equal.

Weight One patient was 'very' obese, thereby making surgery generally difficult and leaving the component slightly loose to distraction. Obesity was not seen as a major factor influencing dislocation in this sample.

Early or late dislocation Seventeen of the 19 dislocations were early. The average time from surgery to dislocation was 4.6 days. There were two late dislocations, one at six months and one at twelve months, both of which involved implants with small heads. Patients in this sample were significantly more likely to dislocate early.

Position on theatre list The relative position of the patient on a list did not influence the dislocation rate, although it must be considered a possible variable.

Primary diagnosis, medical condition and previous hip surgery In the dislocated group, 16 of the patients were diagnosed as having primary osteoarthritis of the hip. One female patient had congenital dislocation of her hip and an adduction deformity. One patient had avascular necrosis. Another female patient had suffered a fractured neck of femur, which was treated with a dynamic hip screw that failed and was subsequently converted to a custom total hip replacement. Previous surgery has been shown to increase the likelihood of dislocation (Ali Khan et al 1981, Beckenbaugh and Ilstrup 1978, Dorr et al 1983, Fackler and Poss 1980, Lewinnek et al 1978).

Three patients who dislocated had medical conditions that make dislocation more likely, (Ali Khan et al 1981, Fackler and Poss 1980): one was mentally handicapped and became confused post-operatively; another had a long standing left hemiplegia with a fixed adduction contracture; and a male patient who was an alcoholic and became very confused in the high dependency unit post-operatively, was also considered to be at a higher risk of dislocation (Ali Khan et al 1981, Sheppeard et al 1980).

The common denominator for all these dislocations was 'improper patient positioning' (Rothman and Plozack 1988). This has been defined as: 'When the patient assumes a position that exceeds the mechanical stability of the prosthesis.'
Table 1. Number of operations by surgeon

<table>
<thead>
<tr>
<th></th>
<th>22.225mm heads</th>
<th>28mm heads</th>
<th>Total operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>(No. of dislocations)</td>
<td>(No. of dislocations)</td>
<td>(Dislocation rate)</td>
<td></td>
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<tr>
<td>Surgeon A</td>
<td>104 (8)</td>
<td>413 (5)</td>
<td>517 (2.5%)</td>
</tr>
<tr>
<td>Surgeon B</td>
<td>14 (1)</td>
<td>302 (2)</td>
<td>316 (0.9%)</td>
</tr>
<tr>
<td>Surgeon C</td>
<td>141 (3)</td>
<td>49 (0)</td>
<td>190 (1.57%)</td>
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Table 2. Dislocation rate by surgeon (percentage)

<table>
<thead>
<tr>
<th></th>
<th>22.225mm heads</th>
<th>28mm heads</th>
<th>Overall</th>
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</thead>
<tbody>
<tr>
<td>dislocation rate</td>
<td>dislocation rate</td>
<td>dislocation rate</td>
<td></td>
</tr>
<tr>
<td>Surgeon A</td>
<td>7.7</td>
<td>1.21</td>
<td>2.5</td>
</tr>
<tr>
<td>Surgeon B</td>
<td>7.14</td>
<td>0.66</td>
<td>0.9</td>
</tr>
<tr>
<td>Surgeon C</td>
<td>2.12</td>
<td>None</td>
<td>1.57</td>
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Table 3. Range of hip motion

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<thead>
<tr>
<th></th>
<th>Minimum range of motion</th>
<th>Maximum range of motion</th>
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<tr>
<td>(Dislocation group)</td>
<td>225.5°</td>
<td>255°</td>
</tr>
<tr>
<td>(Control group)</td>
<td>220°</td>
<td>290°</td>
</tr>
</tbody>
</table>

Khan et al (1981) reported that in 3,935 lateral or anterolateral approaches there were 74 dislocations (1.9 per cent); and from 2,527 posterior approaches there were 53 dislocations (2.1 per cent). The authors stated that the surgical approach seemed not to influence the dislocation rate.

In this study the rate of dislocation when using a 28mm head and the posterior approach appears acceptable. Surgeons may find the modified posterior approach as used in this centre technically more demanding. For a posterior approach, patients are placed in a lateral position, whereas for an anterior approach they are placed supine. The lateral position is implicated because the pelvis tips in such a way as to make it technically more difficult to position the acetabular cup in the correct degree of flexion, abduction/adduction, than when the patient is supine, with the resulting tendency to produce component malposition.

**POST-OPERATIVE FACTORS**

**Contributing factors**

In terms of contributing factors in relation to dislocation, eight patients had significant ‘activity related’ or ‘improper positioning’ factors such as: during transfer in theatre; as the result of a fall; as the result of abnormal movements; during an episode of confusion post-operatively; and due to extreme flexion.

In the other 11 patients, three dislocations occurred while sitting down on a chair, two in the high dependency unit, one in bed on the ward, one in a car on the way home from review (16 days post-operatively), two while getting out of bed (flexion combined with rotation), one when turning away from the hip (rotation combined with extension), and one when the patient arose from her chair on day five post-operatively.

**Range of hip motion post-operatively**

Of the 19 patients who dislocated, 14 have been reviewed after one year. At review, a physical examination is carried out which includes an assessment of the range of hip motion. A further sample of 140 patients who had not dislocated and who had also been reviewed, were selected at random for comparison of their range of hip motion (Table 3). This was to determine whether or not the range of motion of the hip after prosthetic replacement might predispose to instability. Although all patients are cautioned against certain extreme positions of the hip, these limits can be exceeded easily in daily activities.

It is evident that the mean range of motion in the dislocated hips is higher and may be a factor influencing dislocation. However, a greater range of motion does not necessarily imply instability. The lax capsule that is observed when a dislocation occurs late suggests that motion may increase with time, and the increased motion may allow impingement that causes instability.

**Reduction of dislocation**

In relation to the reduction of dislocations, there were six open and 13 closed reductions. Dislocations that did not recur after reduction were labelled ‘one’ and the others ‘recurrent’. Fourteen of the patients had only one episode of dislocation and five had recurrent dislocation. In our study, four of the 22.225mm heads dislocated more than once (0.39 per cent) and one 28mm head dislocated more than once (0.9 per cent). Therefore, a 22.225mm head was not only more likely to dislocate, it was also more likely to dislocate more than once.

In terms of the patients’ management, nine patients were routinely mobilised following reduction of dislocation. It is standard practice for surgeons who carry out custom hip replacement to mobilise patients immediately following satisfactory reduction (Beverland 1996b). Two patients who were admitted to another unit following dislocation had skin traction applied – one for two days and the other for seven days – after which they were mobilised.

The use of an abduction brace around the hip to maintain abduction and occasionally to limit flexion has been described in the literature (Clayton and Thirupathi 1983, Dorr et al 1983). Both studies attested to the usefulness of bracing. Four patients in this study were treated with an abduction brace for eight weeks without further dislocation.

Three patients had their sockets revised from 22.225mm to 28mm inner diameter. One patient had...
the modular femoral head changed to a longer neck size to increase tension in the replaced joint.

DISCUSSION
In the analysis of results, differences between groups were examined statistically using confidence interval analysis (Gardner and Altman 1989).

Femoral head size was seen to be the most important factor in this series. The smaller femoral head size was significantly more likely to dislocate (p<0.01). A small head was not only more likely to dislocate it was also more likely to dislocate more than once. It was concluded that a 28mm head size is to be recommended for the Custom X-Press hip. In custom prostheses where there is a thick taper (12-14mm taper) and a small head, there is a higher risk of dislocation. The influence of the various modular head sizes on dislocation rates must be reviewed in future studies. It is important to remember that the use of a large head does not eliminate instability (Lowell 1974).

Most of the dislocations in this study (16) were posterior and this may reflect the influence of the surgically created defect on the direction of dislocation. However, the dislocation rate when using a 28mm head and the posterior approach appear acceptable. Clearly, surgical technique and expertise play a role, and some surgeons who use the posterior approach may achieve a stable hip in a higher percentage of patients than is reported in the literature.

Posterior dislocations were evident in our series even if there was adequate anteversion of the cup. According to Pierchon et al (1994): "Even 25° of anteversion does not prevent posterior dislocation: The maximum degree of retroversion in this study was 15°, however this did not influence the dislocation rate. This might seem surprising but often it is not measured in other studies, and therefore this issue requires further study to establish thresholds in relation to the version of the acetabular component.

The custom hip design aims to restore normal hip biomechanics and should be theoretically more stable. It is evident that the mean range of motion in the dislocated hips is higher and may be a possible factor influencing dislocation. Patients' hips in this study were significantly more likely to dislocate early. Also, the two hips which dislocated late were both in female patients and both had small femoral heads. Late instability may be due to the fact that patients become more active as time passes and if there is intrinsic instability of the joint, for example through malposition of the components, this may lead to impingement or in fact dislocation. In this sample, females had a higher frequency of dislocation than male patients.

When the level or experience of the surgeon was examined, there was no evidence of any statistical difference in dislocation rate. However, surgical experience and technical expertise must have a bearing on dislocation rates in total hip replacement.

Significant 'improper patient positioning' factors do influence dislocation rates. In the dislocated hips, eight patients have been classified as having been involved in activity deemed unsafe in terms of preventing dislocation. This is extremely difficult to quantify as we do not know if patients in the control group were performing similar activities and not dislocating. Therefore, dislocation may often be patient activity related and not simply incorrect orientation of the components.

This study suggests that patients with neuromuscular disorder, those in a confused mental state and those who have had previous surgery to their hip or revision operations are probably at increased risk of dislocation. Since 25 per cent of the dislocations reported in Woo and Morrey's study (1982) occurred after one year, the length and completeness of documentation and follow-up are critical for the determination of the true frequency of this complication. This report does include all known dislocations, since the outcome process for custom hips specifically elicits such information. However, many patients with uncomplicated dislocations are treated in their local hospital and may not come to the attention of the orthopaedic surgeon or the multidisciplinary audit department.

In only one case in the dislocated group could malalignment of the components be seen as the definitive cause of dislocation. There can be, therefore, little doubt that the problem of dislocation following hip replacement is a complex, multifactoral problem. Most clinical studies of dislocation involve one group of patients having a given factor or factors and another group of patients without that factor.

Statistical differences between the groups are calculated using one of several simple means. This approach can be powerful, but it can fail to disentangle other (sometimes interrelated) factors that might contribute more to the results than the factors under consideration. With simple analysis one factor that seems to be significant is often found to be irrelevant when other factors are considered. It is difficult to identify the major influences in a multifactorial problem when known factors are difficult to quantify (for example, patient activity) and when there are likely unidentified factors.

In this study an effort was made to identify the most relevant factors. Another important aspect of this study is that the data recorded on each patient is standardised using clinical and radiological evaluation of total hip replacement (CART) (Johnson et al 1990). Standardisation of studies allows for multi-centre comparison.

PREVENTION
Prevention of dislocation is better than treatment. Patients must be advised to avoid excessive flexion and adduction of the hip in the first six weeks following surgery and should externally rotate and abduct their hips when sitting (Davis 1994, Footner 1987, Love 1994). The restoration of correct tension in the soft tissues and musculature around the hip is impor-
tant and to this end the custom hip is designed to reconstitute the natural centre of rotation of the femur in each individual to ensure correct tension in the soft tissues and thus avoid dislocation.

**CONCLUSION**

This study has shown that a combination of factors contribute to the problem of dislocation. Prevention is better than treatment and there is clear evidence from the nursing and medical literature that increasing experience and careful technique coupled with comprehensive patient education will minimise this complication of total hip replacement.

If multidisciplinary teams are brought together to look at health outcomes in orthopaedics, it will lead to positive outcomes for the organisation and better patient care in total joint replacement.

**Implications for practice**

1. Nurses must provide effective patient education in relation to mobility and range of physical activity to decrease the incidence of dislocation in hip replacement patients.
2. Detailed pre-operative planning is required to ensure that patients do receive an implant which matches their joint anatomy as closely as possible around the time of surgery.
3. Nurses must be aware that in most patients dislocation is more likely to occur in the first six weeks post-operatively.
4. Nursing care of the patient post-operatively should take into consideration the range of factors which predispose to dislocation.

Next week’s article considers how factors such as femoral component placement and component head size affect dislocation rates.

**REFERENCES**

Beverland DE (1996a) Personal communication. Post operative management of custom cemented total hip replacement.