FAILURE OF ACETABULAR CUPS INFLUENCED BY MARKER WIRE ANCHORAGE

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Failure of an acetabular cup is uncommon and has been attributed to wear or creep, trauma or bony irregularities in the acetabulum. We report ten cases in which fracture of the cup occurred at the site of drill holes used to anchor the marker wire.

The role of such indentations as stress raisers has not been previously reported; we suggest that deep indentations or grooves should not be placed in the most highly stressed areas and that the cup thickness should allow for predicted wear rates.

Revision of a hip arthroplasty for mechanical failure of a component is rare, and usually involves fracture of the femoral stem (Charnley 1975; Johnsson, Thorngren and Persson 1988). We could find only ten reported cases of mechanical failure of the acetabular cup (Salvati et al 1979; Volz 1980; Harley and Boston 1985).

We report ten cases of failure of the acetabular cup attributable to the design of the implant and its orientation in the acetabulum.

PATIENTS

Details of the ten cases are given in Table I. All had Müller total hip replacements using acetabular cups of 44 mm external diameter and 32 mm inside diameter. In all ten cases, the postoperative radiographs showed that the cup had been cemented with the gap in the marker wire placed superiorly. This orientation had occurred entirely by chance.

Failure of the cups was at seven to eight years after implantation. In one patient (case 1) the onset of pain and difficulty in walking was after a fall, but the others reported gradual deterioration with no history of trauma or any sudden change. In all ten cases, the acetabular marker wire was displaced and the femoral head had migrated proximally and medially to give a ‘slipped halo’ sign (Figs 1 and 2). At revision operation, each of the acetabular cups had fractured at the site at which the two ends of the marker wire had been turned in, and there was some local fragmentation. There were no fractures or significant irregularities of the bony acetabula.

Measurement of the remaining wall thickness of the cups gave a mean rate of wear of 0.19 mm per year (0.13 to 0.25). This rate is comparable with those previously reported (Dowling et al 1978; Livermore, Ilstrup and Morrey 1990).

DISCUSSION

The acetabular components in these cases were manufactured from high density polyethylene with a marker wire

Table I. Details of ten cases of mechanical failure of an acetabular cup

<table>
<thead>
<tr>
<th>Case</th>
<th>Sex</th>
<th>Weight (kg)</th>
<th>Age at failure (yr)</th>
<th>Time after original THR (yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>58.5</td>
<td>75</td>
<td>8*</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>75</td>
<td>76</td>
<td>7</td>
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<tr>
<td>3</td>
<td>F</td>
<td>55</td>
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<td>4</td>
<td>F</td>
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</tr>
<tr>
<td>10</td>
<td>F</td>
<td>63</td>
<td>75</td>
<td>8</td>
</tr>
</tbody>
</table>

* definite trauma

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Anteroposterior radiographs of a right hip before and after fracture of the acetabular cup.

Diagram of a cross-section of an acetabular cup showing the wire fixation, the grooves and a representation of wear.

Inset around the rim in an equatorial groove 1 mm deep. The wire was anchored by bending each of its ends to 90° and inserting them into two 4 mm holes drilled in the floor of the groove. The site of these holes is visible radiologically as a gap in the wire. Each cup has two other circumferential grooves; a deep one near its apex and an intermediate one which is 1 mm deep (Fig. 3).

In each of our ten cases, the cup had been inserted with the marker wire anchorage point placed superolaterally and the cup fracture had occurred through it, being visible radiologically by disruption of the normal shape of the marker wire.

An acetabular cup with an external diameter of 44 mm and an internal diameter of 32 mm can only have a maximum wall thickness of 6 mm. At the base of the drill holes in the rim of the cup, the thickness of the polyethylene is approximately 2 mm. When this region of the cup is placed, by chance, in a superolateral position, normal wear is more likely to cause a fracture through this weakened zone.

Examination of the cups at the revision operations showed that the superior aspect of the cup had been affected by wear. All the fractures passed through one of the wire retaining holes and appeared to propagate to the apical groove and then pass circumferentially (Fig. 4). This pattern of failure has been reported, but the
influence of the anchoring holes as stress raisers and potential points of weakness has not previously been emphasised.

We conclude that the failures in our ten patients were due to the combination of chance cup orientation, cup wear and local weakness due to the anchoring points of the marker wire. The implications are that the design of cups should anticipate wear by using thicker polyethylene (a larger cup or a smaller head), avoiding deep grooves and indentations, and that the orientation of this type of cup has some significance.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

REFERENCES


