MIDLINE OR PARAPATELLAR INCISION FOR KNEE
ARTHROPLASTY

A COMPARATIVE STUDY OF WOUND VIABILITY

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The viability of three incisions for knee arthroplasty were analysed by transcutaneous estimation of the skin oxygen tension. Wound viability was found to be significantly reduced following knee arthroplasty. The lateral wound edge is more hypoxic than the medial, but there were no significant differences between the three incisions.

Design modifications in prostheses for knee arthroplasty has resulted in dramatic reduction of the once high incidence of implant failure. Good or excellent results have been reported in over 90% of cases (Insall, Lachiewicz and Burstein 1982; Hungerford and Krackow 1985; Goodfellow and O'Connor 1986), but complications of wound healing occur in 16% (Insall et al. 1982). Superficial infection has been found to occur in 6.4% of cases and though it usually settles with treatment, a proportion progress to become a deep infection. This usually results in failure of the arthroplasty, and salvage even by arthrodesis is not always successful (Johnson and Bannister 1986).

Wound healing in elderly arthritic patients depends upon many factors. The most important following knee arthroplasty are: the orientation of the incision to the skin cleavage lines, the tension to which the incision is subjected while healing and the viability of the wound edges (Niinikoski 1977; Bucknall 1984).

Previously the most commonly used incision for knee arthroplasty was the curved medial incision though this has become unpopular because of problems with wound healing. Recently the medial parapatellar incision centred upon the medial border of the patella, and the anterior midline incision have been preferred. The medial parapatellar incision is aligned parallel to the skin cleavage lines and is subjected to significantly less disrupting wound tension than the anterior midline incision during knee flexion (Johnson, Houghton and Radford 1986). Consequently the medial parapatellar incision can be expected to accumulate collagen, to gain strength faster, and to be less likely to undergo dehiscence during early mobilisation than the anterior midline incision.

The other major factor influencing wound healing is the viability of the wound edges produced by the incisions. The longer lateral flap created by the medial parapatellar incision and the curved medial incision relies on the lateral geniculate vessels. This skin flap may be subject to poor skin oxygenation. Transcutaneous estimation of the skin oxygen tension (Tc PO2) is now possible (Rooth, Hedstrand and Ogren 1979; Dowd, Linge and Bentley 1983; Christensen and Klarke 1986), and is superior to other methods of measuring skin viability and of determining the capacity of the local circulation to deliver oxygen to the skin (Dowd 1982; Franzczek et al. 1982). The technique of Tc PO2 estimation is safe, free of complications, easy to use, non-invasive, reliable and repeatable. In the present study it has been used as a measure of wound viability in a comparison of the medial parapatellar incision with the anterior midline and the curved medial incision.

PATIENTS AND METHODS

Sixteen knee arthroplasties in 13 patients were investigated; seven operations were for rheumatoid arthritis and nine for osteoarthritis. The operations were randomly allocated one of the three incisions; an anterior midline incision, a curved medial incision or a medial parapatellar incision (Fig. 1). Pre-operatively Tc PO2 estimations were taken from the site of the medial and lateral wound edges adjacent to the midpoint of the proposed incision. Further recordings were made from the identical sites on the first and eighth postoperative day. The wounds were inspected daily and the site and severity of any wound healing problems noted. The
results were statistically analysed using the chi-squared
Student's r-test and by the analysis of variance.

For the Tc PO2 estimations the Radiometer TCM
oxygen monitor was used with a Clarke electrode. The
patients were placed supine with pillows to support the
head and the skin was prepared by cleaning with alcohol.
A plastic fixation ring was attached to the skin, a drop of
contact fluid placed on the skin, and the electrode screwed into the fixation ring. The electrode heats the
skin to 44°C causing dilatation of the cutaneous capillary
network. When an equilibrium has been achieved
between the cutaneous capillary network and the oxygen
electrode, the oxygen tension displayed is recorded.

RESULTS

Tc PO2 measurements demonstrated that pre-operative-
ly the skin was well oxygenated. There was a significant
reduction in the oxygenation of the wound on the first
post-operative day averaging 67% of the pre-operative
value (p < 0.01). The oxygenation improved during the
postoperative period and the Tc PO2 measurement on
the eighth postoperative day averaged only 16% less than
the pre-operative value, a difference which is not
significant (Table I). The Tc PO2 of the medial wound
edge was significantly higher than that of the lateral
wound edge, pre-operatively and throughout the post-
operative period (p < 0.01) (Fig. 2).

There were no significant differences between the
results for the different incisions, although the absolute
values for the anterior midline incision were marginally
higher than those for the other two incisions. The lateral
flap had higher Tc PO2 values with the midline incision,
than did the larger lateral flaps of the other incisions, but
once again the differences were not statistically signifi-
cant (p < 0.2).

Of the 16 cases clinical evidence of a delay in wound
healing occurred in only two. In both cases there was
discoloration of the central part of the lateral wound edge
following a curved medial incision. This occurred after a
period of immobilisation. The pre-operative Tc PO2
measurement was of no value in predicting delay in
wound healing, but both patients had very low Tc PO2
measurements in the lateral wound edge on the first
postoperative day. Even in this small study the curved
medial incision (now largely abandoned) appeared to be
associated with a higher incidence of wound healing
problems and poor oxygenation of the lateral wound flap.

There was no difference in the pre-operative Tc PO2
measurements of those patients with rheumatoid arth-
ritis compared to those with osteoarthritis. In the
postoperative period the oxygenation of the wound was
lower in the rheumatoid patients but the difference was
not statistically significant.

DISCUSSION

Adequate oxygenation and viability of the wound edges
is a major factor determining wound healing following
any incision. The oxygen gradient created between the
capillaries of the wound edge and the centre of the wound
stimulates angiogenesis and the migration of macro-
phages and fibroblasts into the wound. However if the
wound edges are hypoxic, angiogenesis, the migration of

Table I. Transcutaneous skin oxygen tension in mmHg on each side of the incisions at various stages, with the standard deviation in parentheses

<table>
<thead>
<tr>
<th>Incision</th>
<th>Side</th>
<th>Pre-operative</th>
<th>Day 1</th>
<th>Day 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midline</td>
<td>Medial</td>
<td>65.0 (17.4)</td>
<td>36.6 (18.0)</td>
<td>60.6 (14.6)</td>
</tr>
<tr>
<td></td>
<td>Lateral</td>
<td>59.4 (19.0)</td>
<td>23.6 (16.7)</td>
<td>51.2 (11.9)</td>
</tr>
<tr>
<td>Curved</td>
<td>Medial</td>
<td>67.0 (11.3)</td>
<td>31.2 (13.6)</td>
<td>57.2 (19.5)</td>
</tr>
<tr>
<td>medial</td>
<td>Lateral</td>
<td>60.2 (7.7)</td>
<td>15.7 (15.2)</td>
<td>41.2 (14.6)</td>
</tr>
<tr>
<td>Medial parapatellar</td>
<td>Medial</td>
<td>52.4 (16.4)</td>
<td>28.8 (10.9)</td>
<td>45.4 (10.0)</td>
</tr>
<tr>
<td></td>
<td>Lateral</td>
<td>46.8 (16.2)</td>
<td>16.6 (9.7)</td>
<td>40.2 (11.9)</td>
</tr>
<tr>
<td>Mean</td>
<td>Medial</td>
<td>61.8 (15.4)</td>
<td>32.1 (13.8)</td>
<td>54.6 (15.9)</td>
</tr>
<tr>
<td></td>
<td>Lateral</td>
<td>55.8 (15.0)</td>
<td>18.4 (13.8)</td>
<td>44.0 (13.1)</td>
</tr>
</tbody>
</table>

Mean transcutaneous skin oxygen tension on the medial and the lateral
sides of the incisions at various stages.
macrophages and fibroblasts and consequently the cellular response of wound healing is inhibited. In areas of low oxygen tension the cellular function of fibroblasts and macrophages also is inhibited (Niinikoski 1977).

This study has analysed the viability of the wound edges produced by three incisions for knee arthroplasty using the transcutaneous assessment of skin oxygen tension. The results demonstrate that before the operation the vascularity of the skin over the anterior and medial aspects of the knee is good, but with all the incisions it is reduced in the early postoperative period and has not fully recovered by the eighth postoperative day. This may have important implications for early mobilisation, since hypoxia may delay healing and increase the risk of wound breakdown and infection. This may explain why knee arthroplasty is more susceptible than hip arthroplasty to failure of wound healing and to infection.

The lateral aspect of the wound has been found to have a significantly lower oxygenation and viability than the medial side throughout the postoperative period. The recorded Tc PO2 value on the first postoperative day correlated well with the occurrence and site of clinical wound discoloration and delayed healing. However, patients at risk could not be identified from the preoperative measurements, contrary to experience with amputation stump healing (Dowd et al. 1983; Christensen and Klarke 1986).

When the oxygenation of the medial parapatellar incision, and particularly its longer lateral skin flap, was compared with that of the anterior midline incision, no statistically significant reduction in wound viability was found; and since the medial parapatellar incision is in alignment with the skin cleavage lines, it is the preferred incision for knee arthroplasty. The curved medial incision, now seldom used, showed particularly low levels of oxygenation in the long lateral flap; this was the only site at which healing problems were encountered.

Patients suffering from rheumatoid arthritis are known to be subject to impaired wound healing, but in this small series there was no discernible difference in the oxygenation of the wounds between them and the osteoarthritic patients. Therefore impaired wound oxygenation was considered not to be the cause of the increased incidence of wound healing problems in rheumatoid patients, though this would be worthy of further investigation.

Conclusion. Following knee arthroplasty the viability of the wound, especially on the lateral side, is significantly reduced in the early postoperative period. The viability of the medial parapatellar incision is not significantly lower than that of the anterior midline incision; it is therefore preferable as it is aligned to the skin cleavage lines and is subjected to less disrupting wound tension during mobilisation.

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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


