WEDGE RESECTION OF AMPUTATION STUMPS
A VALUABLE SALVAGE PROCEDURE

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We describe the technique of wedge resection for revision of an amputation stump, and report the results of this at below-knee level in 57 patients with peripheral vascular disease; healing occurred in 42 of these (74%).

Wedge resection as a salvage procedure for unhealed below-knee amputation stumps, which would otherwise require re-amputation at a higher level, was described by Murdoch in 1977. Kronberg and Netz (1984) have recently reported four successful cases, but no large series has been published.

Wedge resection is appropriate for stumps which fail to heal because of a localised area of ischaemia and infection around the suture line, but without major necrosis of the flaps.

The principle of the procedure is to regard the end of an amputation stump as a hemisphere. Any local excision which does not encompass the entire hemi-circumference, or which is not deepened to the centre of the hemisphere, will, when sutured, produce a local increase in tension near the centre of the flaps (Fig. 1). Since this tissue is already critically ischaemic further necrosis will follow. If, however, a wedge incorporating the full diameter of the stump is excised, the "hemisphere" may be re-formed without distortion and tension is avoided (Fig. 2). Necrotic tissue is removed without dissection of tissue planes and the consequent risk of spreading infection.

Technique of operation. The procedure is most suited to below-knee stumps fashioned with a long posterior flap, but may also be applied to above-knee stumps. Prophylactic benzylpenicillin is given peri-operatively.

The skin incision is an ellipse encompassing all non-viable tissue and the full length of the original suture line (Fig. 3). The posterior incision is deepened by sharp dissection through the calf muscles to encounter bone at a level above the upper limit of ischaemic tissue. A wedge of tissue is then removed en bloc by using a Gigli saw to cut anteriorly through both bone and soft tissue (Figs 4 and 5). The tibia is then contoured in the usual way, and the wound is closed in two layers (muscle and skin) over suction drainage, the revised stump usually being encased in plaster.

PATIENTS AND METHODS
Review of the records at the Dundee Limb Fitting Centre showed that, from 1967 to 1984, wedge resection had been performed on 57 stumps for revision of below-knee amputation. There were 43 men and 14 women, with an average age of 67.7 years (range 42 to 91 years). Of these, 47 patients had their initial amputation in Dundee, while 10 had been referred for prosthetic fitting after amputation elsewhere. In all cases the primary amputation had been by the standard long posterior flap technique, though one had a medially skewed flap. All but one were performed for vascular insufficiency, the exception being an 85-year-old woman with melanocarcinoma; 17 patients (30%) were diabetic. The average time from amputation to revision by wedge resection was 47.9 days (range 17 to 141 days).

Stumps were regarded as "healed" after wedge resection only when they were ready for fitting with a permanent prosthesis.

RESULTS
After wedge resection, 42 of the 57 stumps (74%) had healed in an average of 30.6 days from operation (range 10 to 81 days). By the stringent criteria of the rehabilitation medical staff, 24 stumps were entirely

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Fig. 1

LOCAL RESECTION

Fig. 2

WEDGE RESECTION

Diagrams of end-on and side views of amputation stumps. Local resection produces uneven tension; this is reduced and evenly distributed after wedge resection.

satisfactory (57%). No comment was recorded in seven cases (17%), while 11 patients (26%) had the problems shown in Table I. All of these patients were, in fact, successfully fitted with a prosthesis.

Wedge resection was unsuccessful in 15 patients (26%). Five of these died within two months of the procedure and are classed as failures since they were not fitted with a prosthesis. Seven stumps had to be re-amputated above the knee, and three patients had a further wedge resection. Only one of these three was successful; this healed in 26 days. The other two patients each had a third wedge resection, but neither was successful and both needed revision to an above-knee level. There was no significant difference in the success rate or healing times between diabetic and non-diabetic patients.

Of the 42 patients whose wedge resection was successful, 37 or 88% were discharged to their own homes at an average time of 65.4 days after operation (range 17 to 148). Of the whole series of 57 patients, 45 (79%) eventually returned to their own homes, while all surviving patients were successfully fitted with a below-knee or above-knee prosthesis.

The average time of survival after successful wedge resection was 3.4 years (range 3 months to 9.5 years); after unsuccessful wedge resection, excluding deaths within 60 days of operation, the mean survival was 1.6 years (range 3 months to 4.6 years).

Table I. Complications and fitting problems seen in 42 healed stumps after wedge resection

<table>
<thead>
<tr>
<th>Complication</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion contracture of knee</td>
<td>2</td>
</tr>
<tr>
<td>Short stump</td>
<td>2</td>
</tr>
<tr>
<td>Painful stump</td>
<td>2</td>
</tr>
<tr>
<td>Ulcerated stump</td>
<td>1</td>
</tr>
<tr>
<td>Bulky stump</td>
<td>1</td>
</tr>
<tr>
<td>Significant phantom pain</td>
<td>1</td>
</tr>
<tr>
<td>Recurrent sebaceous horn</td>
<td>1</td>
</tr>
<tr>
<td>Late sinus formation</td>
<td>1</td>
</tr>
</tbody>
</table>

Fig. 3

Operation for wedge resection. Figure 3 – Elliptical incision across the whole width of the stump. Figure 4 – Use of Gigli saw to excise the wedge of tissue. Figure 5 – Before suture, showing the newly contoured tibial stump.
DISCUSSION

Most patients requiring an amputation for peripheral vascular disease are elderly. The advantages of a below-knee over an above-knee stump for this group are recognised in terms of postoperative mobilisation (Pedersen 1968), reduced energy expenditure (Waters et al. 1976), and the convenience of using a much less cumbersome prosthesis.

Modern techniques of pre-operative assessment of ischaemic limbs (Burgess and Matsen 1981) enable the level of amputation to be chosen with more confidence than formerly; this is reflected in an increasing ratio of below-knee to above-knee amputations. In Dundee, where approximately 90 major amputations for ischaemia are performed each year, the BK:AK ratio has changed from 1:1 in 1967 to 2.4:1 in 1984. Although the success rate of below-knee amputation is around 90%, it is inevitable that some stumps will fail to heal: this must be accepted as the price to be paid for attempting to preserve the knee joint whenever possible. For patients suffering a localised area of necrosis or infection, wedge resection appears to give a 70% chance of successful healing, and a good result in terms of prosthetic fitting, discharge from hospital and quality of the stump. Although the operation involves some shortening of the tibia, only two of the resulting stumps were short enough to pose fitting problems, despite which both had satisfactory below-knee prostheses.

The principle of wedge excision has also been applied to late revision of healed stumps for problems such as neuroma or adherence of scar to bone.

REFERENCES