A TECHNIQUE FOR DIFFICULT ARTHRODESIS OF THE KNEE

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Twenty knees, in which a total of 32 previous operations had been performed, were arthrodesed by the Charnley compression technique combined with intramedullary nailing. Patients with previous infection were excluded from the series, but three neuropathic knees were included. Bony union was evident after an average of six months in all but one patient who died three months after operation. One patient developed deep infection that resolved after removing the nail. The combined technique is simple and only limited bone resection is needed; it gives immediate stability and relief of pain with minimal morbidity.

Arthrodesis has proved its value over the years as a useful and lasting salvage procedure for many disabling knee problems; various techniques have been used with varying degrees of success (Charnley and Baker 1952; Green, Parkes and Stinchfield 1967; Drennan, Fahey and Maylahn 1971; Stulberg 1982). In 1932 Key recommended positive pressure in arthrodesis of the knee using a turnbuckle apparatus, and in 1948 Charnley renewed and refined this compression technique. A 98.8% success rate for fusion was reported by Charnley and Baker in 1952. Orthopaedic surgeons have always faced the challenge of arthrodesing a knee with Charcot’s disease, but the challenge in the modern era is that of fusing a knee after failed total knee replacement.

Drennan et al. reviewed the English literature in 1971 and assessed the incidence of successful fusion of knees with Charcot’s disease as being only 55% (after a long follow-up). In 1982 Stulberg reviewed the results of arthrodesis for failed total knee replacements (usually by external fixation); the success rate varied from 25% to 100%, with an average of 74%. In 1948, Chapchal introduced intramedullary nailing for knee arthrodesis; the nail was inserted through a window in the anterior aspect of the femur. This technique often failed when applied to neuropathic knees (Stack 1952; Brashear 1954; Mazet and Urist 1960; Green et al. 1967).

Holt (1957) succeeded in fusing five neuropathic knees by combining Charnley compression and intramedullary nailing. We have modified Holt’s technique to attain fusion in various difficult cases of knee arthrodesis.

MATERIAL AND METHODS

Patients. Combined intramedullary Küntscher nailing and Charnley compression was performed in 20 knees in 19 patients, 6 of whom were men. The age varied from 44 to 78 years with an average of 65 years. The primary disease was osteoarthritis in 12 knees, rheumatoid arthritis in 5, and neuropathic arthritis (Charcot’s disease) in 3.

A total of 32 operations had been carried out previously on the 20 knees; the details are shown in Table 1. All these operations were carried out on separate occasions.

Table 1. Previous operations

<table>
<thead>
<tr>
<th>Operation</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed Charnley compression arthrodesis</td>
<td>18</td>
</tr>
<tr>
<td>Failed total knee replacement</td>
<td>5</td>
</tr>
<tr>
<td>Load angle inlay implant</td>
<td></td>
</tr>
<tr>
<td>Semiconstrained</td>
<td></td>
</tr>
<tr>
<td>Spherocentric</td>
<td>2</td>
</tr>
<tr>
<td>Attenborough</td>
<td>1</td>
</tr>
<tr>
<td>Un-united supracondylal femoral osteotomies</td>
<td>2</td>
</tr>
<tr>
<td>High tibial osteotomy</td>
<td>1</td>
</tr>
<tr>
<td>Patellectomy or synovectomy</td>
<td>3</td>
</tr>
</tbody>
</table>

Table II. Indications for the combined technique

<table>
<thead>
<tr>
<th>Indication</th>
<th>Number of knees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-union after Charnley compression arthrodesis</td>
<td>7</td>
</tr>
<tr>
<td>Failed Charnley compression arthrodesis after arthroplasty</td>
<td>3</td>
</tr>
<tr>
<td>Failed arthroplasties</td>
<td>5</td>
</tr>
<tr>
<td>Un-united supracondylal femoral osteotomy</td>
<td>2</td>
</tr>
<tr>
<td>Neuropathic joints</td>
<td>3</td>
</tr>
</tbody>
</table>

The indications for performing the combined technique are shown in Table II, and examples in Figures 1 to 14.

Technique. It is imperative to have pre-operative radiographs of the whole of the femur and of the tibia so that the degree of bowing and the width of the medullary canals can be assessed. The length and the diameter of the Küntscher nail should be calculated and ordered before operation. Previous scars should be used whenever.

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possible for the incision, and thin skin flaps should be avoided.

The lower end of the femur and the upper end of the tibia are exposed. The bone ends are cut at right angles to the longitudinal axes and removed. A Kuntscher nail of suitable length and diameter is passed up the medullary canal of the femur emerging through the greater trochanter; it is then passed down the medullary canal of the tibia to about half way. There is no need to ream the medullary canals.

The Steinmann’s pins are now inserted, avoiding the side slot of the Kuntscher nail (Fig. 7). If necessary, two sets of compression clamps (arranged perpendicular to each other) may be used. If indicated, the patella may be used as a bone graft, either as a free graft or screwed to the front of the knee.

The combined technique should not be applied to previously infected knees. In our series, infection was considered absent if there were no clinical or radiographic signs of infection, the white blood count and the ESR were within normal limits, and swabs taken during the operation did not grow organisms. The diagnosis of syphilis in the three patients with Charcot’s disease was based on a positive history and clinical signs, and verified by serological tests.

Double clamps were used on three occasions and bone grafts in nine. Four bone grafts were taken from the patella, two from the patella and part of the femoral condyles, and three from the iliac crest. Synovectomy was performed in one of the three neuropathic knees.

**Postoperative routine.** The Charnley clamps were left in position for 2 to 10 weeks, with an average of four weeks. After their removal a plaster cylinder was applied and retained for an average of four weeks, followed by some other form of external support until bony union was achieved.

**RESULTS**

The average follow-up was 7½ years, with a range from 1 to 19 years (excluding one patient who died of ischaemic heart disease three months after operation and before bony union was evident). Sixteen of the 19 patients were interviewed by one of us (NRMF) for the purpose of this study. The follow-up of the remaining two was extracted from carefully documented notes and radiographs.

One of the patients developed deep infection, which was eradicated after removal of the Kuntscher nail and irrigation of the medullary canals with gentamicin solution. There were two instances of pin-track infection and one of superficial infection with skin necrosis; all settled with simple measures.

Two Kuntscher nails had to be removed because of discomfort; one had to be reinserted because of proximal migration, and one penetrated the cortex of the tibia (but with no ill effects).
None of the patients complained of pain in the operated knee, but two had tenderness around it.

Union was considered to have taken place when the knee was painless without external support, and had radiographic evidence of union. It was achieved in all but the patient who died. Fusion occurred after an average of six months, ranging from 2 to 11 months.

Shortening on the operated side averaged 3.75 cm and a shoe-raise (average height 1.25 cm) was needed in 17 of the 19 patients.

DISCUSSION

As tuberculous and syphilitic arthritis have, like poliomyelitis, decreased in the West, and as the technique of total knee arthroplasty has continued to improve, so the indications for knee arthrodesis have decreased. However, occasionally the orthopaedic surgeon faces a problem knee which requires arthrodesis (Figs 9 and 10), but in which a standard Charnley compression technique is likely to prove inadequate.

In the presence of infection, external fixation using multiple pins is the method of choice (Stulberg 1982); but in the absence of infection, many alternatives, performed separately or in combination are available. Neuropathic knees are an acknowledged problem, but Figures 11 to 14 show a successful result with our technique, whereas fusing these knees by Charnley compression alone may well be unsuccessful (Stewart and Bland 1958; Valls 1958; Cristina and Marchetti 1961). Similarly, intramedullary nailing alone was unsuccessful and was associated with many complications in the series reported by Stack (1952), Brashear (1954), Mazet and Urist (1960), and Green et al. (1967). Only Drennan et al. (1971) reported successful fusion in all of the nine neuropathic knees they fused using intramedullary nailing as described by Chapchal (1948). They stressed the importance of synovectomy and the application of protective casts until bony union was evident. However, Horwitz in 1948 had 10 failures in 12 neuropathic knees, despite synovectomy and debridement. Successful fusion has been achieved in many neuropathic knees without performing synovectomy (Soto-Hall 1938; Morris and Mosiman 1951; Lucas and Murray 1961; Abell and Hayes 1964). Holt, in 1957, advocated excision of thickened synovium or capsule if these structures impeded bony apposition; he performed synovectomy in three out of five knees that he fused successfully.

In the present series, synovectomy was performed in only one of the three knees with Charcot’s disease. It seems to us that the most important factors in achieving successful arthrodesis of a neuropathic knee are: the quality of the apposing bony surfaces, adequate mechanical fixation, and protection until union is achieved.

As total knee replacement is becoming commoner,
and as results from it are improving, surgeons may extend the indications (Frymoyer and Hoaglund 1974), and perform the operation in younger patients. Consequently failures are bound to occur and will undoubtedly increase in the next few years, so that a reliable technique of arthrodesis is clearly necessary.

The combined technique has proved valuable in achieving arthrodesis of problem knees in the absence of infection. All our patients were very satisfied with the outcome, even the patient who had both knees fused (Fig. 8). This is consistent with other reports (Green et al. 1967; Brattström and Brattström 1971). Fusion of the knee in full extension did not seem to hamper the patients more than if the knee was fused in slight flexion (Charnley 1960).

The advantages of the combined technique are the immediate intrinsic stability and relief of pain, the limited bone resection and the low morbidity. It also avoids the complications and inconvenience which can accompany the long-term application of external fixation devices into frail cortical bone (Stulberg 1982).

From this study we conclude that, in the absence of infection, the combined technique is an excellent salvage procedure for knees with Charcot’s disease, for un-united arthrodesis and for cases of failed total knee replacement where revision is not indicated.

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REFERENCES