WHERE ANKLE FUSION STANDS TODAY

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A retrospective study involving thirty-six patients with thirty-seven ankle fusions was undertaken to assess the rate of fusion, the subjective and objective results, the residual subtalar and midtarsal movement, and the functional disability. Fusion occurred in thirty-one ankles (84 per cent). Twenty-four patients were reviewed, on average 7.5 years after fusion, and eighteen had good or excellent results; only four had been unable to return to their previous employment. The conclusion is that fusion is still a good treatment for the painful post-traumatic arthritic ankle, the resulting functional disability being minimal.

Many methods of fusion of the ankle have been reported, most of which are concerned with the results achieved by a specific surgical technique. Adams (1948) reviewed the results of fusion of thirty ankles by the transfibular approach and found that in 93 per cent fusion occurred in an average of thirteen weeks. Ratliff (1959) reviewed the results of the Charnley compression arthrodesis, in which bony fusion occurred in 91 per cent of fifty-five cases, 88 per cent having good or excellent results.

MATERIAL AND METHODS

Thirty-six patients were treated by thirty-seven procedures (one being a bilateral case), in three hospitals: fifteen patients in Queen Mary Veterans between 1955 and 1974, eighteen in the Montreal General from 1970 to 1974, and three in Reddy Memorial from 1970 to 1974. All the charts and radiographs were reviewed. There were seven women and twenty-nine men, aged between nineteen and sixty-seven, with an average age at operation of forty-five (Fig. 1).

For twenty-seven of the ankles fusion was performed because of post-traumatic arthritis; of the other ten three were for equinus deformity in spastic paraplegia, two for non-united or malunited

Fusion of the hip or the knee leaves the patient with considerable disability, but with the recent advances in arthroplasty we see fewer of these fusions today. The object of this review is to establish whether the problem of post-traumatic pain in the ankle can be solved by fusion, or whether we have to wait for the perfection of arthroplasty. At present, total replacement seems favoured for the rheumatoid ankle.

Fig. 1

Histogram showing the age of thirty-six patients at the time of fusion of the ankle.

Fig. 2

Radiograph of a man aged thirty-six with comminuted fractures, who was fused primarily by the Crawford Adams method.

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fractures of the ankle with instability, one as the primary treatment for a severely comminuted fracture (Fig. 2), and one each for tuberculous arthritis, gout, chronic non-specific synovitis and post-traumatic drop-foot.

In the group of patients with post-traumatic arthritis, the period between injury and fusion varied from six months to thirty-five years. In 48 per cent of cases it was less than five years (Fig. 3).

![Graph showing time from injury to fusion](image)

**Fig. 3**

Time from injury to fusion in the twenty-seven patients with post-traumatic arthritis.

Of thirty-seven fusions fourteen were carried out by the Charnley compression technique (Charnley 1951), thirteen by the Crawford Adams (R.A.F.) method using the transfibular approach and a fibular strut graft (Adams 1948), and seven were fused using a tibial sliding graft as an onlay, or an inlay, or by the Hatt modification (Hatt 1940). Three ankles were fused by other methods, one by simple cast immobilisation alone, and the other two with local bone chips and staple fixation. Five of the fourteen Charnley compression arthrodeses were made through the classical transverse incision, the rest through other standard anterior approaches.

**COMPLICATIONS**

There were no deaths from the operation. Two ankles were fused in a poor position: one in 20 degrees of valgus and the other with medial rotation deformity of the foot on the tibia. Infection occurred in three of the thirty-seven ankles (8 per cent): in two, fusion was solid at the time of the review but the wound continued to discharge; the third had an infected pseudarthrosis which was eventually treated by below-knee amputation. Oedema of the ankle was present in two patients at the time of review. Fusion of the ankle resulted in stiffness of the subtalar joint in the majority of patients.

**RESULTS**

**Fusion rate.** Bony fusion occurred in thirty-one of the thirty-seven ankles (84 per cent). Failure occurred in six (16 per cent), of which three were done by the Crawford Adams (R.A.F.) method, two by Charnley compression and one by a tibial sliding graft. Five patients whose fusions failed had successful fusions carried out later, and one with an infected pseudarthrosis had to have a below-knee amputation. All the failures had symptoms that justified a surgical revision.

The total period of immobilisation in plaster after operation (Table I) varied from twelve to twenty-eight weeks, with an average of 17.5 weeks.

The fusion time was studied in the thirty-one successfully fused ankles. Because the clinical evaluation was difficult, and in many instances impossible, the time for fusion was determined by the radiological demonstration of bone trabeculae crossing the joint and found to vary from eleven weeks to eighteen months.

<table>
<thead>
<tr>
<th>Time</th>
<th>Number of ankles</th>
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<tbody>
<tr>
<td>12-14 weeks</td>
<td>12</td>
</tr>
<tr>
<td>15-17 weeks</td>
<td>10</td>
</tr>
<tr>
<td>18-20 weeks</td>
<td>6</td>
</tr>
<tr>
<td>21-23 weeks</td>
<td>4</td>
</tr>
<tr>
<td>24-26 weeks</td>
<td>4</td>
</tr>
<tr>
<td>Over 26 weeks</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table I.** Immobilisation period

<table>
<thead>
<tr>
<th>Time</th>
<th>Number of ankles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 13 weeks</td>
<td>3 (58 per cent)</td>
</tr>
<tr>
<td>13 to 16 weeks</td>
<td>15</td>
</tr>
<tr>
<td>17 to 20 weeks</td>
<td>5</td>
</tr>
<tr>
<td>21 to 24 weeks</td>
<td>3</td>
</tr>
<tr>
<td>25 to 28 weeks</td>
<td>4</td>
</tr>
<tr>
<td>18 months</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table II.** Fusion time

With an average of 19.4 weeks (Table II). In eighteen (58 per cent) fusion occurred within sixteen weeks. In the one case where fusion was delayed until eighteen months, osteomyelitis had developed and the wound was still draining at the time of the review.

![Bar chart showing number of patients](image)

**Fig. 4**

The follow-up period for twenty-four patients.

**Review.** Out of thirty-six patients in the study, twenty-four were interviewed and examined; one had had bilateral fusions. This review took place from one and a half to seventeen years after fusion, with an average of seven and a half years (Fig. 4).
Twelve patients were not reviewed. Two had died from causes unrelated to the operative procedure. The remaining ten could not be traced for interview and examination.

The clinical evaluation of the results was both subjective and objective and was based on four factors: pain; residual deformity (varus or valgus of the heel or rotational deformity of the foot); gait (in patients in whom the ability to walk was not affected for reasons other than the fusion of the ankle); and the patient's own evaluation. The results were rated excellent, good, fair or poor according to the criteria shown in Table III.

Two ankles were excluded due to the technical failure of the operation: one was fused in 30 degrees of medial rotation and the other in 20 degrees of valgus. Of the remaining twenty-two patients (twenty-three ankles) eleven had excellent results, seven good (with one having a bilateral fusion), one fair, and three poor. The patient with only a fair result had pain and swelling of the fused ankle and a considerable limp. He, however, was satisfied. Of the three poor results, one had a below-knee amputation for infected pseudarthrosis and the remaining two had chronic osteomyelitis with solid fusion but pain. Excluding the two technical failures, eighteen out of twenty-two patients had excellent or good results at review.

**Table III. Clinical evaluation of results**

<table>
<thead>
<tr>
<th></th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>Minimal</td>
<td>Mild on</td>
<td>Mild on</td>
<td>Considerable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>excessive</td>
<td>normal activity</td>
<td></td>
</tr>
<tr>
<td>Deformity</td>
<td>None</td>
<td>5 degrees valgus</td>
<td>10 degrees valgus</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>or mild rotation</td>
<td>or rotation</td>
<td></td>
</tr>
<tr>
<td>Limp</td>
<td>None</td>
<td>Mild</td>
<td>Moderate</td>
<td>Severe</td>
</tr>
<tr>
<td>Patient</td>
<td>Satisfied</td>
<td>Satisfied</td>
<td>Admits some improvement</td>
<td>Denies improvement</td>
</tr>
<tr>
<td>assessment</td>
<td></td>
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Gait and its relation to movement at the joints. Gait was studied in nineteen patients whose ankles were fused for monarticular lesions. In none was the ability to walk affected for reasons other than the fusion. Eleven showed no limp, or only a minimal limp on close inspection, five showed a mild limp and in three it was marked. Eighteen of the nineteen had no known lesion or stiffness of the subtalar or the midtarsal joints before operation and the mobility of these joints was therefore assessed after fusion of the ankle.

Subtalar stiffness was found in sixteen of the eighteen patients when compared to the normal foot. In eleven, the midtarsal joint was hypermobile, and their gait was classified as excellent. Midtarsal joint movement was normal in two and less than normal in five; these patients all had a limp.

It would seem that fusion of the ankle has a detrimental effect on the subtalar joint, a conclusion that was reported by Ratliff (1959). A compensatory hypermobility frequently occurs at the midtarsal joint, resulting in an excellent gait (Fig. 5). However, subtalar stiffness after fusion of the ankle does not necessarily have a detrimental effect on gait. This may be because the axis of the compensatory motion of the midtarsal joint is now parallel to the ankle, while that of the subtalar joint is perpendicular to it.

In patients with excellent gait, the range of “pseudo” movement varied from 5 to 10 degrees of dorsiflexion and 20 to 35 degrees of plantarflexion.

**Position of fusion.** There are many statements in the literature on the best position of fusion. Barr and Record (1953) preferred a position of 5 degrees of equinus, Knight (1956) recommended the right angle as the best position for men, Watson-Jones (1955) recommended

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Radiograph of a woman aged twenty-six treated by cast immobilisation (for injury) in early childhood. She was unaware of the spontaneous fusion which was only discovered incidentally at this examination. She has a normal gait and almost normal “ankle movement”, which is really occurring at the midtarsal joint.

**Fig. 5**
15 degrees of equinus, and Ratliff (1959) reported the best position to be the right angle or close to it.

The position of the fused ankle was assessed clinically in the eleven patients (all men) who had excellent gait. Four ankles were at a right angle, six in 5 degrees of equinus and one in 10 degrees of equinus. Fusion of the ankle at a right angle or in a few degrees of equinus appeared to be the most satisfactory position for these men.

Return to employment. Of the twenty-four patients reviewed, six had retired some years before fusion, and two were housewives who were coping with their household duties at the time of interview. Of the sixteen patients who had been employed, twelve had returned to the same type of job after fusion, while three had to change because of their disability. The man who had a below-knee amputation as a complication of his fusion was unemployed.

CONCLUSION
Successful bony fusion occurred in 84 per cent of thirty-seven ankles that were fused by various different methods. All failures were symptomatic, the subjective and objective results were good to excellent in eighteen of the patients at review.

Compensatory hypermobility of the midtarsal joint occurred frequently after ankle fusion (Fig. 5), resulting in an excellent gait, while subtalar stiffness, although often found, was not necessarily detrimental to gait. Fusion of the ankle in the neutral position or in a few degrees of equinus, a range of pseudo-dorsiflexion of 5 degrees or more and of pseudo-plantarflexion of 20 degrees or more (occurring at midtarsal joint), were compatible with excellent gait. Fusion is therefore considered to be a good treatment for the painful post-traumatic arthritic ankle, the resulting functional disability being minimal. Assessment of fusions for the rheumatoid ankle are beyond the scope of this paper.

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REFERENCES