THE LATE RESULTS OF TARSOMETATARSAL JOINT INJURIES

J. A. BRUNET, J. J. WILEY

From the Ottawa General Hospital

The late results of tarsometatarsal injuries in 33 patients have been reviewed. The average follow-up period was 15 years (range 11 to 20 years). Methods of treatment included cast immobilisation, and closed or open reduction with or without internal fixation. All patients noted diminishing symptoms after injury and all but six returned to their former occupation. Neither the initial fracture type nor the treatment had any apparent bearing on subsequent function; nor was there any correlation between radiographic assessment of the injury and the patient's symptoms.

Tarsometatarsal joint injuries are generally managed by accurate repositioning of the displaced metatarsals and stabilisation with percutaneous wires (Hardcastle et al. 1982; Goosens and De Stoop 1983). However, these injuries are often missed because radiographs of this joint area are difficult to interpret (Bassett 1964); they may also be diagnosed late in unresponsive, severely injured patients (Trillat et al. 1976).

The management of these injuries has been derived from studies with a relatively short follow-up. Because these foot disruptions are relatively uncommon, few long-term results have been published except to record those that range between good and disastrous (Aitken and Poulson 1963; Cassebaum 1963; Granberry and Lipscomb 1962; Willpula 1973). The purpose of our study was to review the late anatomical, radiological and functional results.

PATIENTS AND METHOD

One hundred and seventy patients treated for tarsometatarsal joint injuries from 1964 to 1985 were reviewed. All cases with a follow-up of less than 10 years were excluded from this review, as were injuries in children. Of the 70 patients who met our criteria, 33 with 34 fracture-subluxations or fracture-dislocations of the tarsometatarsal joint presented for interview and examination at an average follow-up time of 15 years (range 11.5 to 20 years). The mean age at time of injury was 30 years (14 to 61 years).

Table 1. Distribution and type of 34 fracture-dislocations and fracture-subluxations in 33 patients

<table>
<thead>
<tr>
<th>Type*</th>
<th>Number</th>
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<tbody>
<tr>
<td>A: Total incongruity of the tarsometatarsal joint</td>
<td>8</td>
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<tr>
<td>B: Incongruity of part of the joint</td>
<td>23</td>
</tr>
<tr>
<td>C: Divergent pattern (either partial or total incongruity)</td>
<td>3</td>
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* Hardcastle et al. 1982

Using the classification of Hardcastle et al. (1982), we found that 23 patients (70%) suffered Type B partial injuries, that is, either medial displacement of the first metatarsal or lateral displacement of one or more of the remaining metatarsals (Table I). The most common mechanism of injury was a head-on motor vehicle collision, during which the patient's foot was impacted in tiptoe position against the engine firewall (the vertical insulating and protective plate between the passenger and the engine compartments). Only one of the patients in our series sustained a direct crushing injury. Two patients had compound injuries.

Factors influencing management at the time of injury were delay in diagnosis, the degree of displacement and, most importantly, the extent of local tissue injury. Closed reduction followed by a cast was the most common form of treatment (Table II). One injury required open reduction because of an entrapped anterior tibial tendon. Five injuries were unreduced and never immobilised in plaster casts, while four were immobilised for up to six months because of ipsilateral femoral fractures requiring plaster hip spicas. In the remaining 25 injuries, the mean period of cast immobilisation was eight weeks (range 4 to 16 weeks, mode 6 weeks). Associated injuries, especially those affecting the same leg (Table II), proved very relevant, often compromising late results.
 Twenty-eight patients started weight-bearing on their injured foot an average of seven weeks after injury (range 4 to 16 weeks, mode 6 weeks). In the remaining five patients, other injuries precluded weight-bearing until six months after injury. Only seven patients received specific physical therapy for the injured foot.

Before this study, four feet had required additional corrective surgery for residual injury-related problems (Table II). One patient had two attempts at fusion of the tarsometatarsal joint but was left with a pseudarthrosis at the bases of the second and third metatarsals; nevertheless, five years after injury, he returned to full-time regular work as a stationary engineer.

Foot comfort or discomfort was assessed in relation to the patient’s occupation, activities of daily living, ability to participate in sport or other social activities, and relative comfort in shoes. Questions were generally adapted to each patient’s interests, so that a measure of their tolerance to light and heavy work, as well as their ability to take part in sports, could be obtained. Foot pain was evaluated as indicated in Table III (Richardson et al. 1983).

### RESULTS

Despite the variety of treatment methods used, foot comfort had usually progressed to a stable level by about 1.3 years after injury (median 1 year; range 3 months to 5 years). Twenty-six patients (76%) were able to return to their original occupation (10 had been labourers and 16 had been engaged in office or clerical work), whereas seven sought lighter work due to persistent foot discomfort. Using the pain-intensity rating scale, almost all the patients reported that they had, at most, Grade 1 pain in relation to light-duty work; 27 reported that they felt either no pain or Grade 1 pain when engaged in heavy work. Those injuries associated with most pain or most disability included four designated as Type A (one of which involved a compound and direct injury), one Type B and one Type C.

Moulded arch supports initially prescribed for many patients were still being worn by three patients. Sixteen patients reported no preference for special shoe design or modifications; the remaining 13 patients selected a variation of either loose-fitting or tightly-laced shoes.

Residual foot deformity was not uncommon, particularly because of residual lateral subluxation of the lesser metatarsals. Planus or planovalgus deformities were apparent in 10 feet and cavus deformity in two. Twenty patients had bone irregularity or exostoses of tarsometatarsal joints with post-traumatic arthritis and, in some cases, this made the wearing of certain types of shoe difficult. In 19 feet, passive stretching of the joint revealed a mild to severe restriction of mobility, although in this area it is difficult to assess the range of movement accurately. Pain on stressing was present in six feet only. All but one patient could stand on tip toe. No patient walked with a noticeable limp.

Complaints about pain in the foot could be attributed to malunion of metatarsal fractures in three patients, to sesamoiditis in four, and to late arthritic changes in other adjacent uninjured joints in six (hallux rigidus in three feet; talonavicular or naviculocuneiform arthritis in three). In six patients, minor surgery on the forefoot may well have alleviated some of the discomfort.

The post-traumatic arthritic changes noted on radiographs had little relationship to functional impairment (Table IV). Only seven patients had no radiographic evidence of gross arthritic changes of the joint; one

<table>
<thead>
<tr>
<th>Table IV. Correlation of radiographic appearance and function of the tarsometatarsal joint</th>
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<tr>
<td>Osteoarthritis</td>
</tr>
<tr>
<td>Severe</td>
</tr>
<tr>
<td>Number of feet radiographed</td>
</tr>
<tr>
<td>Effect on work</td>
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<td>Effect on other activities</td>
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</table>
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Fig. 1
Fig. 2

Case 1. Bilateral tarsometatarsal fracture-dislocations at the time of injury (Fig. 1) and 18 years later (Fig. 2).

Fig. 3
Fig. 4

Case 2. Figure 3. - Eleven years after injury to the left foot: note the degree of mid-tarsal and tarsometatarsal arthritis. Despite the radiographic appearance, the patient was satisfied with the functional result.
Case 3. Figure 4 - Twenty years after injury to the left foot, this patient had pes planus, hallux rigidus and marked arthritic changes (Grade 2 pain after walking and Grade 3 during heavy work). Despite the radiographic appearance the patient was satisfied with the functional result.

of these did have minor symptoms related to his work. In seven patients, the arthritic changes were marked but in only one of these was foot comfort affected by work or by playing certain sports. Ten patients had persistent subluxation of 4 to 10 mm between the first and second metatarsal bases; however, such gaps, reflecting incomplete reduction, had little bearing on the final outcome as far as pain and function were concerned.

CASE REPORTS
Case 1. A 45-year-old lumberjack sustained bilateral injuries when a bulldozer shovel fell directly onto his heels while he was kneeling (Fig. 1). The injuries were treated by closed reduction with percutaneous pinning and casting. One year after his injuries, he returned to full-time work.

Eighteen years after injury, he was still employed as a labourer and had no pain during light work, and either Grade 1 or 2 pain during heavy work or after walking more than three miles. Examination revealed moderately severe hallux valgus, bilateral medial sesamoiditis, and moderately restricted movement of the right tarsometatarsal joint. Radiographs showed mild osteoarthritis (Fig. 2).

Case 2. A 20-year-old construction worker sustained multiple injuries, including a Type B tarsometatarsal joint injury and ipsilateral fractures of the humerus, femur, os calcis and subluxation of the cuboid. The tarsometatarsal injury was managed by closed reduction and cast immobilisation. Six months after the accident he returned to work as an apprentice auto mechanic.

Eleven-and-a-half years after injury he was still employed as a mechanic, standing for between 60 and 70 hours a week on a concrete garage floor. He could run any distance, regularly played 18 holes of golf each week, and felt no foot pain while hunting or fishing. He could stand comfortably for hours on the rung of a ladder and he was essentially unaware of any restriction of activity (Grade 1).

Examination revealed a pes planus deformity with a very large exostosis over the calcaneocuboid joint region, and mobility of the tarsometatarsal joint was moderately restricted. Radiographs revealed severe osteoarthritis of the tarsometatarsal joint region with naviculo-cuneiform and calcaneocuboid joint involvement; there was also persistent subluxation of the cuboid (Fig. 3). The third and fourth metatarsal bases as well as the lateral cuneiform also appeared subluxated. Despite this striking radiographic appearance the patient expressed satisfaction with the result.

Case 3. This 33-year-old construction worker fell backwards when his foot was pinned under a paving machine. Along with a Type B injury to the tarsometatarsal joint complex, he suffered ipsilateral fractures of the os calcis, navicular, cuboid and medial malleolus. Treatment consisted of closed reduction and a cast worn for two months; this was
followed by physiotherapy and he wore moulded arch supports and
laced boots with rocker-bottom crêpe soles. Because of persistent pain
on the lateral border of his foot, a calcaneocuboid fusion was performed
three years later. He returned to full-time work as a high school janitor
three-and-a-half years after injury.

When examined 20 years after injury (Fig. 4), he was still doing the
same work. He complained of Grade 2 pain after walking for more than
two hours at work, and Grade 3 pain if engaged in heavy work.
Examination of his feet revealed pes planus and hallux rigidus, but full
painless mobility of the tarsometatarsal joint. Radiographs revealed a
healed calcaneocuboid fusion, severe talonavicular arthritis and mild to
moderate arthritis involving the joint between the medial cuneiform
and the first metatarsal.

DISCUSSION

Many previous reports describing the results of treating
injuries of the tarsometatarsal joint have been
incomplete, making meaningful conclusions difficult
(Aitken and Poulson 1963; Cassebaum 1963; Granberry
and Lipscomb 1962; Wilppula 1973; Dunn 1975; Trillat
et al. 1976). This review of a large collection of cases with
a long average period of follow-up permits a number of
important observations.

Despite different methods of treatment, recovery
appears to progress until a stable level is reached at about
1.3 years after injury. Most patients (almost 80% in our
series) are able to return to their original occupation, and
the majority are painfree or report very little foot pain.
The fact that many are labourers still engaged in heavy
physical work indicates that successful results do not
appear to deteriorate with time. The remarkably good
levels of endurance while taking part in sport also suggest
that functional recovery progresses and that most
patients can eventually lead an active life.

These encouraging results are also important for
managing unreduced subluxations in which the diagno-
sis was either delayed or missed, or in which complete
reduction was not obtained or maintained. Our experience,
along with that of Aitken and Poulson (1963),
Cassebaum (1963) and Cotton (1924), suggests that such
cases may not necessarily require the aggressive treat-
ment described by others (Compere, Banks and Com-
pere 1958; Granberry and Lipscomb 1964; Trillat et al.
1976). In fact, many of our excellent functional results
had gross malalignment of the metatarsal bases with
widening of the foot.

The relative absence of pain, even with persistent
gross subluxations or radiological evidence of advanced
arthritis, may be secondary to a stable ankylosis or to a
disruption of the sensory fibres of the torn capsular and
ligamentous structures of the joint. In this series and in
other reviews (Aitken and Poulson 1963; Bassett 1964)
the discrepancy between subjective and objective evi-
dence of arthritis is obvious and suggests caution in
ascribing clinical significance to radiographic changes.

As explained by Quenu and Küüs (1909) the
functional organisation of the foot comprises a medial
supportive column composed of the first metatarsal and
tarsal bones, and a lateral column or spatula of the lesser
metatarsals whose chief function is foot balance.
According to this concept, injuries which spare the
medial column may possibly be associated with a better
prognosis. Indeed, in our study, the functionally
unsatisfactory results (four Type A, one Type B, one
Type C) were attributable to disruption of the medial
column.

Finally, although we support the contention that
fracture-subluxations of the tarsometatarsal joint require
accurate and stable reductions, we believe that this series
and a review of other similar reports indicate that most
patients appear to regain their pre-injury function no
matter which method of treatment is used.

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