LEVELLING THE TREAD

Elevation of the Dropped Metatarsal Head by Metatarsal Osteotomy

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Most orthopaedic surgeons must be familiar with the type of foot shown in Figure 1. There are hard, painful callosities under the first and fifth metatarsal heads, but there is no deformity of the toes. The patient with this condition has usually attended the chiropodist but has gained only transient relief after the callosities have been pared away. The wearing of metatarsal insoles or metatarsal bars gives only partial relief. If a “skyline” view of this forefoot is observed (Fig. 2) it is seen that the first and fifth metatarsal heads are at a lower level than the heads of the middle metatarsals. Figure 3 shows how the skyline photograph is taken.

The commonest type of foot is the one shown in Figure 1, but other patients present with callosities under one or more of the middle (second, third or fourth) metatarsal heads. A photograph of such a foot is shown in Figure 4. It will again be seen that there is no clawing or hammer deformity of the toes.
TREATMENT

Plantar callosities secondary to claw or hammer toes must, of course, be dealt with by correction of the toe deformity. In those patients with "idiopathic" dropping of metatarsal heads it seemed reasonable to treat the condition by elevation of the offending metatarsal head or heads by osteotomy of the appropriate metatarsals. Since 1966 the author has treated twenty-three patients in this way.

THE OPERATION

For the foot shown in Figure 1 separate longitudinal incisions 5 centimetres in length are made over the bases of the first and fifth metatarsals. The tarso-metatarsal joints are identified and the osteotomy is made 1.75 centimetres distal to the joints. At this point the bone is largely cancellous and is easy to cut. Union after the osteotomy is quick. In the earlier patients in the series a curved, or domed, osteotomy was made with a thin gouge (Figs. 5 to 7). In some of these cases correction proved difficult and latterly the author has excised a thin wedge of bone with its base on the dorsum of the metatarsal.

If one or more of the middle metatarsals are to be elevated a curved longitudinal incision is made on the dorsum of the foot. The extensor tendons are retracted and the bases of the...
metatarsals to be divided are defined by passing small bone levers around the metatarsals as near to their bases as possible. A small dorsal wedge is excised about a centimetre distal to the tarso-metatarsal joint.

After osteotomy it should be easy to mould the tread manually so that all the metatarsal heads are at the same level, and it must be demonstrated that this is possible before the incisions are closed. After operation a padded plaster is applied extending from the tips of the toes to below the knee. While the plaster is setting the forefoot is carefully moulded to maintain the correction of the tread. After two weeks a walking rocker is fitted to the plaster, which is retained for a total of six weeks. If there is any toe stiffness after this, a short course of faradic footbaths and toe exercises is given.

In the earlier patients in the series correction of the tread deformity was maintained by drilling a Kirschner wire transversely through all the metatarsals just proximal to their necks, but some patients developed stiffness of the metatarso-phalangeal joints. One patient suffered severe pin-track sepsis and after this the use of a transfixed wire was abandoned.

**DISCUSSION**

Acton (1967) stated that "some of the concepts of foot anatomy that tend to be perpetuated are simply not true. One still sees in the literature diagrams of the arch of the metatarsal heads. The actual arch of the foot in transverse section is only present proximal to the heads of the metatarsals" (Fig. 8).

![Fig. 8](image_url)  
(By permission of Rush K. Acton.) "The metatarsal heads lie in a straight line in the normal foot."

Many authors of standard textbooks of orthopaedic surgery describe the condition of anterior metatarsalgia, and some of them refer to this condition as anterior arch planus or splay foot. This condition is well described by Slez (1963): "When the intrinsic muscles of the foot are functioning properly, the weight borne by the forefoot is shared between the metatarsal heads and the toes, the first and fifth metatarsal heads taking more of the load than the others. If the intrinsic muscles are functioning inefficiently the toes may cease to perform their share of the weight-bearing with the result that all the load is carried on the metatarsal heads. This increased pressure leads to pain, tenderness and callosity formation beneath the metatarsal heads, and frequently there is splaying of the forefoot." Ultimately the patient with this condition may develop claw or hammer toes and when this stage is reached operation may be needed to straighten out deformed toes and to release tight extensor tendons. Some authors (McMurray 1937, Mercer 1947) have advocated excision of a single metatarsal head when a solitary painful callosity has formed beneath it.

The author has been unable to find any reference to the type of foot in which there is dropping, or depression, of one or more metatarsal heads in the absence of any toe deformity.
This type of foot is fairly rare but it undoubtedly exists. It must be stressed that elevation of a depressed metatarsal head by osteotomy of its metatarsal must only be considered when the condition exists in the absence of any toe deformity.

It seems likely that dropping of one or more of the middle metatarsal heads with plantar callosities on the tread occurs in those patients with splay feet who have not developed claw or hammer toes. The commoner deformity of dropped first and fifth metatarsal heads may be due to the fact that in some patients the transverse arch that is present at the tarsometatarsal level (Fig. 9) is carried forward so that the metatarsal heads themselves have a transverse arch convex upwards. According to Gray's Anatomy all the tarsometatarsal joints are flat and permit only slight gliding movement. They do not permit any appreciable vertical hinging movements of the metatarsals. In youth, the mobility of the tarsometatarsal joints allows all the metatarsal heads to make contact with the ground, in spite of the fact that the middle metatarsal heads are elevated. In adult life the tarsometatarsal joints may lose some of their mobility, with the result that an undue proportion of weight is borne on the first and fifth heads. This results in thinning of the fibro-fatty cushion under them and later the formation of painful plantar callosities.

CLINICAL MATERIAL AND RESULTS

Since 1966 twenty-eight feet have been operated on in twenty-three patients. Thirteen of these patients were women and ten men. The oldest patient was sixty-seven at the time of operation, the youngest twenty-one. The average age for the whole series was forty-one years. The longest follow-up was seven years, the shortest six months. The cases fall naturally into three groups.

Group 1: Dropping of first and fifth metatarsal heads (ten patients—thirteen feet)—The condition was bilateral in three patients in this group. Of the unilateral cases five were right feet and two were left.

Group 2: Dropping of one or more of the middle metatarsal heads (nine patients—eleven feet)—The metatarsal heads needing elevation in this group followed a varied pattern. Two patients had dropped second, third and fourth metatarsals in the left foot and in the third the condition was bilateral. Two had dropped first and third metatarsals, one in the left (Fig. 4) and one in the right foot. One patient had dropped first and fourth heads in the left foot, and one patient had dropping of the first right and third left metatarsals.

Group 3: Dropping of an isolated metatarsal head following operation or trauma (four patients)—The first patient was a man aged thirty-six who had had multiple metatarsal fractures, with malunion of the third metatarsal, the head of which was depressed with a plantar callosity under it. The second patient, a man aged twenty-eight, had undergone subtalar fusion after a calcaneal fracture. The joint was fused in too much varus with the result that excessive weight on the fifth metatarsal head produced a painful callosity under it. The third patient
The foot shown in Figure 1, after operation.

Various feet from the series, before and after operation. The upper photograph of each pair shows the appearances of the tread before operation. The four photographs above show the right and left feet of the same patient.
was a man aged twenty-one who had sustained a compound fracture of the right tibia and fibula. The posterior tibial artery had been severed and severe ischaemic contracture of the calf muscles ensued. He also had a tibial nerve palsy which recovered incompletely. The ankle was subsequently arthrodesed but the rigid foot was in slight varus and this produced a painful callosity under the fifth metatarsal head. The fourth patient was a girl aged twenty-two. She had anterior poliomyelitis in childhood and underwent tibial leg lengthening. Later ankle arthrodesis was carried out to correct a painful equinus deformity, but the foot was placed in too much valgus. The painful callosity that formed under the first metatarsal head was relieved by elevation of the metatarsal by osteotomy through its base.

With one exception all the patients in this series had satisfactory results. The plantar callosities disappeared and the fibro-fatty padding beneath the previously dropped metatarsal heads reappeared.

The single patient in whom the result was bad should not have undergone this operation. He was a man of twenty-three with severe bilateral pes cavus and mobile claw toes. There were painful callosities under the first and fifth metatarsal heads. These were elevated by osteotomy and a Kirschner wire was drilled across the forefoot through the metatarsal necks to maintain correction of the tred deformity. He developed severe pin-track sepsis which produced rigid clawing of his toes. Ultimately a Fowler forefoot arthroplasty relieved his symptoms.

Figure 10 shows the skyline view of the tread of the foot in the patient whose foot is shown in Figure 1 after correction. Figure 11 shows an assortment of feet from the series. The upper photograph in each case was taken before operation, the lower one after correction.

SUMMARY

1. Attention is drawn to a type of foot in which painful plantar callosities form under one or more metatarsal heads. The affected metatarsal heads are shown to be depressed, or dropped, and this dropping is not caused by toe deformities.
2. An operation is described which elevates a dropped metatarsal head by a wedge osteotomy through the base of the metatarsal.
3. The various deformities of the tread are described, and the possible causes of this condition are discussed.
4. It is stressed that corrective metatarsal osteotomy is not appropriate for patients with deformities of their toes, who require correction of the toe deformity.

REFERENCES


