THE INTERMETATARSOPHALANGEAL BURSA—ITS SIGNIFICANCE IN MORTON’S METATARSALGIA

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The intermetatarsophalangeal bursa was investigated by dissection, radiography and injection. In the web spaces between the second and third and the third and fourth digits the bursa lies superior to the transverse metatarsal ligament but projects distally to it, closely applied to the neurovascular bundle. Tissue from the web spaces of patients with classical Morton’s metatarsalgia often shows lymphocytic infiltration, with additional fibrinoid necrosis of the bursal wall. It is suggested that inflammatory changes in this bursa could account for the pathological and histological findings in this condition. The bursa in the most lateral web space does not extend beyond the ligament and is not in contact with the neurovascular bundle, which may explain the rarity of symptoms in this space.

Many of the standard anatomical texts make no mention of bursae in the web spaces of the foot, and if they do, name them intermetatarsal. Splatelholz (1941) described a bursa in all four web spaces, but said the lateral one was only occasionally present. Jones (1946) discussed a “bursa intermetatarsophalangeae”. The swollen bursa noticed on occasions when operating in the region of the metatarsophalangeal joint, and the bursal wall seen in histological sections, have stimulated a study of the intermetatarsophalangeal bursa.

METHOD AND RESULTS

Dissection. Heated, dyed gelatin was injected into the intermetatarsophalangeal bursae of cadaveric feet from the dorsal aspect of the web spaces. Some leaking occurred because the bursa is normally thin-walled and sometimes communicates with the joint, but with practice it could be filled and dissected. It was found that in the web spaces between the second and third and third and fourth digits the bursa was flattened, oval, up to three centimetres long, lying in a vertical plane, applied to the metatarsal neck, the capsule of the joint and the proximal phalanx, and surrounded by a thin layer of loose connective tissue (Fig. 1). The transverse metatarsal (plantar) ligament lay on the plantar surface of the bursa, at about its mid point. The digital neurovascular bundle and lumbral muscle passed beneath the plantar aspect of this ligament, but at its distal margin they turned upwards into the web space, closely applied to the intermetatarsophalangeal bursa (Figs 2 and 3). In the lateral web space the distal limit of the bursa lay at the same level as the distal margin of the transverse ligament. The bursa was intermetatarsal only and did not have the same close relationship to the neurovascular bundle (Fig. 4).

The contents of the web spaces, including the neurovascular bundles, connective tissue, fat and bursae, were excised from the feet of other cadavers, ranging in age from 19 to 70 years. Although complete histories were not available, it was considered unlikely that all would have had symptoms in their forefoot. The digital nerves of these “normal” feet showed more perineural and endoneural fibrosis than would be seen in similar nerves elsewhere in the body, and the vessels had markedly thickened walls, mainly of the muscularis; these changes were present in the teenagers, and increased with age. The bursal wall was closely applied to the neurovascular bundle, but showed no inflammatory or degenerative changes.

Radiography. The intermetatarsophalangeal bursae of patients with pain in the forefoot were injected with Angiografin (65 per cent) and in several cases the asymptomatic foot was injected as a control. The bursa lies just below the skin of the dorsal web. In the second–third and third–fourth spaces the bursae are normally smooth-walled, oval sacs, with their mid points at the level of the metatarsophalangeal joint (Fig. 5). However, in the fourth–fifth space the bursa did not extend beyond the joint (or by inference the transverse ligament) in any foot injected (Fig. 6). There were no consistent abnormal radiological

![Diagram of transverse section across metatarsal necks.](image)

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Intermetatarsophalangeal bursa

Figure 2—Diagram of longitudinal section of third–fourth web space. Note relationship of bursa and neurovascular bundle. Figure 3—Longitudinal section of cadaveric dissection showing bursa (b) distended with gelatin surrounding the neurovascular bundle (n). The needle is in the metatarsophalangeal joint.

Figure 4—Diagram of transverse section across bases of proximal phalanges, with no bursa in the most lateral web space.

Figure 5—Dye in intermetatarsophalangeal bursae in second–third and third–fourth web spaces. Figure 6—Dye in bursa in fourth–fifth web space. Note that the distal end of the bursa is level with the joint. Figure 7—Bursagram of a patient with rheumatoid arthritis. Note proximal lymphatic filling. Figure 8—Bursagram of a patient with a large palpable bursa. Contrast medium was injected dorsally into second–third web space.

Clincal Investigation. Eleven patients with typical Morton’s metatarsalgia had an injection of a steroid suspension and Angiografin into the bursa. This was done, under radiographic control, from the dorsal aspect to lessen the possibility that the effect of the steroid would be directly on the nerve itself. Symptoms were relieved completely in four patients and had not returned over a year later. The seven others had temporary relief, lasting from a few days to several weeks, and five of these patients have subsequently had a typical “neuroma” resected with relief of symptoms. The results of injection suggest that some of the symptoms might have been secondary to bursitis. When the swollen nerve was exposed through a plantar incision, lateral compression of the foot sometimes caused bulging of the bursa and prolapse of the “neuroma” into the wound.

Histological examination of tissue from the web spaces of patients with Morton’s metatarsalgia showed oedema, inflammation and demyelination of the nerves, with more extensive fibrosis (both within and around the neurovascular bundles) than was seen in the controls.
Betts (1940) said that the symptoms indicated stretching of the nerve rather than compression as being the cause of the attacks. He maintained that the fourth digital nerve was larger, formed from branches of both medial and lateral plantar nerves, joining around opposite sides of the flexor digitorum brevis; when this muscle contracted, the proximal end of the digital nerve was fixed and dorsiflexion of the toes in walking stretched it around the unyielding transverse ligament. Later authors have pointed out that the double origin is not constant, and that classical symptoms and swelling of the nerve can occur in the space between the second and third digits.

McElvenny (1943) described five “tumours” which on histological examination appeared to be either neurofibromata or angioneurofibromata. King (1946) did not consider that the increased mass of connective tissue and relatively few nerve bundles could be a true neoplasm, and suggested the term “sclerosing neuroma” to differentiate it from an amputation neuroma. Other writers (Bickle and Dockerty 1947; Winkler, Feltner, and Kimmelstiel 1948) agreed that the changes were degenerative and associated them with reactive fibrosis. Scotti (1957) suggested that ischaemia could make the nerve more sensitive to injury and fibrosis. Nissen (1948) stated that the lesion was ischaemic in nature, histological examination having shown severe degenerative changes in the digital artery with disruption of the arterial wall, thrombosis and incomplete recanalisation. Mulder (1951) said that the swelling was so intimately connected with the plantar wall of the intermetatarsal bursa that it could not be removed without opening this bursa, but then went on to say that the neuroma was caused mechanically by repeated pinching of the plantar nerve between the metatarsal heads. This paper stimulated a reply from Nissen (1951), saying that when he had operated on early cases the nerve had not been thickened nor adherent to either transverse ligament or bursa; also, a series of specimens arranged in order of duration of symptoms had shown a continuous progression of vascular and neural changes, which reinforced his ischaemic theory. He added that “Mulder’s article should stimulate surgeons to pay more attention to the intermetatarsophalangeal bursae, which are quite inadequately described in most anatomical works”.

Scotti (1957) described fibrin in the bursa but was not sure how this contributed to the picture. Reed and Bliss (1973) recorded a thickened bursal wall, with hyalinised fronds projecting into the lumen and secondary arteritis of the vessels. Other authors (Ringertz and Unander-Scharin 1950; Nora, Nora and Ghislandi 1965; Meachim and Abberton 1971) have noted, as we did, that “endarteritis” and neural fibrosis are as prevalent, although usually less extensive, in controls as in patients with symptoms. It is tempting to speculate that these changes occur to resist the pressure of weight-bearing.
Anatomical, histological and radiological investigations of the intermetatarsophalangeal bursae in the second–third and third–fourth web spaces show that distal to the transverse metatarsal ligament they are very close to the neurovascular bundles. Inflammation of these bursae could cause secondary fibrosis leading to the classical symptoms. Ringertz and Unander-Scharin (1950) pointed out that subsidence of the symptoms after excision of the nerve does not necessarily mean that the cause of the pain is a change in the nerve itself: lateral compression of the foot of a patient with Morton’s metatarsalgia invariably causes pain, probably because the inflamed bursa (but not the nerve) is squeezed between the metatarsal heads. If the examiner applies further pressure over the plantar surface of the affected web space, pain will increase as the “neurora” is pushed out by a swollen bursa. If a plantar incision is used, careful dissection of the thickened nerve will sometimes show the swollen bursa bulging from its dorsal (deep) aspect. If the foot is compressed laterally, this bursa will be squeezed from between the metatarsal heads and push the swollen nerve into the wound. When the swelling is excised, the underlying inflamed bursal wall is often adherent and the bursa can easily be opened and demonstrated. This can be confirmed histologically (see Fig. 9). Occasionally it contains a small quantity of fluid. This bulging may be the cause of Mulder’s click.

In contrast, when the most lateral bursa was similarly investigated, its distal margin did not project beyond the transverse metatarsal ligament and was not in contact with the neurovascular bundle. This could explain the rarity of symptoms in this web space.

The number of symptomatic cases was not large enough to correlate duration of symptoms with pathological changes. However, a long history did not adversely affect the chances of a good response after a local injection of a steroid.

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