

## Why do I Choose Surgery to Treat Diabetic Foot Osteomyelitis? A Personal View

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Osteomyelitis is one of the most frequent diabetic foot infections, accounting for 10-15% of mild infections and almost 50% of severe infections [1]. The treatment of osteomyelitis of the foot in patients with diabetes continues to spur debate and so far optimal treatment is yet to be defined [2-5]. The major continuing controversy centres on the relative roles of surgery and antibiotic treatment [5]. There are two principal approaches to the treatment of osteomyelitis of the foot in diabetic patients: these can be defined as conservative treatment, by means of antibiotics, and surgical treatment. We have always advocated that osteomyelitis is a surgical disease and we have reported our experience involving conservative surgery for this challenging problem. Why do I choose surgery to treat diabetic foot osteomyelitis? Probably the answer is obvious: because I am a surgeon and I was trained to resolve diseases using the scalpel but there are more important reasons that have led me to perform surgery routinely to resolve this clinical situation. Osteomyelitis is the most frequent type of infection I have to treat in patients referred to our department: 63% of the patients admitted to our department for foot infections have osteomyelitis [6]. This population has several characteristics: 71% of the patients have been treated with antibiotics by other teams and the infections have not been resolved. Amputation was the only alternative treatment, which was offered to the patients after unsuccessful medical treatment, and for this reason they were referred to our department. Of the patients admitted for osteomyelitis, 61% had advanced cases: bone exposed and/or gangrene and/or destruction of the soft tissue envelope and/or soft tissue infection [6]. Antibiotics had been given to 70.5% of the patients with advanced disease. What does that mean? It means that despite the fact that many patients received antibiotics to treat foot osteomyelitis, medical treatment was not able to prevent spreading and worsening of the infection. When antibiotics do not control the infection, it produces severe bone and soft tissue destruction and amputation becomes the only possible treatment. The problem is that one cannot predict with certainty for which of the patients medical therapy will fail [7] and the failure could be associated with a more proximal level of amputation [8]. In fact, it has been reported that preadmission antibiotic use was associated with limb loss in a series including patients with and without diabetes and toe osteomyelitis [9]. In our experience, many patients could have been referred before this severe tissue destruction occurred and amputation could have been avoided. Furthermore, several key questions still need to be clarified when opting for exclusive use of antibiotics for treatment: What is the optimum offloading method for diabetic foot osteomyelitis? A total contact cast is contraindicated in cases of osteomyelitis, for example. What kind of wound care is needed? How can infection spreading through the foot be detected? When should medical treatment be abandoned and surgery pursued? Are outcomes worse when surgery is delayed?

Regardless, I certainly understand doctors who want to treat patients exclusively with antibiotics because most surgeons only perform amputations to halt the bone infection and that may not be acceptable for many patients. Our surgical approach to the patient with diabetes and foot osteomyelitis has changed considerably over the years. In 1997, for example, we offered our patients amputation following the dominant thought. Five years later, however, we began

to develop new surgical techniques that we call “conservative surgery” in which only infected bone and nonviable soft tissues are removed, without amputation of any part of the foot. Ha Van et al. first reported the contribution of conservative surgery to the management of diabetic patients with foot osteomyelitis [10]. They retrospectively compared the results of the treatment of osteomyelitis without ischaemia over two different periods. Thirty-two patients belonged to a historical group (1986-1993) of patients treated with antibiotic therapy, offloading, and local wound care. The second group consisted of 32 patients who underwent conservative surgery followed by the same regime of care (September 1993-March 1995). Healing rates were 57% in the case of the group undergoing medical treatment and 78% in the case of those who underwent surgery ( $p < 0.008$ ). There was also a significant difference in healing time: 462 +/- 98 days for the group undergoing medical treatment as opposed to 181 +/- 30 days ( $P < 0.008$ ) for those who underwent surgery. In the group who underwent conservative surgery, only two patients (6.25%) required a minor amputation. In the medical treatment group, the failure of the medical management resulted in 40% of patients undergoing amputations: 9 toe, 3 transmetatarsal, and 2 below-the-knee amputations. These authors concluded that in the case of osteomyelitis of the foot in diabetic patients, conservative surgery reduced healing time, the duration of antibiotic therapy, and the number of secondary surgical procedures [10]. However, conservative surgery is not always possible because the clinical presentation of diabetic foot osteomyelitis can be extremely varied. Osteomyelitis can be accompanied by severe necrotising soft tissue infections [6,11-13], critical ischaemia or severe destruction of the bone [14,15]. Therefore, it is easy to understand why 40% of the patients in our experience initially required minor or major amputations: 38.4% of the patients initially required a minor amputation and 1.6% required a major amputation in our series of 185 patients. Sixty per cent of patients initially underwent conservative surgery but subsequent amputations were required: 12% minor and 6% major. Final outcomes of the treatment of this series of patients were 49% conservative surgeries, 43% minor amputations, and 8% major amputations. Predictive variables associated with amputation were: bone exposed, limb ischaemia, and necrotising soft tissue infections [6]. What are the outcomes of conservative surgery when osteomyelitis is not associated with soft tissue involvement? In our new cohort of 81 patients with osteomyelitis, 41 did not present soft tissue involvement. In this group, 90% did not undergo amputation, while

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the remaining 10% had minor amputations. No major amputations were carried out in this selected group. Complete healing was achieved by secondary intention at 8 weeks [11]. However, there are several unresolved issues associated with surgical treatment for diabetic foot osteomyelitis. Who needs early surgery? [8] Should antibiotics be given for one month to reduce soft tissue infection, and the patient then offered elective bone surgery? [16] Should surgery be early performed and followed by postoperative culture-guided antibiotics based on bone samples? [6,11] What type of surgery should be performed? [8] Who can safely perform this surgery? Are recurrences and reulcerations more frequent with surgery than without? When can a patient who undergoes treatment for osteomyelitis be considered cured? [6,11] Several different answers to the last question can be found in existing literature regarding remission criteria. These include the resolution of clinical findings [17], the absence of any sign of infection at the initial or contiguous site [18], limb salvage [9,19] and wound healing [11,20]. There is no current consensus about it. In my opinion, the cure of osteomyelitis should be defined as the complete epithelialisation of the ulcer and/or surgical wound that was created whilst treating the infection without recurrence. Several authorities have noted that with appropriate wound care and offloading a soft tissue wound can heal while underlying bone infection remains. That would be possible exclusively during a short period; if the bone infection persists, the wound will reopen [8].

Our outcomes cannot be explained by surgery alone because postoperative antibiotics based on bone cultures taken during surgical procedures were given. The median length of time for which any type of antibiotic was given was 36 days [11]. Previous reports treating patients exclusively with antibiotics used longer periods of antibiotic therapy. There were differences in the duration of antibiotic therapy determined by patient characteristics. Patients with peripheral arterial disease, those who needed reoperation, and those who underwent open transmetatarsal amputations required longer periods of antibiotic therapy [11].

In my opinion, when the bone is exposed and when osteomyelitis is accompanied by extensive radiological damage, progressive bone destruction seen in sequential x-ray images, gangrene, or destruction of the soft tissue envelope and spreading of soft tissue infection, surgery must be carried out as soon as possible in order to prevent a more proximal level of amputation. In cases of chronic osteomyelitis without these complications one could opt for exclusive use of antibiotics or surgery but one cannot predict with certainty for which of the patients medical therapy will fail and the failure could be associated with a more proximal level of amputation.

Recently, we have published a randomised trial comparing the outcomes of medical versus surgical treatment in patients with diabetes and forefoot osteomyelitis without ischaemia or soft tissue infections [21]. Antibiotics and surgical treatment had similar outcomes in terms of healing rates, time to healing, and short-term complications in patients with neuropathic forefoot ulcers complicated by osteomyelitis without ischaemia or necrotising soft tissue infections. However, this study was carried out in a highly specialised centre and it is unknown whether these outcomes could be achieved in other not so specialised centres. On the other hand, patients with ischaemia and foot osteomyelitis could have different outcomes.

Currently, our usual approach is to perform early conservative surgery followed by antibiotic therapy and reoperation if necessary. This procedure has some advantages: duration of antibiotic therapy is shorter than in medical series of treatments; the rate of infection

recurrence is low; healing is achieved in a reasonable period of time; amputation is avoided when no ischaemia or soft tissue infection is present; and there is a low rate of *major* amputations. The disadvantages are: cost effectiveness is unknown, hospitalisation is required (though outpatient surgery is a possible option) and so are experienced diabetic foot surgeons, reoperations and readmissions could be necessary, and the effects on patients' quality of life are unknown.

The optimum management of diabetic foot osteomyelitis remains one of the most controversial issues when dealing with diabetic foot syndrome. More research is needed from other working groups.

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