Two-stage operation to treat destructive midfoot tuberculosis: 14 cases experience

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Introduction: Tuberculosis (TB) in midfoot is often secondary to tuberculosis elsewhere in the body. The experience and literatures to treat midfoot tuberculosis are rare. Up until now, no successful method is reported to treat midfoot tuberculosis.

Hypothesis: Stage surgery is an effective method to treat midfoot bone TB.

Material and methods: Between January 2008 to January 2011, 14 patients who were diagnosed midfoot tuberculosis and suffered stage operation were enrolled. All the patients had been diagnosed definitely relying on imaging examination and laboratory tests preoperatively. Two-stage operation was performed to all patients. At the first stage, TB tissue and infective tissue were completely removed and replaced by antibiotic bone cement. Normal foot length and arch would be restored and maintained by K-wires and external fixators. At the second stage, autologous iliac and allogeneic bone graft were used to replace bone cement and by fixed by locking plates. American Orthopaedic Foot and Ankle Society (AOFAS), SF-36 and visual analogue scale (VAS) pain score were recorded at the last follow-up.

Results: The average bone union time was 3.8 (range 3–6) months. There is no case of local recurrence or skin sinus. Neither implant broken nor screw loosen was present in this study. The AOFAS score was increased from 51.7 ± 6.8 (range 43–61) preoperatively to 82.9 ± 3.9 (range 76–90) postoperatively (P < 0.001). The SF-36 score increased from 46.1 ± 6.1 preoperatively to 83.1 ± 5.4 postoperatively (P < 0.001). The VAS score decreased from 6.1 ± 1.1 preoperatively to 1.4 ± 0.9 points postoperatively (P < 0.001).

Discussion: Stage operation is an effective treatment to stage III, IV midfoot tuberculosis.

Levels of evidence: Level IV, retrospective.

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1. Introduction

Despite tuberculosis (TB) had been controlled effectively for a short period of time, in the late 1990s, the rise of tuberculosis has become a threat to public health in the world [1,2]. According to Fifth National Tuberculosis epidemiological survey in China in March 2011, it was published that the incidence of tuberculosis in China is about 130 million, accounting for 14.3% of global incidence, and is second place among the world [3]. Although the incidence of TB in the foot and ankle is less than 1% of TB in bone and joint, the incidence of TB in midfoot is about 20% of that in foot and ankle [4–6]. TB in midfoot is one kind of chronic disease and is often secondary to tuberculosis elsewhere in the body, which always combines with synovial inflammation, granulation and bone destruction at Chopart joint. Tuberculosis, which develops gradually, is characterized by worsening joint pain with mild fever, inflammation of the joint, and cold abscesses with sinus tracts. Patients with TB in foot and ankle often complained of pain, swelling, and movement limitation of involved joints. There is sometimes sinus around involved joints. Fever, weight loss and other body symptoms are rarely [7,8].

Because of atypical symptoms and non-specific imaging findings in bone and joint TB, the diagnosis of bone and joint TB is difficulty [9–12]. Imaging findings include osteoporosis, soft tissue swelling, joint space narrowing and bone invasion [11,13]. Even there are radiographic abnormalities, it maybe misdiagnosed as other infection diseases [14]. Looking for TB granulation by biopsy is the definitive diagnosis of TB. Anyway, patients with TB are often missed or misdiagnosed as osteomyelitis, bone tumor or other inflammatory diseases [5,7].

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The basic treatment of foot and ankle TB is reasonable and long-term anti-tuberculosis. Operative treatment includes biopsy in cases that were not diagnosis clearly, debridement and arthrodesis. If there were obvious destruction and pain persists around foot and ankle joints, arthrodesis including triple arthrodesis and Lisfranc joint arthrodesis can be used to achieve a stable and painless foot. Operative treatment can be used to shorten anti-TB drug usage period and improve prognosis as well [15–17].

There is low incidence of TB in developed countries [14,18], so the literature about foot and ankle TB are rare. These articles are mostly case reports of ankle TB. There is no detailed introduction or guideline of operative method or procedure in literature. According to past experience to treat foot and ankle TB, debridement of infective tissue and arthrodesis were performed in one same stage. After arthrodesis, cast immobilization was used to stabilize the fracture site without internal fixation but K-wire. This kind of fixation was not stable enough that failure of arthrodesis and joint stiffness could occur. On the contrary, arthrodesis with rigid internal fixation can be performed after infection was controlled and cleaned in staging operation.

From January 2008 to January 2011, 14 cases with TB in midfoot were treated by stage operation in our department. The authors hypothesized that infection could be eliminated completely without secondary infection by implant, and rigid internal fixation could also improve bone union rates by stage operation.

2. Materials and methods

2.1. General information

Between January 2008 to January 2011, 14 patients who were diagnosed with midfoot tuberculosis were enrolled in this study. Nine patients were male and five were females. The average age of was 29.7 (range, 20–41) years. This study was conducted with approval from the Ethics Committee of Jiaotong University. Written informed consent was obtained from all participants. There were 8 patients of left side and 6 patients of right side. The patients suffered from 8 months to 6 years. All patients complained of pain and dysfunction in midfoot. There was sinus on the surface of skin in five patients. All patients denied there was tuberculosis in the remaining parts of body, such as lungs or stomach. All the patients accepted chest X-ray examination, there were the presence of lung tuberculosis in five patients. Old tuberculin tests (OT tests) were positive in 10 patients. Before the first stage surgery, biopsy had been performed in all cases. If the histologic appearance consisted of multifocal aggregates of epithelioid and foamy, infected macrophages, with scattered multinucleated giant cells, lymphocytes, and plasma cells flooding alveoli, with significant lymphoplasmacytic perivascular cuffing, the diagnosis of TB was definite. The results showed all cases were TB. The culture of Mycobacterium tuberculosis is not performed routinely. All the patients had been diagnosed definitely relying on imaging examination and laboratory tests preoperatively. Plain film, computed tomography (CT) and magnetic resonance imaging (MRI) of foot and ankle were regularly taken preoperatively (Fig. 1A and B). Eight patients were in stage IV and 6 patients were in stage III. ESR and CRP were both increased in all patients without HIV infection (Table 1). Because of pain, dysfunction of feet and destruction of Chopart joint, all patients were selected to surgical treatment.

2.2. Operative methods

Two-stage operation was performed to all patients. At the first stage, medial incision, lateral incision and combined incision were used to expose Chopart joint and eliminate TB tissue. All the articular surface involved TB tissue should be completely removed until normal bone tissue were exposed. Infective and TB tissue were sent to pathological examination. Then, the defected bone tissue was filled with antibiotic bone cement. An amount of 1.0 g vancomycin and 2 million unit streptomycin were mixed to 40 g cement. Normal longitudinal arch height should be restored and fixed by multiple K-wires in the cases of arch collapsing. At the same time, external fixator was used on the lateral side to maintain the length of foot.

Fig. 1. A 34-year-old man was diagnosed TB in left midfoot. A. Plain film showed destruction in Chopart joint and TMT joints, as well as osteoporosis in whole foot. B. CT showed destruction in calcaneocuboid joint. C. After first operation, two mini external fixators were used at both sides to maintain the length of foot. Bone cement was used to fill into the bone defect. D. The appearance of left foot after first operation.
Table 1
The information of all patients.

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(Fig. 1C and D). Surrounding skin and soft tissue of sinus should be completely removed at the same time. Cast was used while ankle was placed neutral position postoperatively. Anti-TB drugs, such as isoniazid, rifampicin, pyrazinamide and streptomycin were used orally per day postoperatively for 2 months. Then, isoniazid, rifampicin and streptomycin were used per day for 10 months. Intravenous antibiotics were also used for 2 weeks postoperatively. Follow-up was performed per month including plain film examination and blood biochemical examination. When erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) were both normal, the second-stage operation should be performed at least 6 months after the first operation, as well as all the symptoms were under controlled.

Original incisions were selected when second-stage operation was performed. Though bone cement was completely removed (Fig. 2A), there was big bone cavity left. Autologous iliac graft was harvested and cut into suitable size to fill to the bone cavity. If iliac graft was insufficient, allogeneic bone graft was also used. After the arch and foot length were restored, K-wires were used to stabilize bone sites temporarily. If the alignment was satisfied according to fluorooscopic monitor, locking plates were used for rigid fixation (Fig. 2B and C).

2.3. Postoperative treatment

Patients were encouraged to active and positive foot and ankle motion after 4 weeks cast immobilization. Anti-TB drugs were used continuously for at least one year. Operative outcomes were assessed prior to surgery and again at every three months postoperatively with the use of clinical, laboratorial and radiographic outcome measures. American Orthopaedic Foot and Ankle Society (AOFAS), SF-36 and VAS pain score were recorded at every follow-up. Complications including recurrence, infection and implant failure was also recorded.

2.4. Statistical methods

Statistical analysis was performed using SPSS software, version 11 (SPSS Inc, Chicago, IL). Continuous data were expressed as mean values ± standard deviation. Comparisons between different time points were made using paired Student’s t-tests. A significant result was taken as P < 0.05.

3. Results

Fourteen patients all got follow-up with average 58.9 (range, 50–70) months after second operation (Table 1). There was no super infection in this study. Blood ESR and CRP decreased to normal level 3.8 months after second operation. The average bone union time is 3.8 (range, 3–6) months. After the second stage operation, the duration of anti-TB therapy was 13.6 (range, 12–17) month. There is no case of local recurrence or skin sinus (Fig. 2D). Neither implant broken nor screw loosen was present in this study. The AOFAS score was increased from 51.7 ± 6.8 (range, 43–61) preoperatively to 82.9 ± 3.9 (range, 76–90) postoperatively (P < 0.001). The SF-36 score increased from 46.1 ± 6.1 preoperatively to 83.1 ± 5.4 postoperatively (P < 0.001). The VAS pain score decreased from 6.1 ± 1.1 preoperatively to 1.4 ± 0.9 points postoperatively (P < 0.001). The pain could be relieved by non-steroidal anti-inflammatory drugs (NSAIDs). On physical examination and plain film, there was no varus or valgus of midfoot.

4. Discussion

The incidence of osteoarticular tuberculosis is increasing in the past two decades [19]. Although the incidence in developed countries, such as Europe, USA and Japan was low, there was high rate in some developing countries [14,20]. According to epidemiological statistics, skeletal involvement constitutes less than 3% of the extrapolmonary presentations of tuberculosis [21,22].
There was no pulmonary presentation in 50% patients with skeletal tuberculosis [10]. However, approximately half of the skeletal tuberculosis affects the spine, the frequency of ankle joint involvement in skeletal tuberculosis varies from less than 1% to 6% [5,23]. Study had found midfoot involvement in only 20% patients with foot and ankle tuberculosis. It was found by Tuli [24] in a retrospective study of 1074 cases with osteoarticular tuberculosis in 32 years that the incidence of foot and ankle tuberculosis is 14.1%. This high incidence may be related to vulnerable to injuries with barefoot walking due to poverty.

Tuberculosis of the foot and ankle is one kind of chronic diseases and almost always secondary to a primary focus elsewhere in the body, such as pulmonary and gastrointestinal tract, etc. [16,20]. TB of foot and ankle could often cause structural destruction. However, osteolytic bone lesions around the foot and ankle can represent benign, malignant, or infectious processes, and there were quite a broad differential diagnosis. Patients in this study are not aware of the presence of tuberculosis. There was pulmonary TB in only five patients according to the chest plain film and CT. However, the primary lesion is not readily identifiable in rest patients. It is the same in the literature. Patient with foot and ankle TB complained pain, swelling, and limited motion of involved joints, as well as sinus near joint. Systemic complaints, such as fever or weight loss were rare, so patients were often missed or misdiagnosed as osteomyelitis, bone tumor or other inflammatory diseases [6,7,20].

It is difficult to make a right diagnosis of foot and ankle TB before biopsy, because of the atypical presentations of symptoms and non-specific findings on imaging studies. Traditional plain film is the first and most commonly used method to diagnose TB. There are 4 stages [25]:

- osteoporosis without bone damage;
- joint space narrowing with one or more bone tissue invaded;
- destruction of the joint, but it is still complete in bone structure;
- both bone structure and alignment are completely destroyed.

The author thought it was possible that there was no atypical clinical presentations and imaging findings in earlier stage, or it was misdiagnosed, patients were both in stage III and IV when they were enrolled in this study. MRI can help early diagnosis, mainly as follows [9,10,12]:

- destruction of the articular cartilage and cortical bone with a defect in the hypointense cortical rim;
- synovitis manifested as a joint effusion and high signal intensity on a T2-WI with enhancement on a post-contrast T1-WI;
- juxta-articular soft tissue changes seen as a replacement of subcutaneous fat signals on a T1-WI, high signal intensity on a T2-WI, and enhancement on post-contrast images.

Although MRI can help diagnosis early lesion of TB, it still needs relevant clinical and other laboratory tests to confirm TB diagnosis together. In active stage, elevated ESR and CRP are always used as reference criterions of TB. Although OT test is a classic test to diagnose TB, only 10% positive rates will be presented in osteoarticular TB cases [3,19]. The clinical value is not high. The culture of M. tuberculosis of sputum, urine and pus sinus can also be used as a reference criterion according to long culture period and low positive rate. In summary, the right diagnose of osteoarticular TB depends on biopsy, operative findings and pathology. Tuberculosis granuloma, cold abscesses are the main characters of TB. In addition, high risks population, such as HIV infection patients, post-traumatic patients with alcoholism, hormones used and drugs chemotherapy, should accept comprehensive examination [3,26].

The most common pathological presentation of foot and ankle TB is granulomas adjacent to joints. If the patients cannot receive anti-TB treatment in time, the midfoot joints including Lisfranc joint, Chopart and subtalar joints will be involved and lesion will spread fast because all of these joints are closely connected.

The basic treatment of osteoarticular TB is reasonable and long-term anti-TB therapy [3,27,28]. Operative treatment can be avoided if the patients got satisfied prognosis and residual function with anti-TB therapy in early stage. The operative indications of TB in foot and ankle are not clear. The author thought the indications included TB in stage III, IV, pain persists with articular surface destruction, deformities with functional limitation and infection with sinus. Operative treatment includes biopsy in unclear diagnosis cases, debridement and arthrodesis. The goal of arthrodesis including triple and TMT joint arthrodesis is to acquire a stable, painless, plantar grade foot. Anyway, there was proper failure rate of operation. Rigid internal fixation with plates and screws is the demands of arthrodesis, but it would cause infection and recurrence. Though K-wire can be used to reduce infection rates, it is not strong enough to support the bone structure or cause fusion failure finally. In this study, stage operation was selected to treat midfoot TB. At the first stage, debridement of TB, infective tissue and sinus, as well as using bone cement with streptomycin could prevent recurrence effectively. Meanwhile, foot alignment and arch height should be recovered and be fixed with K-wires. Two external fixators were placed at both medial side and lateral side to maintain the length of foot, especially in the cases of cuboid involved. It is essential for patients with tuberculosis involving the cuboid bone. When TB symptoms were under controlled, both ESR and CRP were at normal level, the second stage operation could be performed. According to the author’s experience, it was usually six months from the first operation. Not only can rigid internal fixation be used at second stage, but also the infection risks would not increase. In summary, operative plan should be decided by the severity of TB and infective lesions. Operative treatment, in a manner, not only can shortened the period of anti-TB drug therapy, but also have a satisfied prognosis.

Non-weight-bearing is one of important factors to treat osteoarticular TB. But, it is unclear how long non-weight-bearing should be persisted. According to the author’s experience, non-weight-bearing has advantages to TB, which was in active stage. CRP and ESR are both blood criteria to evaluate whether TB is in active stage, partial weight-bearing should not be allowed until CRP or ESR is in normal level or bone healed.

This study still has some limitations. The culture evidence of M. tuberculosis was absent. Though there was no case of recurrence, we did not know whether TB was resistance to anti-tuberculous drugs. There was no controlled group to evaluate whether surgery could shorten anti-TB therapy. ESR and CRP were not accurate markers in bone and joint TB and would be influenced by other facts. Other sensitive biomarkers should be used to identify infection in further research.

5. Conclusion

TB in midfoot is relatively rare with rare literature or reports. Clinical manifestations, plain film, MRI and laboratory tests are used to diagnose tuberculosis, but there are still risks of misdiagnosis and missed diagnosis. Biopsy is an important method to osteoarticular TB diagnosis. Anti-TB drug therapy is an effective method to treat TB in early stage without bone structure destruction, but operative treatment should be chosen to the cases with infection or functional limitation. In summary, stage operation has the advantage to eliminate TB lesions, lower recurrence, improve bone union.

Disclosure of interest

The authors declare that they have no competing interest.
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