Management of osteoarticular tuberculosis of the foot and ankle: a scoping review

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Abstract

Background

The purpose of conducting this review was to determine the optimal medical and surgical management of patients in the adult population with foot and ankle tuberculosis from the available literature.

Methods

A systematic literature search was undertaken through PubMed, Web of Science, Scopus, and the Cochrane Library. The phenomenon of interest was defined as tuberculosis of the foot and/or ankle in patients over 14 years of age. A qualitative data description was performed and reported as per Preferred Reporting Items for Systematic Reviews and Meta-Analysis Extension for Scoping Reviews (PRISMA-ScR) guidelines.

Results

The median total duration of medical treatment was 12 months (range 6–18). Most studies used a combination of rifampicin, isoniazid, pyrazinamide and ethambutol as intensive phase treatment for a median duration of two to three months. The continuation phase involved two or three agents for up to 16 months. The most common indication for surgery in active disease was failure to respond to medical treatment alone. In quiescent disease, surgery was employed for impending midfoot collapse or painful, deformed joints. It was found that 17% of patients (32 of 184) required arthrodesis.

Conclusion

Medical treatment remains a mainstay of management. Evidence supporting surgical management in early disease is limited. No single approach, implant or fixation method for the purpose of arthrodesis has been proven superior to another. Further research is needed, specifically comparative studies to address the lack of consensus surrounding surgical intervention.

Level of evidence: Level 5

Keywords: tuberculosis, TB, foot and ankle, surgery

Introduction

Extrapulmonary tuberculosis (TB) made up 10–16% of cases notified in 2019, with musculoskeletal TB accounting for 10–25% of these.[1] Osteoarticular TB generally favours, in sequence, the spine, hip, knee, foot and ankle, with spinal TB making up more than half of cases.[2,3] Foot and ankle TB comprises approximately 0.1–0.3% of all cases of TB.[4] While typically localised, multifocality has been observed in approximately 10% of cases.[5] Delayed treatment of juxta-articular foci allows for spread into adjacent joints and further. The natural progression typically involves worsening stiffness and deformity.[6] According to Tuli, early detection and treatment may result in up to 90% of patients achieving healing with near-normal function.[6]

The disease burden is particularly heavy in lower- and middle-income countries (LMICs). Once diagnosed, appropriate antitubercular treatment (ATT) should be commenced. There is, however, little consensus regarding the optimal timing and manner of surgical interventions.[6-8] To our knowledge, there are currently no documented guidelines or consensus statements regarding surgical management of foot and ankle TB. It is for this reason that we performed a scoping review of the available literature. We aimed to determine the optimal medical and surgical treatment of foot and ankle TB in the adult population that would result in a favourable outcome. Our objectives included summarising current practices relating to the management of TB of the foot and ankle, with specific reference to medical management, ascertaining the indications for and outcomes of surgery, and determining the

optimal timing and surgical techniques that would be likely to achieve a successful clinical outcome.

Methods

This study was performed as per the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Extension for Scoping Reviews (PRISMA-ScR) guidelines.[9]

Only English-language original peer-reviewed studies were included, including randomised and non-randomised control trials; prospective and retrospective cohort studies; and case-control, analytical, cross-sectional, and observational studies, at all levels of evidence. No time limit criterion was set. Case series involving five or fewer patients, systematic and diagnostic reviews, and non-clinical and radiological studies were excluded.

A systematic literature search was undertaken of PubMed, Web of Science, Scopus, and the Cochrane Library on 15 August 2023. The MeSH terms used, as per the 2020 MeSH descriptor data, were as follows: ("Tuberculosis" OR "TB") AND ("Foot joints" OR "Foot bones" OR "Foot" OR "Ankle"). Bibliographies of retrieved studies were cross-referenced for additional potential articles.

Authors performed the literature search on 15 August 2023. As an example, the electronic search strategy for PubMed is presented here and was undertaken as follows: PubMed's advanced search builder was employed. Filters/limitations applied included English language and Human studies. The MeSH terms ("Tuberculosis" OR "TB") AND ("Foot joints" OR "Foot bones" OR "Foot" OR "Ankle") were used.

Phenomena of interest were defined as TB of the foot and/or ankle involving bone and/or joints in adult patients over the age of 14 years. After performing the literature search, articles were excluded based on title and abstract. All remaining articles were assessed on full text, considering the inclusion/exclusion criteria. Selection was performed independently by the two reviewers, and disagreements were resolved by consensus.

Extracted data descriptors included authors, year of publication, study design, number of participants, and outcomes of interest. Extracted data were charted onto a Microsoft Excel spreadsheet. Regarding our outcomes of interest, the following data were extracted from each study:

- Clinical features (age, site of infection, duration of symptoms, how the diagnosis was made)
- Treatment (medical agents used and their duration of use, surgical procedures performed and complications)
- Outcomes of treatment (follow-up period, quiescence achieved, reported functional outcome)

Results were reported according to PRISMA-ScR.[9] Due to the paucity of data and lack of high-level evidence, a qualitative description of the data was performed as a thematic analysis. A risk of bias assessment was performed using the Joanna Briggs Institute (JBI) critical appraisal checklist for case series (*Appendix A, available online*).[10]

Results

A synopsis of the literature search is provided in *Figure 1*. Fourteen studies were ultimately included in this scoping review.[11-24] The oldest published was in 1993, and the most recent in 2023. Most studies were from India (n = 6), five from China, and one each from Turkey, Taiwan and Indonesia, respectively. All studies were retrospective. In total, the treatment and outcomes of 370 patients were described, with a mean of 26 cases per study (range 9–74). The combined mean follow-up period for the ten studies that reported it was 42 months (range 22–100). The ankle was the focus in seven studies, the foot in three and the midfoot in one. Three studies included TB of both the foot and ankle. None of the included data sources classified their patients as having active, quiescent or healed disease.

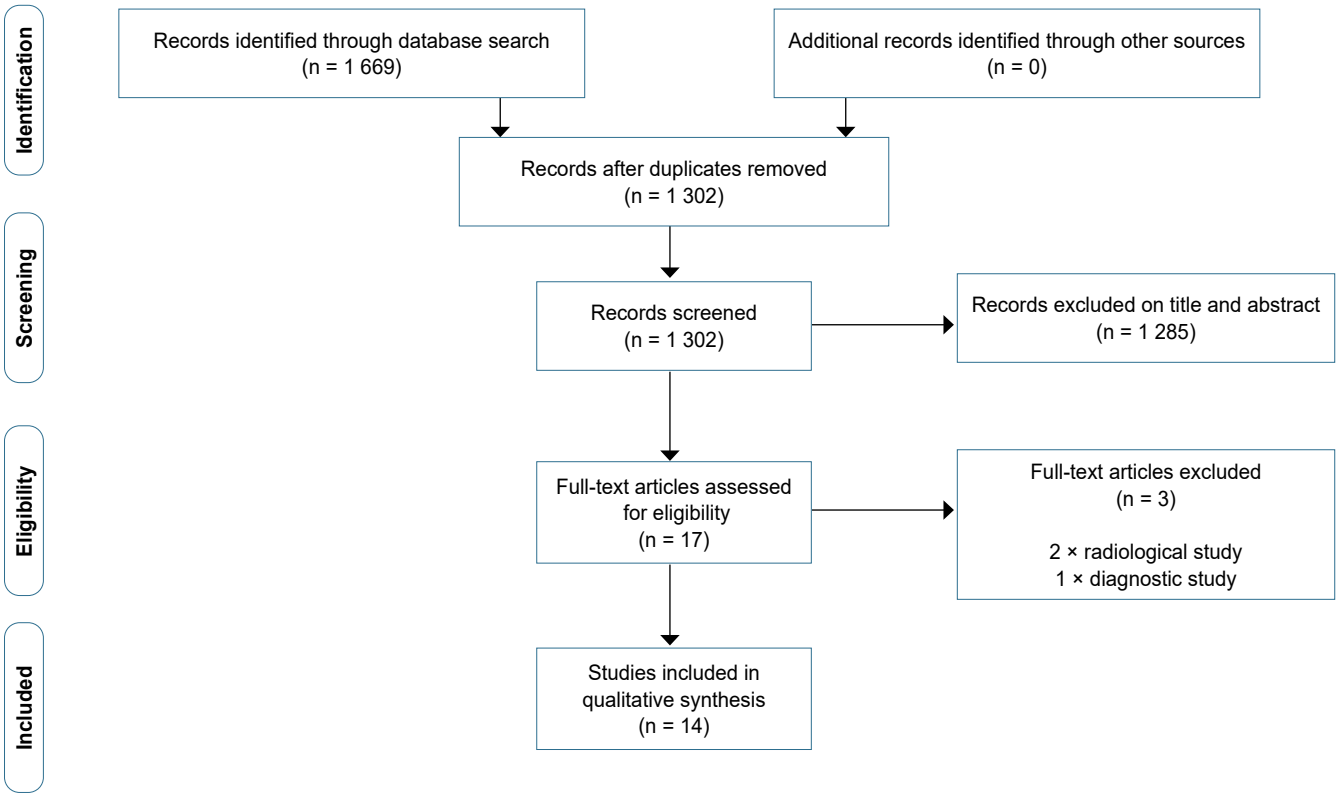

Figure 1. PRISMA flow diagram showing selection of included studies

Table I: Medical management strategies employed

Authors, year	Antitubercular drugs and dosage	Intensive phase		Continuation phase		Maintenance phase		Total duration of treatment (months)
		Agents	Duration (months)	Agents	Duration (months)	Agents	Duration (months)	
Zou et al., 2016[12]	HRZS (doses not documented)	HRZS	2	HRS	10	–	–	12–17
Zhang et al., 2020[22]	Rifampicin 450–600 mg/day Isoniazid 300–450 mg/day Pyrazinamide 20–25 mg/kg/day Ethambutol 15–25 mg/kg/day	HRZE	3	HRZ	3	HR	12	25 (mean)
Qu et al., 2020[13]	HRZS (doses not documented)	HRZS	2–3	HRS	10–12	–	–	12 (mean)
Tang et al., 2007[15]	Rifampicin 900 mg/day Isoniazid 300 mg/day Pyrazinamide 1.5 g/day Ethambutol 750 mg/day Streptomycin (dose not documented)	HRZES	1–3	HRZE	6	HRE	6	15 (mean)
Duan and Yang, 2019[23]	Rifampicin 450–600 mg/day Isoniazid 300–450 mg/day Pyrazinamide 20–25 mg/kg/day Ethambutol 15–25 mg/kg/day	HRZE	3	HRZ	3	HR	12	18
Gursu et al., 2014[16]	3–4 drug antitubercular treatment, drugs and doses not reported	–	–	–	–	–	–	18
Samuel et al., 2011[20]	HRZE (doses not documented)	HRZE	2	HR	4–16	–	–	6–18
Gavaskar and Chowdary, 2009[21]	HRZE (doses not documented)	HRZE	3	HR	9	–	–	12
Dhillon, Aggarwal, Prabhakar and Bachhal, 2012[19]	Rifampicin 450–600 mg/day Isoniazid 300–450 mg/day Pyrazinamide 20–25 mg/kg/day Ethambutol 15–25 mg/kg/day	HRZE	3–4	HRZ	12–14 **(3 mo for 7 patients only)**	HR	12 **(7 patients only)**	16–18
Mittal, Gupta and Rastogi, 1999[18]	HRZE (doses not documented)	HRZE	2	HR	16	–	–	18
Dhillon and Nagi, 2002[11]	Rifampicim 400–600 mg/day Isoniazid 300–450 mg/day Pyrzinamide 10–25 mg/kg/day Ethambutol 15–25 mg/kg/day Streptomycin 0.75–1 g/day (used in only 3 cases)	HRZE	3–4	HR	12–14	–	–	15–18
Dhillon, Sharma, Gill and Nagi, 1993[14]	Rifampicin 400–600 mg/day Isoniazid 450–600 mg/day Pyrazinamide 10–25 mg/kg/day Ethambutol 15–25 mg/kg/day Streptomycin 0.75–1 g/day	HRE	4–6	HR	9–12	–	–	18
Chen, Lee, Wong, and Feng, 2013[17]	Rifampicin 10–15 mg/kg/day Isoniazid 5 mg/kg/day Pyrazinamide 20–20 mg/kg/day Ethambutol (dose not documented)	HRZE	2–3	HRZ	4–10	–	–	9–12
Primadhi, Prasetia, Rahim and Mulyadi, 2022[24]	HRZE (doses not documented)	HRZE	2	HR	10	–	–	12

H: isoniazid; R: rifampicin; E: ethambutol; Z: pyrazinamide; S: streptomycin; mo: months

Medical management

The studies reviewed revealed various medical management protocols (*Table I*). Most studies used rifampicin, isoniazid, pyrazinamide and ethambutol as intensive phase treatments. Seven studies omitted the doses of antitubercular drugs (ATD) used.[12,13,16,18,20,21,24] Duration of phases varied between studies. The median duration of intensive phase therapy was two to three months (range 1–6). Two studies employed a continuation phase of three months followed by a maintenance phase of 12 months for a total duration of medical treatment of 18 months.[22,23] In the remaining studies that reported on duration of therapy, the continuation phase ranged from four to 16 months.[11-14,17,18,20,21,24] The median total duration of medical treatment was 12 months (range 6–18). Most studies aimed for a total treatment duration of at least 12 months except for Chen et al. and Samuel et al., who managed some patients in their study with six to nine months of ATT.[17,20]

Table II: Study characteristics and surgical management employed

Author, year	Study site	Study design	Sample size	Anatomic location	Surgical management	Follow-up period (mean)	Outcomes
Zou et al., 2016[12]	China	Retrospective descriptive case series	14	Midfoot	Two-stage reconstructive procedure	59 months	Time to union (average 3.8 mo), recurrence (0), AOFAS[i] (mean ↑ 31.2), SF-36 (mean ↑ 37), VAS (mean ↓ 4.7)
Zhang et al., 2020[22]	China	Retrospective descriptive case series	9	Ankle	Arthroscopic ankle arthrodesis	55 months	Union rate (100%), time to union (18 ± 4 weeks), AOFAS[i] (mean ↑ 51.89), VAS (mean ↓ 7.23)
Qu et al., 2020[13]	China	Retrospective descriptive case series	10	Foot and ankle	Three-stage Masquelet or one-stage reconstruction	33 months	Recurrence (0), time to union (average 3.7 mo), AOFAS[i] (mean ↑ 30), VAS (mean ↓ 30)
Tang et al., 2007[15]	China	Retrospective descriptive case series	10	Ankle	Arthroscopically assisted ankle arthrodesis	23 months	Union rate (100%), time to union (± 14.5 weeks), AOFAS (average 66)
Duan and Yang, 2019[23]	China	Retrospective descriptive case series	15	Ankle	Arthroscopic debridement and biopsy	24 months	Recurrence (0), AOFAS[i] (mean ↑ 47), VAS (mean ↓ 6.1)
Gursu et al., 2014[16]	Turkey	Retrospective descriptive case series	70	Foot and ankle	Biopsy (60%), soft tissue debridement (40%), bony debridement (34%), fistulectomy (13%), synovectomy (6%), arthrodesis (7%), disarticulation (3%)	22 months	Recurrence (25.7%), radiological outcome
Samuel et al., 2011[20]	India	Retrospective descriptive case series	16	Ankle	Open biopsy, debridement, and curettage (25%), arthrodesis (31%), synovectomy (31%), curettage and excision biopsy (12%)	24 months	Healing as defined by Dhillon and Nagi[ii]
Gavaskar and Chowdary, 2009[21]	India	Retrospective descriptive case series	7	Ankle	Tibiotalocalcaneal arthrodesis using a supracondylar femoral nail	Not documented	Union rate (100%), time to union (13 ± weeks), FAOS (mean ↑ 59),[iii] recurrence (0)
Dhillon, Aggarwal, Prabhakar and Bachhal, 2012[19]	India	Retrospective descriptive case series	24	Foot	Open biopsy and debridement (21%), curettage and joint distraction (0.04%), debridement (0.04%)	8.3 years	Healing, recurrence (0)
Mittal, Gupta and Rastogi, 1999[18]	India	Retrospective descriptive case series	44	Foot	None	30 months	Clinical and radiological features of healing
Dhillon and Nagi, 2002[11]	India	Retrospective descriptive case series	74	Foot and ankle	Arthrodesis (0.1%), curettage (< 0.1%), curettage and joint distraction (< 0.1%)	Not documented	Dhillon and Nagi criteria[ii]
Dhillon, Sharma, Gill and Nagi, 1993[14]	India	Retrospective descriptive case series	22	Foot	Debridement (0.1%)	Not documented	Clinical and radiological features of healing
Chen, Lee, Wong, and Feng, 2013[17]	Taiwan	Retrospective descriptive case series	29	Ankle	Aspiration (72%), biopsy (20%), synovectomy (52%), arthrodesis (66%)	73 months	Teeny and Wiss ankle-hindfoot rating scale[26]
Primadhi Prasetia, Rahim, and Mulyadi, 2022[24]	Indonesia	Retrospective descriptive case series	26	Ankle	Debridement and arthrodesis	2.5 years	FAAM[iv] (mean ↑ 18.81%)

(i) American Orthopaedic Foot and Ankle Society score. (ii) Dhillon and Nagi criteria for clinical healing. The disease was considered healed when there was 1) resolution of local symptoms such as pain, swelling, and healing of the sinuses had occurred; 2) a decrease in the serial erythrocyte sedimentation rates; and 3) radiologic evidence of remineralisation, a decrease in osteoporosis, and fusion in patients in whom arthrodesis was done. (iii) Foot and Ankle Outcome Score. (iv) Foot and Ankle Ability Measures

Table III: Indications for surgical intervention in active disease as proposed by Qu et al.[13]

	Description
1	Marked radiographic erosions above stage I
2	Erosions accompanied by a sinus or patients with mixed infection
3	No healing or worsening after appropriate antituberculosis treatment (ATT)
4	No improvement or worsening erythrocyte sedimentation rate (ESR) or C-reactive protein (CRP) levels despite appropriate ATT
5	Uncertain diagnosis with failure to identify the cause

Surgical management

A range of surgical strategies was employed (*Table II*). In all but one study, patients had a biopsy to confirm the diagnosis.[11-17,19-24] Aside from biopsy, the indications for surgery varied widely. Two of the six studies using the Martini staging system based their treatment strategy selection partly on that staging.[25] Chen et al. treated patients with stage I with medical treatment alone, while those in stage II received debridement. Patients with stage III disease were treated with radical synovectomy, debridement, and possible fusion. Peritalar arthrodesis was reserved for stage IV disease.[17] Qu et al. also managed patients in stage I with medical treatment alone, unless these patients had associations that necessitated the use of surgical intervention (*Table III*).[13]

In active disease, Dhillon reserved surgery for patients with a juxta-articular focus threatening joint invasion. In quiescent disease, surgery was employed for impending midfoot collapse or painful, deformed joints.[11,14,19] Mittal only considered surgery in patients with lesions that failed to heal after adequate ATT. In their study of 37 patients with osseous lesions, none received surgery.[18] Advanced disease in apparent quiescent infection was cited as an indication for surgical management by Samuel and Gavaskar.[20,21]

Debridement

Debridement was performed in six studies, with four performing it at the time of open biopsy.[11,14-17,19,20] Samuel et al. reported successful healing without the need for further surgery in four patients with early, active, localised osseous disease who underwent debridement and ATT.[20] Dhillon and Aggarwal debrided five patients at the time of open biopsy and one due to imminent danger of joint involvement, all of whom healed.[19]

Dhillon and Nagi performed debridement at the time of biopsy in three patients.[11] It is unclear whether these patients had active or quiescent disease. Chen et al. performed joint debridement, synovectomy and open biopsy in active disease when aspiration failed to confirm the diagnosis.[17] Dhillon and Sharma performed third tarsometatarsal joint debridement on one patient with active disease.[14] Twenty-four of Gursu's patients required debridement. However, no information was noted regarding the indication, stage, active or quiescent status of the disease, or any additional procedures.[16]

Arthrodesis

Arthrodesis was performed in ten studies. In the studies that reported this data, the combined arthrodesis rate was 17% (32 of 184 patients).[11,16,17,20] The indication for arthrodesis in Samuels' five patients was advanced disease as evidenced by periarticular osteopenia and articular destruction. It is unclear whether these patients had active or quiescent disease. Tibiotalar arthrodesis was performed in four with good clinical outcomes, and tibiotalocalcaneal arthrodesis on another due to talar and subtalar joint involvement.[20] Dhillon and Nagi reported that, of their 74 patients, only three required triple arthrodesis and one a limited talonavicular fusion.[11] The authors did not specify indications for arthrodesis but noted that surgical correction was offered to those who had destroyed, painful joints, with arthrodesis as a secondary procedure if required.[11] Gursu reported that five out of 70 patients required arthrodesis without specifying the indications.[16] Chen et al. continued this lack of distinction. Nineteen of their patients underwent arthrodesis. The operative procedure was determined by the extent of peritalar involvement and disease progression.[17]

Gavaskar and Chowdary reported on seven patients with quiescent ankle TB who underwent tibiotalocalcaneal arthrodesis. Indications noted were both clinical and radiographic.[21] Primadhi et al. reported the short-term outcomes of 26 patients with advanced ankle TB who underwent single-stage debridement and arthrodesis.[24] Zou et al. treated 14 patients with destructive midfoot TB with a two-staged arthrodesis. Patients were either stage III or IV radiographically. Indications for surgery were pain, dysfunction, and destruction of the Chopart joint. No distinction was made between those with active or quiescent disease. Improved AOFAS and VAS scores were noted. None had metalware failure or malalignment at final follow-up.[12] Qu et al. reported on ten patients who underwent various types of arthrodesis, including tibiotalar, subtalar, triple, or quadruple arthrodesis. Pain scores decreased with improvement in AOFAS scores for all patients. None had implant failure. Four of their patients were radiographically stage III and presumed to have active infection. Of the remaining six who were stage IV, four had sinuses present and, therefore, also likely to have had an active infection.[13] Two studies reported on arthroscopically assisted ankle fusions in patients with end-stage ankle TB.[15,22] The results of these are discussed further in the arthroscopy section.

Single versus staged procedures

Qu et al. employed single-stage arthrodesis in five patients who appeared to have active infection.[13] The remainder underwent a three-stage Masquelet-type procedure. Four of the five patients treated with the three-stage procedure had sinuses. The first stage involved debridement and application of a vacuum-assisted closure (VAC) dressing. Stage 2 included re-debridement and insertion of an antibiotic-laden cement spacer. In stage 3, the spacer was removed, the defect grafted, and rigid fixation was achieved using screws or locking plates. Neither group had reinfection nor implant failure. Aspects considered when planning reconstruction include incision type, presence of a mixed infection, soft tissue cover and implant choice.[13]

Chen et al. performed single-stage debridement and arthrodesis on 19 patients, with ten presenting with sinuses indicating active disease. Results were good to excellent in 17 patients.[17] Primadhi et al. also performed single-stage debridement and arthrodesis of the ankle in 26 patients. Twelve of those had sinuses present at the time of surgery.[24] Zou et al. performed a two-stage technique in 14 patients with midfoot TB. Stage one involved debridement, maintenance of the longitudinal arch, lateral column length, and dead space management. Stage two involved autologous bone graft and rigid fixation using locking plates.[12]

Joint distraction

The use of distraction was noted in only two studies.[17,19] Dhillon and Aggarwal used distraction on one patient with impending collapse of the cuboid to maintain length until evidence of remineralisation.[19] Chen recommended distraction during tibiotalar joint debridement to preserve alignment and joint space. Further information regarding its use and outcomes in this study was not documented.[17]

Arthroscopy

Duan used arthroscopy to take appropriate samples for diagnosis, assess the extent of active ankle TB, prognosticate, and plan surgical management. Arthroscopic debridement purportedly aided in local disease control via removal of infected or necrotic tissue. All patients healed well, with no complications noted.[23]

Tang and Zhang published results of arthroscopically assisted ankle fusion.[15,22] In Tang's study, ten patients with quiescent TB underwent arthroscopically assisted ankle fusion with half-ring external fixation. Patients with ankle deformities or large bone defects were excluded from this study.[15] Zhang et al. used arthroscopically assisted ankle arthrodesis in active TB. Seventy-eight per cent had good to excellent scores at the final follow-up.[22] All patients achieved fusion between 12 and 25 weeks.[15,22]

Results

Several studies did not include a particular outcome measure nor report descriptive statistics for all outcomes. Time to bony fusion (mean 15 weeks) was reported in six articles, with a union rate of 100%.[12,13,15,20-22] Eight studies reported validated patient-reported outcome measures. The AOFAS (American Orthopaedic Foot and Ankle Society) score increased by a mean of 40 (range 30–51) in four studies. The fifth only reported a post-treatment average score of 66.[12,13,15,22,23] The Foot and Ankle Outcome Score (FAOS) increased by a mean of 59 points in one study, and the FAAM (Foot and Ankle Ability Measure) score by a mean of 18 points in another.[21,24] The Teeny and Wiss Ankle and Hindfoot rating scale was used in a single study, with 22 good to excellent, four fair and two poor results.[17,26]

Dhillon and Sharma described cardinal signs for which they considered the disease healed. Dhillon and Nagi also used these signs, which include the disappearance of symptoms including sinuses, no elevation in serial ESR, and radiological evidence of remineralisation, obliteration of cavities, restoration of trabeculae and decrease in osteoporosis. The number of patients who met these criteria was not reported in either study.[11,14]

Zhang et al. reported that all patients in their study were cured at final follow-up. Their criteria for cure were that three months after discontinuation of ATT, the patient had a normal ESR, could walk painlessly for one kilometre, the absence of an abscess or sinus in the local area, and radiographs showing callous through the joint space.[22] Duan et al. used similar cure criteria in their study, without the radiographic findings.[23]

Samuel and Dhillon reported that all patients in their studies who underwent open biopsy, debridement and chemotherapy healed well. These studies did not, however, define what they considered to be healed TB.[19,20] Chen et al. reported resolution of infection in all their patients but did not define resolution.[17] Other studies reviewed did not report on or define quiescence or cure in their patient population. Ten studies reported on recurrence within their cohorts. Eighteen of 255 patients had recurrence, making the recurrence rate 7.1%.[11-16,19,21,22,23]

Few surgical complications were reported. In the series by Chen et al., of 19 patients who underwent arthrodesis, six patients developed talar bone collapse with subsequent rocker bottom or flatfoot.[17] Qu et al. reported that one of their ten fusion patients complicated with skin necrosis, which required a flap, and another with a fracture to the distal tibia.[13] Samuel et al. reported that one of their patients developed forefoot equinus, which responded to stretching and cast application.[20]

Discussion

Cases of foot and ankle TB make up less than 2% of all cases of TB.[8] This rarity is reflected in the relative brevity of data on the topic. ATT is an important aspect of treatment.[6] Medical management protocols differed among the studies in this scoping review. Older studies tended to have longer durations of treatment.[14,18] Doses and drugs were generally consistent, but drug combinations and duration of phases varied.[11-23] The current trend is towards a shorter duration of treatment.[27,28] According to the Centers for Disease Control and Prevention guidelines, a six- to nine-month regimen containing rifampicin is recommended for the treatment of bone and joint TB.[29] Initial medical therapy for drug-susceptible TB should consist of a combination of four drugs, including rifampicin, isoniazid, ethambutol and pyrazinamide, for two months. This should be followed by isoniazid and rifampicin for a minimum of four to seven more months of therapy.[29,30]

Traditionally, therapeutic surgical intervention in active arthritic phase TB was reserved for cases showing inadequate response to medical management or for drainage of large abscesses.[6,16,31,32] Some authors have suggested that surgical debridement and synovectomy may expedite healing in osteoarticular TB.[33,34] While Johansen et al. found no difference in outcomes between patients who did or did not receive surgery, another study showed a relatively high relapse rate (22%) despite 92% of cases receiving synovectomy.[3,35] Conversely, Sandher et al. noted that joints that underwent debridement required no subsequent surgery in the form of arthroplasty or arthrodesis.[36] Similarly, Shen et al. noted X-ray changes in only two of ten patients with early-stage active TB of the knee, treated with synovectomy at a mean follow-up of 30 months.[37] Several authors have suggested that early surgical debridement may improve local disease control in patients with active ankle TB, thereby limiting joint damage.[11,20,23] Our data reveals that debridement was often performed in the active stages of disease in conjunction with the open biopsy. Six studies reported isolated debridement/curettage in patients with early-stage TB.[11,14-17,19,20] A systematic review by Rusdianto et al. looked at outcomes of early debridement in the management of ankle TB. They recommended early debridement to achieve beneficial outcomes.[38] There is insufficient evidence to suggest that results are superior to medical treatment alone. In spinal TB, this issue has garnered attention. Qian et al. performed a randomised control trial comparing no debridement with radical debridement for thoracic and lumbar TB, and found no difference in outcome.[39] Taking our findings into account, failure to obtain a definitive diagnosis, disease progression on ATT, and painful, dysfunctional joints may serve as indications for surgery during the active phase of the disease.

Pain, deformity, and dysfunction have been cited as reasons for surgical intervention during the quiescent phase.[11-13,15,17,20] Procedures performed aim to produce a stable, painless, plantigrade foot/ankle.[13,21] Arthrodesis appears to be the current preferred procedure for painful, deformed joints in inactive end-stage TB.[12,13,15,22] There is little consensus regarding timing, approach and fixation methods to achieve fusion.[12,13,21,22,24] Open and arthroscopic methods have been reported, and one has not been proven superior to the other.[12,22] Fixation methods varied, and no comparison of fixation strategies was found.[12.13.15,21,22]

Arthrodesis may be performed in single or multiple stages.[12,13,21] Results from the reviewed studies suggest good outcomes may be achieved using single-stage procedures.[13,21,24] Patients with sinuses, however, may have superimposed infection. In situations of mixed infection, staged surgery may be the safer option.[13,24] In patients with TB hip, Öztürkmen et al. felt that patients with sinuses were unsuitable for single-stage total hip replacement.[40] Research comparing single and staged procedures is required.

Reports on the use of arthroscopy in the management of foot and ankle TB are scarce, and sample sizes are small. In this review, three studies reported its use.[15,21,22] We have not found any study comparing open and arthroscopically assisted arthrodesis in patients with joint TB. Similarly, studies comparing arthroscopy and ATT alone are difficult to conduct due to low case numbers. In the knee, the preference is to perform arthroscopy at the initial setting to biopsy and release adhesions, as it is minimally invasive. Open procedures are reserved for definitive reconstructive surgery.[27,41]

Limitations of this study include the following: most studies reviewed were descriptive and had small sample sizes. There was often an inadequate description of either the patient cohort, inclusion/exclusion criteria or indications for interventions in included studies. Studies examining the results of a specific intervention type had no control groups. The follow-up period between studies varied, with many interventional studies having a short-to-mid follow-up period. None of the studies clearly defined whether their patients had active or quiescent disease. Foot and ankle cases may have been reported in more general studies on bone and joint TB, which are not included in this analysis. There is heterogeneity between the selected studies. This is likely to be due to the infrequency of foot and ankle TB, and opens the available literature up to selection bias. Future research focusing on the role of early debridement in active disease needs to be explored. Comparative studies are also needed to define the role of arthroscopy, and the optimal timing and technique of reconstruction procedures. Studies comparing the use of medical treatment alone versus those with surgical intervention are also required. Future research should clearly report on whether cohorts have active or quiescent infection.

Conclusion

While regimens may vary, medical treatment remains a mainstay in the management of osteoarticular tuberculosis. Evidence supporting the role of early surgical debridement is limited. In advanced active disease, arthrodesis may be performed in a single setting or staged manner. No single approach, implant, or fixation method for the purpose of arthrodesis has been proven superior to another. There is insufficient evidence to support the use of joint distraction in TB of the foot and ankle. The role of arthroscopy in both early and advanced disease is poorly defined and requires further research.

Ethics statement

The authors declare that this submission is in accordance with the principles laid down by the Responsible Research Publication Position Statements as developed at the 2nd World Conference on Research Integrity in Singapore, 2010. Our study was exempted from ethical review by the UKZN Biomedical Research Ethics Committee (BREC). As this is a review article, patient consent was not required.

Declaration

The authors declare authorship of this article and that they have followed sound scientific research practice. This research is original and does not transgress plagiarism policies.

Author contributions

KH: study conceptualisation, data capture, data analysis, first draft preparation, manuscript preparation, manuscript revision
LCM: study conceptualisation, study design, draft revision, manuscript preparation

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Appendix available online