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Current concepts in the diagnosis and management of tuberculosis of the elbow joint

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ABSTRACT

Elbow is an uncommon joint to be affected by *Mycobacterium tuberculosis* infection. It is involved in approximately 1–5% of all cases with musculoskeletal tuberculosis (TB). Early diagnosis of TB of the elbow joint can be easily missed due to an indolent natural history, delay in presentation, and varied clinical features. Delay in diagnosis can lead to irreversible osteoarticular destruction and loss of joint function. Careful clinical assessment, adequate imaging, microbiological, and/or histopathological confirmation of *Mycobacterium tuberculosis* infection is essential for early diagnosis of TB of the elbow joint. Judicious and early administration of anti-tubercular therapy can lead to preservation of the joint and a satisfactory functional outcome. Surgical intervention may be needed in later stages of the disease to achieve control of the infection, correction of deformity, instability, and restoration of function.

1. Introduction

Worldwide, Tuberculosis (TB) is still a major public health burden. In 2019, approximately 10 million people were infected by TB globally. Out of these, an estimated 1.4 million became symptomatic. India accounts for approximately one-fourth of the global TB disease burden.[1] TB can present in pulmonary and extra pulmonary forms. Musculoskeletal TB accounts for up to approximately 30–40% of extra pulmonary cases and 1–3% of all TB cases.[2,3] The spine is most commonly affected followed by the hip, knee, and other joints.[4] The elbow is an uncommon joint to be affected by TB. The exact incidence remains unknown. It is estimated that the elbow joint is involved in approximately 1–5% of all cases of musculoskeletal TB.[5]

Affecting mainly the children, TB of the elbow is generally a part of hematogenous dissemination from a primary infection elsewhere in the body. In other age groups, osteoarticular TB of the elbow occurs through various routes. It can be hematogenous (most common), lymphatic, local spread from a contiguous location, or direct inoculation.[6–8]

Clinical presentation in a tubercular elbow is usually gradual, chronic, and non-specific. This leads to a delay in diagnosis. Early diagnosis of osteoarticular TB of the elbow is desired since focused treatment under the cover of anti-tubercular therapy (ATT) allows preservation of joint space and restoration of elbow movements. Diagnosis is helped by an accurate history, clinico-radiological evaluation, and microbiological and/or histopathological confirmation. Surgical intervention may be needed for later stages of the disease to achieve control of the infection, correction of deformity, instability, and restoration of function.

In this review, we consider etiopathogenesis, clinical presentation, and current concepts in the management of TB of the elbow joint. An algorithm is presented to aid clinicians for managing the condition (Fig. 1). We have also studied available original articles published in the literature on this subject using a PubMed search

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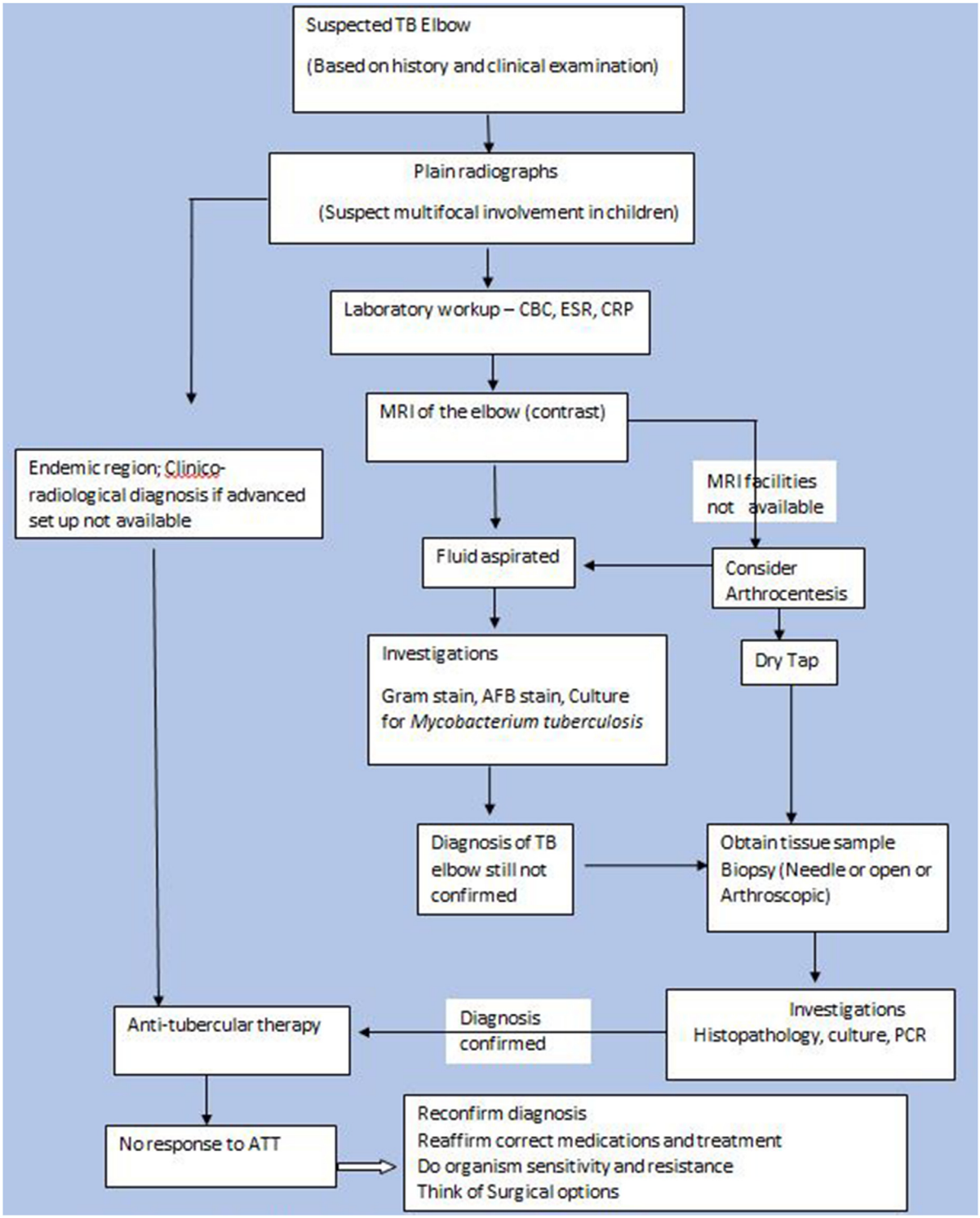

Fig. 1. Management algorithm for tuberculosis of the elbow joint.

(from 1953 to November 2020). Case reports and articles with less than 10 cases have been excluded from this review (Table 1).[9–21]

1.1. Epidemiology

TB is endemic in developing and underdeveloped countries including India. Predominantly a respiratory illness, musculoskeletal TB accounts for a large proportion of extrapulmonary TB, predominantly affecting the spine and weight-bearing joints. About 50% of cases with musculoskeletal TB may show disease on chest radiographs.[4]

Recently, due to a rise in the number of Human Immunodeficiency Virus (HIV) infections, widespread use of biologics, the emergence of drug-resistant strains, and population migration from endemic regions, the incidence of TB of bones and joints has increased and is a cause of concern.[22–24] Co-infection of HIV and

Table 1
Review of literature of original studies published on Tuberculosis of the elbow.

Authors and year	No. of cases	No. of elbows	Age Range (mean age)	Bony involvement	Treatment	Follow up	Function	Prognosis	Delay in diagnosis or mean duration of symptoms before presentation
Wilson JN et al.[9] 1953	31	33 (two bilateral)	4–58 years	Massive-13(39.39%) Coronoid- 8(24.24%) Extraarticular-6(18.18%) synovial-3(9.09%) Unclassified-3(9.09%)	Streptomycin in 04 cases only. Duration NA. Surgery- Either local excision of lesion or excision of joint or arthrodesis.	20 patients followed for 60 months	17 returned to work 07 required permanent splintage and 05 had residual pain or sinuses	NA	08 months (06 months–96 months)
Martini M et al.[10] 1980	29	29	Adult (age not mentioned)	NA	ATT-15 months	NA	All 27-elbow were clinically and radiologically as well as bacteriologically excellent Good range of free movement in 50%. All 27-elbow painless	ROM- Excellent-1 Good-9 Fair-5 Poor-12	NA
Vohra R et al.[11] 1995	10	10	18 –55years (36 years)	Lower end of the humerus was the commonest site followed by upper end of ulna	ATT- 09 months. Surgery in 06 cases (03 cases-curettage of the bone with minimal joint clearance and 03 cases-debridement and total synovectomy)	Mean-12-36 months	Elbow with synovial lesion (03) extra articular (01) and minimal articular involvement (03) All have full or nearly full ROM. Elbow with extreme articular involvement (03)-only 20–60° movement is achieved.	ROM- Excellent-7 Good-0 Fair- 1 Poor-2	NA
Chen WS et al.[12] 1997	23	23	25–72 years (43 years)	Extensive involvement of whole joint in 16(69.56%). Initial lesion identified in only 2(8.69%) cases in lateral condyle. 5(21.73%) cases no bony lesion.	ATT- 12 months (18 months in 04 patients). Synovectomy with joint debridement with curettage in 15 patients of stage 3 & 4. Only synovectomy in 02 patient of stage 1 &2 and 1 patient of stage 3. In 2 cases of PIN palsy-exploration of nerve with synovectomy and drainage	Mean-54 months (36 –108 months).	No relapse during follow up.	ROM-Excellent & Good-15 Fair & Poor-8	NA
Dix-Peek SI et al.[13] 2003	10	10	1–11years (5.5years	NA	ATT- 09 months	Mean-43.2 months (24 –120 months).	All healed radiologically	ROM-Excellent-4 Good-4 Fair-1 Poor-1	2.5 months (0.25–18 months)
Aggarwal A et al.[14] 2006	47	48(01 bilateral)	4–60 years. (most in first three decades)	Proximal ulna –23(47.91%) Distal humerus-17(35.41%) Proximal radius-8(16.66%)	ATT minimum for 09 months	Mean - 09 months for 27 patients.) please use same units for easy comparison	Stage 1–5/5 full ROM. Stage 2–3/7 full ROM. Stage 3–6/11- 20 –130° Stage 4–3/4- 30 –98°	ROM- Excellent-8 Good-9 Fair-3 Poor-7	NA
Agarwal A et al.[15] 2010	10	10	1–12 years (6.9 years)	Proximal ulna-10 (100%) Distal humerus-3(30%) Proximal radius-3(30%)	ATT- 12 months	Mean-26 months (06 –38 months)	No relapse mean flexion arc 78.5°	ROM Excellent- 5 Good-5	NA
Agarwal A et al.[16] 2011	16	6	1–14 years (06 years)	NA	ATT- 12 months	Mean-18 months (6 –24 months)	NA	NA	NA
Dhillon MS et al.[17] 2012	38	40 (02 Bilateral)	6–70 years (33 years)	Olecranon (most common) followed by lateral epicondyle	Modified Martini Stage 1 & 2(10 cases)- ATT + Physiotherapy; Stage 3a (5 cases)- ATT with surgery Stage 3b & 4 (25 cases)- ATT ±surgery; ATT for 14–18 months	Mean-63.6 months (18 –170 months).	Mean Flexion arc Stage1(01 case)-140° Stage 2(09 cases)-107° Stage 3a (5 cases)-	ROM-Excellent-3 Good-17 Fair-15 Poor- 5	08 months (3 –15 months)

Table 1 (*continued*)

Authors and year	No. of cases	No. of elbows	Age Range (mean age)	Bony involvement	Treatment	Follow up	Function	Prognosis	Delay in diagnosis or mean duration of symptoms before presentation
							90° Stage 3b (17 cases)-47° Stage 4 (08 cases)-32° Authors don't mention about the relapse or radiological healing		
Bao YC et al.[18] 2013	20	20	21–76 years (48.45 years)	NA	Forked osteotomy arthroplasty and ATT- duration of treatment NA	Mean-74.4 months (18–96 months)	No relapse Mean Flexion Arc −82.3° (65–100°)	MEPS-Excellent-7 Good-12 Fair-1. 01 patient develops ulnar neuropraxia and 02 developed recurring fistulas.	NA
Prakash M et al.[19] 2015	14	14	13–60 years (34.8 years)	Lateral epicondyle-9(75%) Upper end radius-6(50%) Medial epicondyle-5(41.5%) Upper shaft of ulna-5(41.5%) olecranon-4(33%)	ATT- duration NA No surgery done.	NA	NA	NA	05 months (2–12 months)
Agarwal A et al.[20] 2017	30	31(one bilateral)	1.5–12 years (8.2years)	Proximal ulna-15(50%) Distal humerus-15(50%)	12 months ATT	Mean-18.9 months.	No relapse Mean flexion arc in Martini Stage1−150° (01 case) Stage 2−134.4° (23 cases) Stage 3−110° (04 cases) Stage 4−45° (03 cases)	ROM Total Arc- >120° - 17 80–120° -11 50–80° -2 <50° −1	1.5 months (0.23–3 months)
McGuire E et al.[21] 2020	93	18	IQR-25-46years (Median age-30.5years)	Not mentioned	06 months ATT No Surgery done	Median-88.8 months	No relapse	NA	1.75 months

Abbreviations: IQR-Inter quartile range; ATT- Anti tubercular therapy; NA- Not Available; ROM- Range of motion; MEPS- Mayo elbow performance score; PIN- Posterior interosseous nerve; CPM- Continuous passive motion.

bone and joint tuberculosis leads to challenges in diagnosis and treatment as both need to be treated simultaneously.[25]

2. Site and incidence

Mycobacterium tuberculosis infection of the upper limb joints is rare. The elbow is the most frequently affected joint in the upper extremity; accounting for 1–5% of all cases of skeletal TB.[5,24] Fan et al. reported an incidence of 10.3% from the retrospective data, whilst a recent study by McGuire et al. suggested elbow as the second-largest site (19.4%) of extrapulmonary tuberculosis after knee joint (23.7%) in their large cohort of cases[21,26]

3. Route of infection

The commonest mode of infection of the elbow joint is by hematogenous spread from a primary focus of infection elsewhere in the body, usually the lungs. In children, elbow tuberculosis is generally a part of wider hematogenous dissemination and consequently, multifocal involvement is common. Hematogenous spread of bacteria occurs through the metaphysis with secondary involvement of the joint after crossing the epiphysis. The osseous erosion leads to subcortical bony destruction which may also infect the joint. TB infection can start at any osseous element of the elbow joint. Articular involvement leads to cartilage destruction with progressive narrowing of the joint space and painful arthritis. Direct inoculation of the joint through seeding of bacteria into the synovium without bone involvement is less frequent.[27]

Although rare; primary TB of the elbow joint can involve only the synovial membrane. The prognosis is better in synovial patterns and extra-articular lesions since they can be treated effectively with ATT.[11]

4. Clinical presentation

Delayed presentation of TB involving the elbow joint is common due to the absence of specific systemic and pulmonary symptoms.[5] The average delay between onset of symptoms to diagnosis varies amongst studies and ranges from one week to 8 years with an average delay of 13 weeks.[9–21] It can present in different ways. Some authors have reported the presentation of TB elbow as acute pyogenic arthritis.[12] Compared to other joints, cases with TB elbow may present early as it is a superficial joint. The clinical presentation may be confused with other pathologies such as low-grade pyogenic arthritis, pigmented villonodular synovitis, and in rare cases, a neoplasm.[17,22] Painful elbow due to early TB may also present as tennis elbow or a post-traumatic contusion leading to further delay in diagnosis.[21,28]

Clinical manifestations can be constitutional and/or local. Constitutional features are present in about 20–30% of cases and may range from fatigue, evening rise of temperature, loss of appetite, loss of weight, and night sweats.[29,30] These symptoms are more likely to be present in cases with concurrent pulmonary or disseminated TB infection. TB elbow may also present with no constitutional or pulmonary symptoms.[5,31] Sometimes, TB elbow may be one of the sites of multifocal tuberculosis.[32]

Clinical features of TB of the elbow include pain, swelling, and gradual decline in the range of movement of the joint. Cold abscesses can act as an important diagnostic clue of tuberculosis. These are defined as 'An abscess with the absence of classical features of inflammation such as pain, redness, and increased local temperature'. Chronic cases may present with sinuses in about one-third of cases and joint deformity. Undermined edges, bluish discoloration at the edges with serous discharge, and fixation to underlying bone are the classical features of a tuberculous sinus.[33] The presence of a sinus is an important clinical feature of TB as other infections rarely cause such sinuses.[18] Tubercular sinus may communicate with the elbow joint or lymph nodes and may present on posterolateral, lateral, posterior, and even on medial aspects of the elbow. Epitrochlear, supratrochlear, or even axillary lymph nodes may be affected[14,24,27]

In the initial stages of the disease, protective muscle spasm due to irritation of the joint cause loss of movement and flexion deformity. However, as the disease progresses, the articular cartilage is destroyed, and the deformity gets fixed with restriction of range of movements. The movements of superior radio-ulnar joints may also get affected leading to difficulty in performing activities of daily living. Secondary osteoarthritis of the elbow may develop as sequelae of TB leading to significant disability due to pain, stiffness, and locking affecting the quality of life.

5. Investigations

5.1. Imaging

(a) Radiology

Radiographic changes of tuberculosis infection are non-specific and include peri-articular osteoporosis, osseous erosions, and gradual narrowing of joint space which form the Phemister's triad.[27] Transphyseal spread of the infection to the joint is one of the hallmarks of TB though joint space is relatively preserved in early TB infection. There is a debate in the literature about the most involved bone in the elbow joint. Some studies have quoted the proximal ulna as most involved followed by the distal humerus and the radial head[24,26,27] whilst others have reported distal humerus as the most involved bone.[11,19] Features such as lytic lesion and de-ossification of capitulum as present in Panner's disease can also be seen in TB on radiographs and these cases must be carefully evaluated with advanced imaging.[34] Primary synovial involvement is rare. 'Ice cream scoop' lesion as described by *Agarwal* et al. is an expanding cystic lesion in the proximal ulna metaphysis with its subsequent erosion (Fig. 2A–B), (Fig. 3A–B).[15]

Radiological assessment is done through Kerri and Martini staging classification and is based on plain radiography. (Table 2). This staging classification was based on TB of the knee; however, this can be applied for elbow tuberculosis as well.[35]

As the infection progresses, cold abscesses and sinuses may form. In late stages, severe joint destruction with subluxation/dislocation may occur with the eventual appearance of fibrous/osseous ankylosis.

(b) Computed Tomography (CT) scan

CT scan would show bony changes such as destruction and sequestration more clearly. Bony involvement, as well as the presence of periosteal reaction and sclerosis, can be precisely assessed on a CT scan.

Fig. 2. An eight-year-old female child with pain, swelling and restriction of her Left elbow movements of 4 months duration. At diagnosis: osteopenia, 'ice cream' scoop sign, partial resorption of radial head on elbow AP and lateral Radiographs (A,B) is noted. At follow up of1-year post ATT, 'ice-cream' scoop sign has partially recovered. There is re-ossification of radial head, irregularity of joint but still with good function.

Fig. 3. A 12-year-old female child with pain, swelling left elbow of 5 months duration with severe spasm at her left elbow. AP and Lateral plain radiographs of the left elbow shows cyst in ulna, irregular joint margins, and an additional lesion in distal humerus (A,B).

(c) **Magnetic resonance imaging (MRI) scan**

MRI is an especially useful investigation early in the course of the disease when plain radiographs are inconclusive. Synovial thickening, erosions, intraosseous abscess, and soft tissue abscess are some common findings in MRI. Joint effusion and marrow changes are hyperintense on T2 weighted images and hypointense on T1 weighted images. However, internal debris, loose bodies, calcifications, and septations are shown as hypointense signal intensity (SI) changes on T2 weighted images. Synovial thickening is seen as hypointense SI change on T2 weighted images.[36]

5.2. Laboratory investigations

(a) **Blood tests**

Complete blood count, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP) are non-specific tests for diagnosing TB elbow.

(b) ***Arthrocentesis or joint aspiration***-For suppurative lesions and in cases of elbow swelling, elbow arthrocentesis is used for obtaining synovial fluid or purulent material for diagnosis and as a treatment to relieve the pain. The joint can be aspirated from the Anconeus triangle. Arthrocentesis is a simple and effective procedure that helps to differentiate TB elbow from other causes of joint effusion such as pyogenic arthritis, crystal arthropathy and inflammatory arthritis.[37]

(c) Histopathology:

Definitive diagnosis of TB elbow requires evidence of Mycobacterium tuberculosis infection from microbiological and/or histopathological sample.

Obtaining a sample for histopathological diagnosis

Elbow TB tends to be a dry lesion like shoulder TB. Tissue samples can be obtained either by needle aspiration, percutaneous biopsy (blind, CT-guided, or ultrasound-guided), open or arthroscopic biopsy. Tissue samples can also be obtained from the bony lesions, synovium, cold abscess, sinus tract, or even involved lymph nodes. While performing a biopsy, few points should be kept in mind to decrease the chances of a false-negative result. In case of the bony lesions, biopsy should be obtained from the outermost area of the lesion as the center may be full of necrotic material and the number of mycobacteria may be less. Lymph node biopsy should be performed concomitantly.[38,39] While obtaining tissue samples from sinus tracts, it should be kept in mind that sinus tracks are generally inhabited by polymicrobial flora. So, the results of the culture could be misleading. Staining, microscopy, culture, and molecular diagnostic methods such as polymerase chain reaction (PCR) tests are performed after obtaining tissue samples.

(d) **Laboratory Tests:**

Ziehl-Neelsen (ZN) staining is the traditional method of detecting *mycobacterium tuberculosis* in tissues. In histopathological examination, the presence of epithelioid infiltration, caseous necrosis, and Langhans giant cells are typical of TB infection.

Culture Media: Traditionally, the Lowenstein-Jensen (LJ) medium is used for culture. It takes 4–6 weeks for mycobacteria to grow. The culture-positive rate varies from 28 to 87%.[21] However, with enhanced culture methods such as BACTEC™ radiometric culture, it usually takes 2 weeks to grow mycobacteria with a culture-positive rate reaching up to 90%.[40] Multiple samples from skin, subcutaneous tissue, pus, and bone should be obtained and sent for culture sensitivity, ZN staining, histopathology, PCR, to increase the chances of correct diagnosis.

Table 2
Kerri and Martini staging classification for Tuberculosis of the Elbow joint based on plain radiography.

S.No.	Stage	Radiological feature on plain radiography
1	I	No bone lesions. Periarticular Osteoporosis.
2	II	One or more erosions or lytic lesions in bone. Discrete diminution of joint space.
3	III	Involvement and destruction of joint without anatomical disorganization.
4	IV	Gross anatomical disorganization.

Accuracy of Laboratory Tests: The approximate sensitivity of various laboratory tests for tuberculosis is as follows: AFB staining 10–30%; culture on conventional solid media (LJ) 30–80%; culture on Mycobacterial Growth Indicator Tube (MGIT) 960 is 97%; histopathology 72–97%; Interferon-gamma release assay: QuantiFERON -TB; TSPOT 60–83%; molecular analysis e.g.PCR (polymerase chain reaction), Xpert MTB/RIF assay 61–83%.[41] As is obvious, no test has 100% sensitivity. Therefore, proper sample collection is important for tubercular diagnosis. An image-directed tissue material may have a better yield than blind sampling. An attempt should be made to obtain as much pathological material as possible from a suspected tubercular lesion. Additionally, the laboratory findings should be interpreted in conjunction with the clinical findings.

6. Treatment

The mainstay of conservative treatment is ATT. Additional non-operative and operative management is undertaken depending on the stage of the disease. In endemic regions, and where the facilities for diagnosis of tuberculosis are limited; treatment of tuberculosis can be started based on strong suspicion of clinical history and corroborative radiological findings only.

7. Non-operative management

Non-operative management consists of anti-tubercular (ATT) drugs, rest, splinting, and supervised physiotherapy.

Treatment should ideally be started with a four-drug regime (e.g. rifampicin, isoniazid, ethambutol, and pyrazinamide) for 2–3 months, followed by 6–9 months treatment by 2–3 drugs. Some surgeons prefer to extend the treatment for up to 18 months. Patient compliance is essential for a good outcome.

The affected elbow can be splinted in the position of maximum comfort in the acute stage for 2–3 weeks followed by a range of motion exercises. Out of 13 studies (292 elbows), which were included in the analysis, Wilson et al. did not use combined chemotherapy whilst Bao et al. and Prakash et al. did not mention the duration of combined chemotherapy.[9,18,19] Rest 10 studies have mentioned the duration of treatment.

Duration of treatment-There is a huge variation in the duration of treatment in the literature. Various reports cite the duration from 6 to 18 months.[9–21] The authors preferred duration of treatment is 12 months.

7.1. Operative management options

Surgical intervention may involve curettage of the bony lesion, synovectomy, incision and drainage of the abscess, sinus tract excision, joint debridement, arthrodesis, arthroscopy, and arthroplasty.

Elbow Joint debridement: Joint debridement is used to reduce the disease burden. It also improves vascularity so that drugs can reach the infected tissues. Joint debridement can be performed either by open or arthroscopic technique. The posterior midline approach is the preferred approach for the open technique. Open debridement has the advantage of achieving thorough joint clearance; however, has the disadvantage of slower post-operative rehabilitation. The role of arthroscopic debridement for total joint involvement in TB elbow is unclear. Several authors have reported the use of joint debridement in the management of TB elbow.[11,12,17]

Elbow Arthrodesis: Historically, TB has been the most common indication for elbow arthrodesis, first reported by Hallock.[42] Arthrodesis is indicated in young cases who want to use the arm for heavy manual work. It not only relieves pain but also provides a stable joint. Arthrodesis of an elbow in a functional position allows a person to perform their activities of daily living and carry out personal care. However, the functional position can vary depending upon the dominance of the arm, occupation and personal preference.

Various techniques to increase the success rate of fusion include the use of osteotomy and bone grafting, the use of plates, screws, and external fixation devices.[43] Arthrodesis is a good option for cases in which the joint has been ankylosed in a non-functional position.[44]

The use of bone graft for arthrodesis of a tubercular elbow is controversial. Von Gorder et al. used a graft from the tibia and fibula as a central-graft operation in TB elbow and achieved fusion in 83% of cases.[45] McAuliffe et al. performed arthrodesis with plate fixation and bone grafting in 15 cases. They achieved fusion in 86% of cases.[46] Bilic et al. achieved fusion in 8 out of 9 cases with bone grafting and external fixation.[47] In their series of 11 cases of TB elbow, Arafiles used screw fixation but did not use bone graft and achieved good fusion in all the cases.[48] Nickerson placed a wedge of olecranon against the posterior humerus without internal fixation. He splinted the elbows for prolonged periods and achieved satisfactory results.[49]

Elbow Arthroplasty: Arthroplasty for TB elbow includes total joint arthroplasty (TJA) and excision arthroplasty with modifications. TJA in joint TB has been reported by many authors for knee and hip joint with favorable results with the ability to relieve pain and restore range of motion.[50–52] Asopa et al reported a case of TJA in TB elbow. However; the prosthetic implant was removed after a period of 2 years due to non healing of wound; as authors, could not attribute the cause of osteoarthritis of elbow due to occult TB. A positive culture after implant removal prompted authors to start ATT and revision TJA; resulted in good functional outcome.[53]

To overcome the ill effects of excision arthroplasty, modification such as forked osteotomy arthroplasty has been proposed. In this technique, the distal humerus is osteotomized in an inverted V manner at the widest level preserving the parts of both condyles with excision of one-third of the olecranon (Fig. 4). Hyperextension deformity is prevented as part of the olecranon is preserved. In this procedure, the joint stability is relatively well maintained as compared to excision arthroplasty.[18] Rex et al. performed forked osteotomy arthroplasty in 9 cases and their mean Mayo's elbow performance score (MEPS) increased from 48 to 80 post-operatively.[54] Bao et al. performed forked osteotomy arthroplasty in 20 cases and their mean MEPS increased from 23.25 to 83.7 post-

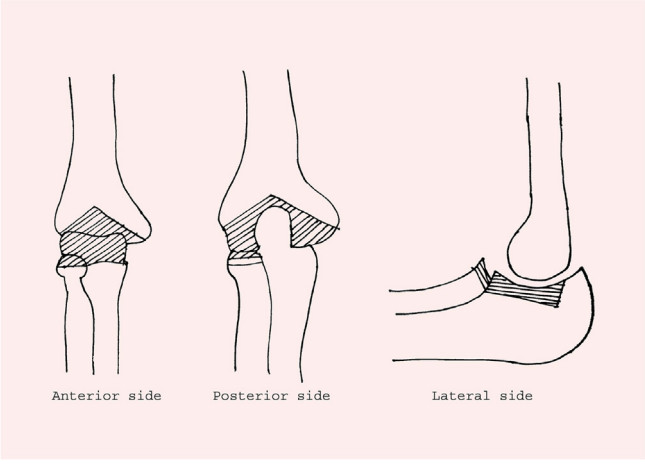

Fig. 4. Anterior Posterior and Lateral images of the elbow depicting various cuts of the forked osteotomy arthroplasty of the elbow joint.

operatively and range of motion (ROM) increased from a mean of 2.5°–82.3°.[18]

Meticulous dissection is required during such surgery since anatomy could have been distorted due to destruction. There are chances of neurological insult in such cases.

Forked osteotomy arthroplasty can provide a functional and mobile joint. However, if it fails, the salvage procedures may be challenging due to insufficient bone stock. Forked osteotomy arthroplasty is a good option for advanced TB elbow in cases who wants a mobile elbow joint. It may not be a suitable operation in the early stages of the disease or in young cases that require a strong and stable elbow for heavy manual work. Arthrodesis of the elbow may be a better option for them.

Elbow Arthroscopy - Elbow arthroscopy may help in the diagnosis and management of TB elbow.[55] It can also be used as an alternative treatment to collect tissue samples for diagnosis and debridement of the joint.[23,56,57]

7.2. Suggestions for surgical intervention

Currently, there are no clear guidelines for surgical intervention in TB Elbow. However, based on literature search some suggestions for surgical intervention in symptomatic cases of TB elbow may be given as below:

- Cases not responding clinic-radiologically to treatment after 4–6 weeks.
- Cases with extra-articular lesions close to the joint with the potential for joint invasion.
- Cases with Kerri and Martini stage III or IV presentations with preserved more than 20° range of movement available in the affected elbow joint.

8. Clinical outcomes

The clinical outcome of TB elbow depends upon the stage of the disease at the time of presentation to the clinician and not on the duration of the symptoms. Cases with stage I and II (Kerri & Martini) generally regain excellent range of motion and have good outcomes with a supervised management plan. The functional outcome has also been found to be similar in both adult and pediatric age groups. Out of 13 studies, 5 studies (102 elbows) have commented on relapse of the tubercular disease however, none of these studies reported features of relapse during their follow-up.[12,15,18,20,21]

Radiological healing is commented on in three studies. Agarwal et al. report complete healing at one year in 6 elbows and two other studies by Dix-Peek et al. and Martini et al. found radiological healing in all 37 cases that were followed up.[10,13,16]

Range of movement: 9 out of 13 studies (198 elbows) have commented on post-treatment range of motion (ROM). 8 of these studies classified post-treatment ROM into excellent, good, fair, and poor. These included 175 elbows of which 40 cases (22.85%) obtained excellent results, 68 cases (38.85%) achieved good results, 38 cases (21.71%) were found to have fair results and 29 cases (16.57%) showed poor results. In the study by Chen et al. 15 elbows revealed good to excellent ROM whilst 08 elbows showed fair to poor outcomes.[10–15,17,18,20]

Stage of disease: 7 out of above mentioned 9 studies (151 elbows) found the post-treatment ROM correlated with the stage of the disease. In these 6 studies, there were 128 elbows, in which 100% (11 elbows) with stage I disease got excellent results. Out of 50 elbows in stage II, 25(50%), 23(46%), 1(2%), and 1(2%) gained excellent, good, fair, and poor results, respectively.

Out of 46 elbows in stage III, 3(6.52%), 18(39.13%), 14(30.43%), and 11(23.91%) gained excellent, good, fair, and poor results, respectively. Out of 21 elbows in stage IV, 3(14.28%), 6(28.57%), and 12(57.14%) got good, fair, and poor results, respectively. The data provided by Chen et al. led to the classification of post-treatment ROM into 2 groups i.e. excellent to good and fair to poor. In their article, 7 elbows of stage I&II got good to excellent results, 8 elbows of stage III&IV on Continuous Passive Motion (CPM) got good results and 8 elbows of stage III&IV without CPM got fair to poor results.[11-3,15,17,18,20]

8.1. Prognosis

Prognosis of TB elbow is generally satisfied with a good range of movements since the advent of chemotherapy. However, poor results may still be obtained if a patient presents at an advanced stage of the disease.

9. Conclusion

Though Elbow is an uncommon site for TB, it is prudent to consider it to avoid delay in diagnosis especially in endemic regions and clinico-radiological correlation. A step-by-step approach towards the diagnosis of TB Elbow is necessary to rule out other causes of elbow pain. The algorithm provided can aid a clinician in this process. Treatment of TB of the Elbow is predominantly conservative under an umbrella of ATT. Cases not responding to ATT, with extra-articular lesions close to the joint or at higher Kerri and Martini stages of the disease at the time of presentation can be managed with surgical options along with ATT. Early diagnosis and management of TB Elbow lead to improved clinical outcomes and functional outcomes.

Author's statements

GKU, AK and VKJ involved in Conceptualization, literature search, manuscript writing, and editing. GKU and KPI - Literature search, manuscript writing, references, data analysis, and editing. AA provided clinical pictures and guided for tables and data analysis. VKJ, AA supervised overall submission and approved the final draft. All authors read and agreed the final draft submitted.

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Declaration of competing interest

- None.

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