

Knee Varus Deformity Correction in Young Adults as a Joint Preservation Surgery

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Abstract

The purpose is to present the possibility of accurate correction of a small magnitude knee varus deformity in young adult patients without signs of knee arthrosis using tibial osteotomy with an Ilizarov ring fixator. One hundred and forty-five patients with bilateral constitutional tibial varus deformities underwent surgery between 1996 and 2018. In all cases, operations were performed on both shins simultaneously using the Ilizarov method. The operation consisted of 3 elements: osteotomy of the fibula, application of the Ilizarov apparatus, and osteotomy of the tibia. Osteotomy of the fibula was performed so as not to interfere with the correction of the tibia in patients with severe deformity. There were 64 men (mean age 31.4 ± 5.6 years, range 18-44 years) and 81 women (mean age 27.4 ± 8.6 years, range 17-50 years). During the postoperative period, patients mastered the skills of caring for the Ilizarov apparatus and using additional support (walkers or crutches). They gradually expanded their modes of activity, using first a walker and then crutches for walking. In the final stages of treatment, patients usually walked freely without additional support. The technique provided stable fixation and early mobilization of patients and achieved accurate correction. Complications encountered were minor and did not affect the outcome. We conclude that external osteosynthesis is a safe and effective method. Young patients more easily tolerate such operations, develop complications less frequently, and have a favorable prognosis.

Keywords: Varus Deformity • Knee Arthrosis • Tibial Osteotomy • Ilizarov Method Rheumatoid

Abbreviation: RA; Rheumatoid Arthritis, RF; Rheumatoid Factor.

Introduction

Rheumatoid arthritis (RA) is the most common form of inflammatory arthritis in adults and is characterized by chronic, progressive, systemic inflammation leading to substantial pain, disability, and other morbidities [1]. The annual incidence of RA has been reported to be around 40 per 100,000, the disease prevalence is about 1% in Caucasian but varies between 0.1% in Rural Africa and 5% in (Pima, Chippewa, Blackfeet, Indian), Women are more affected two to three times more often than men [2] Rheumatoid arthritis is not only characterized by inflammation of the synovial tissue, but bone also is involved in the process of inflammation [3]. Accordingly, Patients with rheumatoid arthritis [RA] have an increased risk of osteoporosis [4] that considered to be one of the most well-known complications in these patients and was reported to be approximately twice as high as in the general population [5] that considered to be one of the most well-known complications in these patients. Osteoporosis is a "silent" complication of rheumatoid arthritis, which may lead to fractures [6]. Also, young women with RA have an elevated fracture risk when compared to healthy controls [7]. Musculoskeletal disorders are among the

principal causes of physical disability and expend a large number of health resources globally and considered as the second cause of healthy years lost to morbidity and adversely impact the quality of life. Early accurate diagnosis is vital to avoid inefficient use of resources, such as additional testing and unnecessary referrals [8].

Low bone mass and falls are important risk factors for fracture. Similarly to low bone mass, historical studies have shown an association between falls risk and RA [9,10]. Despite bone loss being one of the most deleterious consequences of the chronic inflammation seen in RA there are relatively few studies exploring if medications used to treat RA, such as corticosteroids, disease modifying anti-rheumatic drugs (DMARDs), and biologic drugs, have a role in bone protection and these studies have yielded conflicting results [11,12]. Cortisone, the first corticosteroid, was the first pharmacological agent used in the treatment of RA in 1949 and offered rapid symptomatic and disease-modifying effects. Corticosteroids remain an extremely effective means of dampening the inflammation associated with RA but are associated with serious long-term side-effects [13]. Due to their potent anti-inflammatory and immunosuppressive actions, Corticosteroids are added frequently to disease modifying antirheumatic drugs (DMARDs) in various arthritic diseases. However, their prolonged administration or administration at high doses is associated with adverse effects that may be quality of life-threatening, including osteoporosis, metabolic, gastrointestinal and cardiovascular side effects [14]. DMARDs are a group of medications which alter the course or outcome of inflammatory conditions and are most commonly used in RA. This group of drugs is recommended as the first-line treatment for RA and include methotrexate, leflunomide, sulfasalazine and hydroxychloroquine, gold (sodium aurothiomalate), azathioprine, ciclosporin and penicillamine [15].

During our study, we found that previous data on bone fractures in RA patients with were limited especially regarding the frequent site of fractures and the effect of Corticosteroids in bone fractures. Thus we conducted this research to estimate the frequent site of bone fracture and the common risk factors in RA patients. This study will provide a good Data to have a clue about which patient is at risk of bone fracture and thus provide avoidable methods to prevent the Disability.

Material and Method

A cross-sectional study, a health facility-based was conducted in police teaching hospital, Khartoum, Sudan from September 2018 to September 2019. We excluded patient with Rheumatologic disease other than Rheumatoid arthritis, Patients Who've come for the first time (not previously diagnosed), Rheumatoid arthritis patients who have fractures due to Road traffic accident – RTA, Other causes of osteoporosis : (Post-Menopausal, Diabetes mellitus, hyperthyroidism, Cushing's syndrome, hyperparathyroidism), and Patients whose Refuse to involve in the study.

Data collection: It was a self-designed questionnaire that developed based on the research question and objectives and then is reviewed by Rheumatologist and medical Officer to ensure its reliability. At least five questionnaires were used in a pilot study to test its validity.

We enrolled 72 patients, the cases were drawn from Sudanese patients above 18 years with rheumatoid arthritis who consecutively attend Police teaching hospital in rheumatology clinic in Khartoum state for routine follow up by Convenience sampling methods.

We explained the purpose of the study and ensure the confidentiality of the information to the participant, and written informed consent was taken from them. It was an interviewed questionnaire and permission was taken from the participant to look in their follow up a file for information regarding the investigation and treatment. This type of method is the best way to answer questions concerning our research problem.

The questionnaire is in form of Multiple choice questions, Composed of Demographic information Regards their (age, sex, Occupation, and social habit), Information about the rheumatoid arthritis disease (duration,

Risk factor, and investigation) information concerning Bone fracture (if there is any fracture, site, how it detected).

Data Analysis

We examined age, sex, and duration of disease, risk factors, diagnostic tools, fracture duration and prevalence, common management used, and the main site of fracture.

Statistical significance was defined as P<0.05. Analyses were performed using SPSS, Version 20.0. (IBM, USA).

Results

Rheumatoid arthritis is a chronic autoimmune disease that affects female more common than male, A 72 rheumatic patients were involved in this cross-sectional study, 11 of them (15.3%) were males and 61 (84.7%) were females. The mean of age was 50.6 years (48 years for male, 51 years for female). The duration of rheumatoid in the majority of patients (36.1%) was falling between 2-5 years of diagnosis as in Table 1.

A different common Risk factors was considered in this study included family history of Rheumatoid arthritis and osteoporosis, smoking, cancers (breast or prostate) and hypertension. Although 63.9% had no risk of that study was considered, 16.4% of patients were having a family history of osteoporosis, other 8.2% with a family history of rheumatoid arthritis, 6.6% were smokers, one case of breast cancer (1.6%), and 3.3% with hypertension Table 1.

Clinical diagnosis of Rheumatic patients and management, 95.8% of RA patients in our study were positive for Anti-CCP and 77.8% for rheumatoid factor. Also, blood picture was done for 36.1% of patients to calculate baseline complete blood count with differential. In this study 4 major groups of medical drugs were identified including Non-Steroidal Anti-inflammatory Drugs (NSAIDs), Disease-Modifying Antirheumatic Drugs (DMARDs), Corticosteroids and Immune-Suppressive drugs. The majority of patients 88.7% were received DMARDs, 74.6% Corticosteroids,

22.5% Immune-Suppressive drugs and just 12.7% NSAIDs. Approximately one third of patients were used rheumatoid drugs less than two years, one third between 2-5 years and one third in more than 5 years Table 1.

Osteoporosis and loss of bone mass were considered as one of the major RA complication, 25% of RA patients in this study experienced bone fracture because of falling down. However, duration of a bone fracture in one-third of patients falling in the interval of more than 10 years, 39% of patients in an interval of fewer than 2 years, and the rest of the 27.8% between 2-10 years as in Table 1. As shown in Table 2, femur following by carpal bones are the most common sites of bone fracture in RA patients, femur (36.9%), carpal bones (26.3%), then spinal vertebrae (10.5%) and talus bone (10.5%) Figures 1-3.

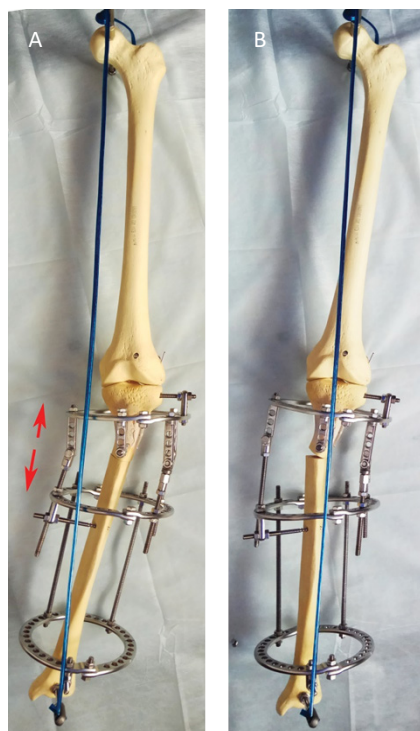


Figure 2. (A) The initial position, the varus deformity of the tibia – the mechanical axis is significantly shifted medially. Red arrows indicate the direction of distraction. On the right, due to the change in the position of the Ilizarov apparatus supports, the mechanical axis of the lower limb occupies the normal (zero) position. (B) Diagram of the change in the position of the mechanical axis of the lower limb (blue string) in the process of correction by the Ilizarov apparatus.

Table 1. Indicators of the duration of correction and fixation, as well as recovery of activity during treatment.

Main factors	Term (days)		
	Average	min.	max.
Correction period	37.4 ± 11.8	14	56
Total duration of treatment	98.7 ± 21.6	64	141
Use of walker	28.6 ± 7.1	5	42
Use of crutches	55.9 ± 13.8	29	76

Table 2. Preoperative and postoperative deformity analysis mMPTA, mechanical medial proximal tibial angle; MAD, mechanical axis deviation.

Indicators	Preoperative	Postoperative	p Value
mMPTA (°)	82.4 ± 3.3	89.3 ± 1.1	< 0,05
MAD (mm)	27 ± 9	-6 ± 4	< 0,05

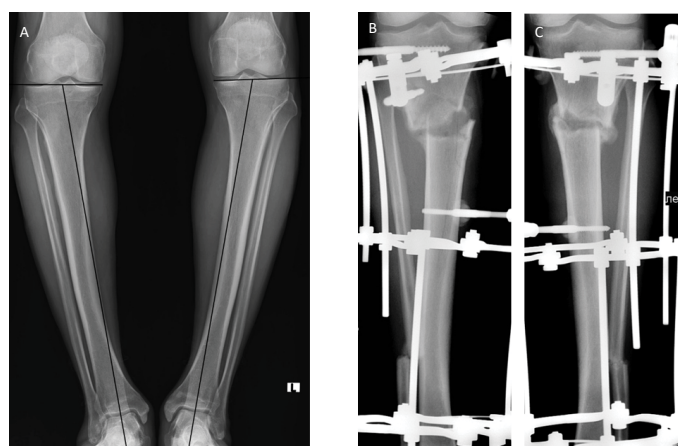


Figure 1. (A) Radiographs of a patient with varus deformity before the operation (on the right MPTA=74°, on the left MPTA=75°). (B) Radiographs of the same patient 3 months after osteotomy. Osteotomy of the tibial bones was performed in the proximal section; osteotomy of the fibular bones on the border of the lower and middle. (C) MPTA, medial proximal tibial angle.

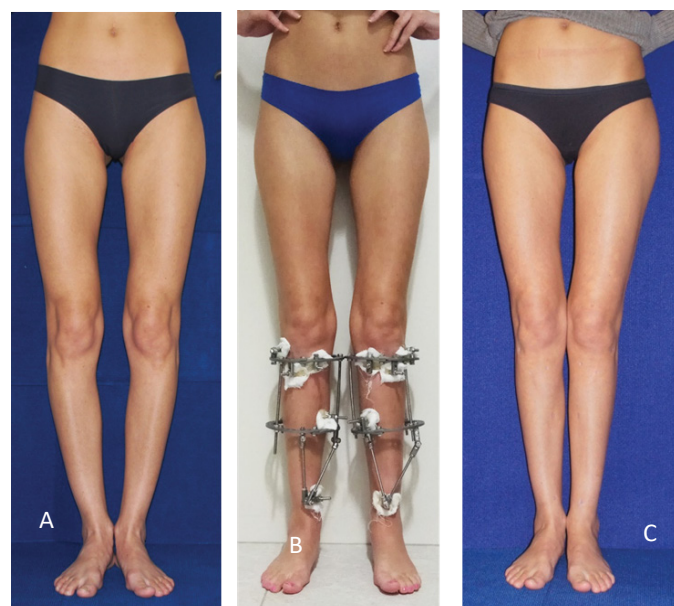


Figure 3. (A) The patient's appearance 32 years before the correction (left). (B) 2 months after the operation (center). (C) 1 year after the correction (right).

Discussion

Rheumatoid arthritis is a systemic chronic inflammatory disabling autoimmune diseases that affect mainly joints, and bones, which ending with bone loss, joint deformities and, bone fractures [16]. Little is known about specific-site and prevalence of bone fracture, risk factors, clinical diagnosis and common drugs use in the management of rheumatoid arthritis patients in Sudan and our study tries to fill these gaps.

A lot of clinical studies emphasized that Osteoporosis incidence increased double-time among RA patients in comparison to non-RA patients [16,17]. Moreover, Aging and some prescribed RA's medication like corticosteroids also lead to osteoporosis [18]. Obviously, osteoporosis is the main risk factor of fracture in elderly patients with RA and uses Corticosteroids. Our study goes further more and try testing a family history of RA and osteoporosis, 16.4%, 8.2% of patients were having a family history of osteoporosis and RA respectively. This percentage of positive family history could be due to running of RA in a family or from familial idiopathic osteoporosis. Even when we studied breast cancer as risk factor one case found to be positive, osteolytic bone metastasis is one of the common patterns of breast cancer that decreases bone density and increases risk of osteoporosis [19].

The presences of Autoantibodies in autoimmune diseases like Rheumatoid arthritis are a characteristic usually used in diagnosis, some auto-antibodies are specific for Rheumatoid arthritis and play a role in disease pathogenesis such as Anti-citrullinated protein antibody (Anti-CCP) and other like rheumatoid factor is not specific and may be present in healthy older patients or in other diseases, such as hepatitis C. Meta-analysis done at 2007 about Anti-CCP Antibody and Rheumatoid Factor for Diagnosis of rheumatoid Arthritis show pooled sensitivity of RF and Anti-CCP are similar, but Anti-CCP is more specific than RF in the diagnosis of RA [20], Our result support meta-analysis evidence by found that 95.8% of RA patients were positive for Anti-CCP and 77.8% for rheumatoid factor.

Rheumatoid arthritis usually managed by specific drugs that diminish the symptoms when treatment begins in the early stages of the disease, but there is no apparent cure. 88.7% of RA patients were using DMARDs which decrease inflammation and temporally ease pain but alone aren't enough to treat RA symptoms. Drugs like NSAIDs used in less frequency and wasn't prescribed a lot (only 12.7% used NSAIDs) may because RA is chronic disease requires chronic treatment and if we use NSAIDs for a long time the annoying side effect and close monitoring of kidney function should be done.

RA is a risk factor for fracture in both male and female across all age group [21,16], decline quality of bone may result from The chronic effect of inflammation which associated with increased risk of fractures and deformities [22], Two main causes may explain why fracture is common in RA patients, firstly osteoporosis which reported to be more common in RA patients, and secondly chronic poly-articular pain is considered to be the main cause of falling [23]. Thus osteoporosis and increase a risk of falling usually associated with each other under RA disease Figures 4 & 5 [24 25].

In our study, approximately a quarter (1/4) of rheumatoid arthritis patients experienced a bone fracture, more than 55% of them are just in the hip (femur) and carpal bones. Other studies that analyzed the data from Oslo registrar more than a decade ago detected that the overall prevalence of hip osteoporosis in pre- and Postmenopausal women with RA was around 15% [26]. Another study concludes that Hip fracture risk is approximately doubled amongst patients with rheumatoid arthritis and among those taking steroids. In Table 3 we can see that the percentages of patients who used corticosteroid are raised with extended of treatment durations. These risk increases are, to some extent, independent of each

Other. In rheumatoid arthritis, the risk was most closely associated with functional Impairment, whereas steroid use did not appear to be confounded by this Variable [18].

A characteristic Loss of bone in the hip and the radius, and relatively preserve the axial bone are found in rheumatoid arthritis patients with osteoporosis unlike postmenopausal osteoporosis [23], thus, we can say especially hip and carpal bones are more prone to fracture in rheumatoid patients with osteoporosis. So appropriate early intervention to prevent hip fractures in RA patients is a critical issue in rheumatology care [27].



Figure 4. (A) Radiographs of the same patient before correction. Right: MAD=22 mm, mMPTA=82°; left: MAD =20 mm, mMPTA=83°. (B) mMPTA, mechanical medial proximal tibial angle; MAD, mechanical axis deviation.



Figure 5. (A) Radiographs of the same patient 1 year after correction. Right: MAD=5 mm, mMPTA=89°; left: MAD=-8 mm, mMPTA=90°. (B) mMPTA, mechanical medial proximal tibial angle; MAD, mechanical axis deviation.

Table 3. Complications.

No	Complications	Number of occurrences	The main type of treatment
1	Pin (k-wire) osteomyelitis	6 (2.1%)	Debridement, antibiotic therapy
2	Inflammation of the soft tissues at the exit points of the wires and rods	46 (15.9%)	Frequent dressings (2-3 times a day), antibiotic therapy. In the absence of effect – remove the spokes (wires) or rod.
3	Suppuration in the osteotomy zone	1 (0.3%)	Suture removal, wound drainage
4	Compartment syndrome	3 (1.0%)	Conservative treatment
5	Technical issues (wires or rods breaking)	5 (1.7%)	The spokes were removed, the fragments of the rods were left in the bone

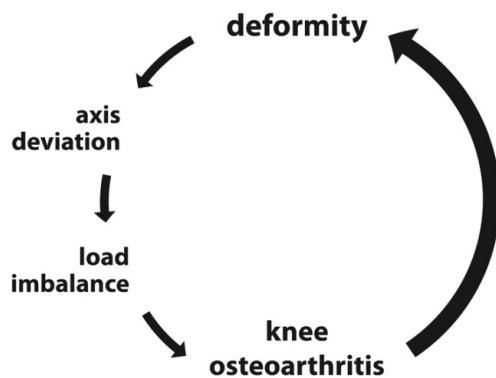


Figure 6. Diagram of the pathogenesis of gonarthrosis in the presence of deformity of the lower extremities (the formation of a vicious circle)

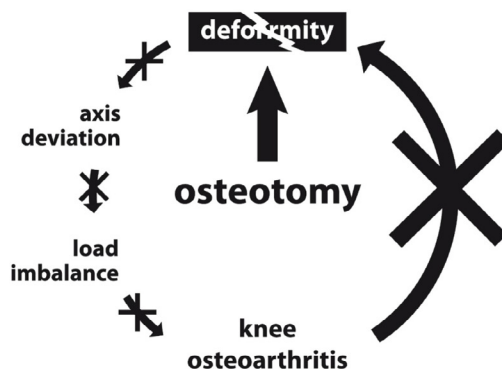


Figure 7. Disruption of the vicious circle of gonarthrosis formation in the presence of deformation.

Regarding vertebral fractures, more new vertebral fractures were found in the new RA patients than in the controls and they were likely to be more severe in the patients Figures 6 & 7 [28-31].

Weight-bearing bones like hip (36.9%), carpal bones (26.3%), spinal vertebrae (10.5%), and talus bone (10.5%) are the most common 4 sites of fracture in rheumatoid arthritis patients, these sites with muscles in healthy individual absorb and distributes falling shocked and reduce fracture risk, but in osteoporotic rheumatoid patients bones lose their density and become more vulnerable to fracture[32-33].

The limitation of this study was the relatively small sample size of the study group, and the fact that the study was conducted in a single outpatient rheumatology clinic, so generalization cannot be ensured.

Conclusion

In our study, we found that a quarter of RA patients experienced a bone fracture by away of falling. Also, we demonstrated that RA patients have an increased risk of fractures at the hip, carpal, spinal vertebrae, talus, knee, elbow, and humerus. In addition, Corticosteroids are a risk factor for bone fracture. So Physicians should know the association between rheumatoid arthritis, fractures, and Corticosteroid use. Also, to decrease the fracture incidence investigations such as bone loss measurement should be done routinely to any rheumatoid arthritis patient.

Ethical approval and consent to publish

The study design and data collection methods were approved by our institutional review board and ethical approval was obtained from the head of a rheumatology clinic at police teaching hospital, Khartoum, Sudan.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

Funding

No fund has been received.

Availability of data and materials

All the data used in the study are available from the first and corresponding author on reasonable request.

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