Ankle Arthrodesis Using Crossed Compression Screws

Basim Sabah Abdullah* FICMS

ABSTRACT

Background: Ankle arthrodesis was first described by Albert in 1882, it was indicated for residuum poliomyelitis, posttraumatic arthritis and rheumatoid arthritis to provide stable plantigrade foot for ambulation.
Objectives: To assess the effectiveness of crossed screws in obtaining arthrodesis of ankle in comparison to other modalities.
Methods: Between July 2012 to May 2014, 12 patients had fusion of the ankle joint by internal fixation using crossed screws, they were operated upon at the AL-Wassity teaching hospital and AL-Sheikh Zayed hospital. The range of age was from 18-36 years old with an average of 27 years, 6 males and 6 females. The indications for arthrodesis was 7 patients (58.33%) with paralytic poliomyelitis with unstable ankle joint, 3 patients (25%) with posttraumatic arthritis and 2 patients (16.67%) with foot drop following sciatic nerve injury. The duration of follow up was form 6-24 months all the patients were evaluated every 3 months postoperatively.
Results: At final follow up union occurred in 11 out of 12 patients (91.7%), 2 patients (16.6%) rated as excellent, 8 patients (66.6%) rated as good, 1 patient (8.3%) fair and 1 patient rated as poor (8.3%) due to no union.
Conclusion: This technique of ankle arthrodesis is simple, reliable way for obtaining fusion and it avoids the inconvenience of external fixation and risk of pin tract infection.
Keywords: Ankle arthrodesis, Compression screws.

Iraqi Medical Journal Vol. 63, No. 1, January 2017; p.73-77.

Ankle arthrodesis was first described by Albert in 1882[1,2], it has been successfully used for end stage arthritis by eliminating motions that causes pain[3,4], and providing stability with a well aligned plantigrade foot[5]. When reviewing the literatures we found no less than 30 different techniques for ankle fusion, this implies that no procedure has been quite satisfactory for most surgeons[6]. Fusion rates ranging from 80% to 100%, successful outcome depends on the etiology for which fusion was performed[7], surgical approaches can be anterior[8], transmalleolar through lateral malleolar or bimalleolar[9,10]. Methods of fixation can be biplanar external fixator or circular external frame[11]. Internal fixation had several advantages over external fixation in form of easy insertion, patient convenience, more resistant to torque forces and more stable fixation although both had comparable rates of delayed and nonunion as well as infection[12]. Here we try to assess the effectiveness of crossed screws in obtaining arthrodesis of ankle in comparison to other modalities.

*Al-Wasity Hospt for Plastic and Reconstructive Surgery, Baghdad, Iraq.

Methods

From July 2012 to May 2014, 12 patients were admitted at AlWassity hospital and AlShaikh Zayed hospital for ankle arthrodesis by internal fixation with crossed screws.

They were 18-36 years of age with an average of 27 years, 6 were males and 6 were females, in 7 patients the right ankle were affected and in the other 5 the left one were involved.

Seven of our patients (58.33%) were suffering from paralytic poliomyelitis, these patients were indicated for ankle arthrodesis as they had no available muscles power in which tendon transfer can be done for them, 3 patients (25%) with posttraumatic arthritis following old ankle injury and 2 patients (16.67%) with drop foot due to sciatic nerve injury above the knee joint with no available planter flexors for transfer.

All of the patients in this study were operated under general anesthesia and

tourniquet was applied to the midthigh. The patients were positioned supine and then prepared with povidone iodine and draped in the usual manner.

Through an anterior approach, now we obtain access to capsule of the ankle joint between the tendons of extensors the synovium, next divide the medial and lateral collateral ligaments to facilitate access to the joint then flex the ankle joint to expose the articular surface of the talus and start denuding the articular cartilage using a wide osteotome until the subchondral bone is exposed, then we reduce the talus back and start denuding the articular cartilage of the distal tibia, make sure to remove all the articular cartilage of the distal tibia and the cartilage covering the joint surface of the medial and lateral malleolus, during the procedure remove only the articular cartilage with as little as possible of bone to minimize shortening of the limb. Then we identify the anterolateral surface of the distal tibia just above the joint, hold the joint in the position of fusion and begin drilling using a drill pit of 3.2 mm, the direction of the drill is downward to the body of the talus, determine the length using depth gage which in most of our cases was about 40-45 mm, and insert a cancellous screw or sometimes malleolar screw of the same length and tighten it, now identify the sinus tarsi which can be found below and anterior to the tip of lateral malleolus and start drilling upward and posteriorly to the tibia, insert another screw of 50 mm length and tighten it as it engages the posteromedial cortex of the tibia.

Obtain hemostasis and put tube drain then close the skin with interrupted or continuous vicryl or prolene suture avoid tight stitches to prevent necrosis of skin edges. Apply below knee cast then complete splitting the cast to avoid pressure necrosis or ischemia.

Postoperative elevation of the foot and removal of sutures was done after 2 weeks. Non weight bearing for the first 6 weeks after operation was advised. Partial weight bearing was encouraged after the application of a below knee walking cast for another 6 weeks.

All the patients were seen 2 weeks postoperatively through a window in the plaster cast the sutures were removed and the wound was examined and any complication was reported and treated accordingly.

Alter 12 weeks, removal of the cast is done, radiographs were taken to ensure union at the arthrodesis site and the patients were evaluated clinically and functionally according to Kitoaka et al system for evaluation of patients with ankle arthrodesis[6]. This evaluation is repeated after another 3 months as well.

The ideal position for fusion of the ankle joint continue to be the subject of some debate and there are relatively few objective data to substantiate a given view[13], however, the ideal position for fusion of the ankle is 0 degree of flexion, 0-5 degrees of valgus angulation of the hind foot and 5-10 degrees of external rotation with slight posterior displacement of the talus under the tibia tends to produce a more normal pattern of gait and decreases the stress at the knee however fusion of the ankle in 5-10 degrees of planter flexion is especially advocated for females to facilitate shoe wear for them[14]. We use 0 degree flexion, 5 degrees hindfoot valgus and 5 to 10 degrees external rotation in our patients.

Results

The duration of follow up was 6-24 months after the operation they were evaluated both clinically for any pain limping or any signs of infection skin necrosis or swelling and radiologically for monitoring union of the arthrodesis.

The patients were evaluated at 3 and 6 months and some patients 12 months after the procedure and the results were assessed according to evaluation system of Ketaoka et al based on the assessment of pain function and alignment[6].

Radiographs were examined at 3 and 6 months after the operation and union was

observed by noting the bone trabecular crossing form the tibia to the talus. Fusion of the ankle joint was achieved in eleven out of the twelve patients (the rate of union was 91.7%).

The results of functional evaluation of patients were as follows: two cases rated as excellent (16.6%), eight cases rated as good (66.6%), one case rated as fair (8.3%) and one case rated as poor (8.3%). Excellent and good results were achieved in 10 patients (83.33%).

Table 1: Clinical evaluation system of Kitoaka et al[6].

Excellent results	No pain	No limitation in daily activities	No brace or walking aid is needed	Could walk more than (300 meters)
Good results	Mild pain	No limitation in daily activities but limitation in recreational activities	No brace or walking aid is needed	Could walk more than (300 meters)
Fair results	Frequent moderate pain	Limitation in recreational and daily activities	Need to wear a modified shoe or to use a cane	Walk from less than 300 meters
Poor results	Severe pain nearly always present	Severe limitation in recreational activities	Need to use a brace or crutches	Walk less than 200 meters

Table 2: Result for each patient according to age and occupation.

Pt. no.	Sex	Age	Occupation	Affected ankle	Lesion of the ankle	Results
1	F	24	Housewife	Right	Poliomyelitis unstable ankle joint	Good
2	F	24	Housewife	Right	Poliomyelitis unstable ankle joint	Good
3	M	32	Free job	Left	Sciatic nerve injury, foot drop	Poor
4	F	22	Housewife	Right	Poliomyelitis unstable ankle joint	Good
5	F	18	Student	Right	Poliomyelitis unstable ankle joint	Good
6	M	30	Free job	Right	Post traumatic arthritis	Good
7	F	27	Housewife	Left	Poliomyelitis unstable ankle joint	Good
8	M	22	Unemployed	Left	Poliomyelitis unstable ankle joint	Good
9	M	34	Retired military personnel	Left	Foot drop following common peroneal nerve injury	Good
10	M	20	Student	Right	Post traumatic arthritis	Excellent
11	M	36	unemployed	Left	Post traumatic arthritis	Excellent
12	F	26	Housewife	Right	Poliomyelitis unstable ankle joint	Fair

Table 3: Complications encountered during the study and their treatment.

Type of Complication	**No. of patients**	**Treatment**
Infection	2 (16.6%)	Regular dressing and antibiotics, ceftriaxone injection 1 gm IV for 7 days, the infection was secondary to mild sloughing of skin edges.
Skin sloughing	2 (16.6%)	Meticulous debridement of the necrotic skin and dressing
Delayed union and nonunion	1 (8.3%)	The patient was a female with poliomyelitis delayed union was apparent at 3 months postoperatively and patient continued to have pain at the ankle the period application was done for her more than other patient and continued for more than 6 weeks after the end of first 12 weeks postoperatively no evidence of union was seen, the patient stay on plastic splint. No attempt for revision of arthrodesis because the patient refuse revision.

Cast ulcer	1 (8.3%)	Treated by removal of the cast and application of a well- padded plaster of Paris and dressing of the ulcer.

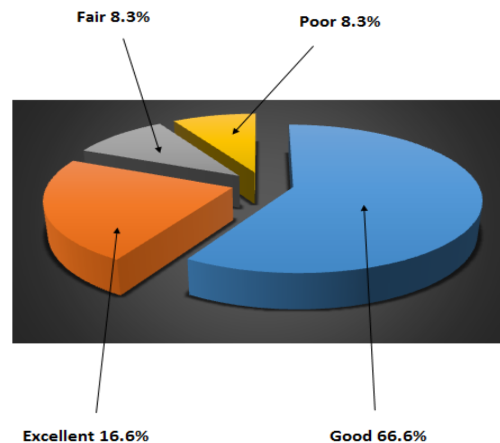

Figure 1: Functional evaluation after ankle arthrodesis at 6 months postoperatively.

Discussion

In the present study, anterior approach to the ankle joint which was popularized by Charnley was used which allows the exposure of entire ankle joint, however, it may carry the difficulty of removing the cartilage form the posterior part of the tibial side of the ankle joint(15).

In this study, we used two screws inserted laterally one form the tibia to talus and the other form the talus to tibia. Union was achieved in 91.7% of cases, excellent and good results were achieved in 10 patients (83.33% of cases), fair results in 1 patient (8.2%) and poor results in 1 patient (8.3%).

Mann RA et al(16) reported ankle arthrodesis using transfibular approach and cancellous screws fixation, the rate of union was 88% (71 of 81 ankles), 10 ankles (12%) of 81 failed to unite, the average postoperative score was 74 points and the rate of patients satisfaction was 89%.

Maurer et al(17) evaluated the results of ankle arthrodesis using internal screw fixation by transarticular cross screws through a transfibular approach with cancellous 35 patients were operated upon using this technique follow up evaluation averaged 2 years and the fusion rate was 100%.

James H et al(10) accomplished ankle arthrodesis with chevron fusion and internal fixation with bone grafting through bimalleolar approach with screws and staples fixation the arte of union was 12 of 13 patients (92.3%) good and excellent results were achieved in 10 patients (76.9%) 3 patients (23.07%) with fair and poor results.

AF Lynch et al(18) reported results after ankle arthrodesis with internal fixation for 62 patients, the rate of union was 84% (53 patients), and the ankle score was 80.

Kitoaka et al(6) study on ankle arthrodesis for arthrosis of the ankle and osteonecrosis of the talus in 19 patients using internal and external fixation techniques, union was achieved in 16 out of 19 patient. The results were excellent in 7 patients good results were achieved in 6 patients fair in 3 and poor in 3 patients.

The complications in this study were seen in 3 patients (25%) infection which developed in 2 patients (16.6%), skin sloughing in 2 patients (16,6%) nonunion in 1 patient (8.3%) who had sciatic nerve injury with flail senseless foot the patient kept on plastic splint and refuse revision, and 1 patient developed cast ulcer (8.3%).

In comparing these results with other studies as Douglas A Dennis et al(19) the

rate of complications was 18.8% (3) cases out of 15 patients, 1 patient with nonunion, 1 patient with persistent subtalar joint pain and 1 patient with infection and skin sloughing.

Marcus et al[20] reported complications in 3 out of 13 patients, 1 patient developed deep infection, 1 patent developed thrombophlebitis and 1 patients with tibial fatigue fracture.

In Johnson H et al[21] study, the complications occurred in 4 out of 19 patients, 1 patient with tibial stress fracture, 1 patient with infection and nonunion and 2 patients with mal alignment in planter flexion.

In Mann RA et al study[16] infection occurred in 19% of cases (12 out of 62 patients), nonunion occurred in 9 patients (14% of cases).

In conclusion; Ankle arthrodesis using internal fixation with crossed screws is a simple reliable way of obtaining fusion of the ankle joint. It avoids the inconvenience of external and the risk of pin tract infection. Bony fusion occurred in 91.7% of cases. The subjective results were good or excellent in 82.2%. Failure of fusion was encountered only in one limb objective neurological deficit. The ideal position of foot was neutral and valgus or varus of the heel is equal to that of the normal side (5 degrees hindfoot valgus and 5-10 degrees external rotation).

References

1. AB Colman, GC Poney. Transfibular ankle arthrodesis, assessment and outcome. Foot and Ankle International 2007;13: 769-81.
2. AF Lynch, RB Bourne, CH Rorabeck. The long term results of ankle arthrodesis. J Bone and Joint Surgery (Br) 1988; 70-B: 113-6.
3. GI Pagenstert, B Hintermann, A Barg et al. Arthrodesis of ankle in presence of large deformity. Bone Joint J Am 2007; (89-B): 615-9.
4. Cracchioli A, Cimino WR Lian G. Arthrodesis of the ankle joint in patients who have rheumatoid arthritis. J Bone and Joint Surgery 1992; 74-A: 903.
5. Morgan CD, Henki JA, Baily RE et al. External ring fixation versus screw fixation for ankle arthrodesis. Foot and Ankle International 2009;30: 353-60.
6. Kitoka HB, Gary Patzer RN. Arthrodesis for arthrosis of the ankle joint and osteonecrosis of the talus. J Bone and Joint Surgery 1998; 80-A: 370-9.
7. Gordon L Slater, Stephanie C Sayres, Martin J O"Malley. Technique tip: open ankle arthrodesis combined with sliding anterior bone graft. Foot and Ankle International 2010; 31: 1125-8.
8. Holt ES, Hansen ST, Mayo KA, Sangeorzan BJ. Ankle arthrodesis using internal screw fixation. Clinical Orthopedics and Related Research 1991; 268: 21-8.
9. MH Perlman, DB Thordarson. Open ankle arthrodesis with fibular sparing technique. Foot and Ankle International 2013; 34: 557-62.
10. James H Beaty. Orthopedics knowledge update 6. American Academy of Orthopedics Surgeons. 1998; 617-8.
11. Johnson EE, Weltmer J, Lian GJ, Crachiolo A. I lizarov ankle arthrodesis. Clinical Orthopedics and Related Research 1992; 280:160.
12. Dennis DA, Clayton ML, Wong DA, Stephanie C, Sayres. Internal fixation compression arthrodesis of the ankle joint. Clinical Orthopedics and Related Research 1990; 253: 212.
13. Muir DC, Amendola A, Sltzman CL. Long term outcome of ankle arthrodesis. Foot-Ankle Clin 2002; 7(4):703-8.
14. Marcus RE, Balourdas GM, Heiple KG. Ankle arthrodesis by chevron fusion with internal fixation and bone grafting. J Bone and Joint Surgery 1983; 65-A: 833-8.
15. R Smith, PLR Wood. Tibiotalar arthrodesis in posttraumatic arthritis. Foot and Ankle International 2013; 34: 851-5.
16. Mann RA, Ringsted KM. Arthrodesis of the ankle: A critical analysis. Foot-Ankle Int 1998;19(1):3-9.
17. Maurer RC, Cimino WR, Cox CV, Satow GK. Transarticular cross screw fixation, a technique of ankle arthrodesis. Clinical Orthopedics and Related Research 1991; (268): 56-64.
18. Ogilvie-Harris DJ, Leiberman I, Fitsialos D. Arthroscopically assisted arthrodesis for osteoarthritis of the ankle joint. J Bone and Joint Surgery 1993; 75-A: 1167.
19. Ogilvie-Harris DJ, Fitsialos D, Hedman TP. Arthrodesis of the ankle: a comparison of two versus three screws fixation in a crossed configuration, Clinical Orthopedics and Related Research 1994; 304:195.
20. P Buck, BF Morrey, Edmund YS Chao. The optimum position of arthrodesis of the ankle. J Bone and Joint Surgery 1987; 69-A:1052-62.
21. Thomas R, Daniels TR, Parker K. Gait analysis and functional outcome following ankle arthrodesis. J Bone and Joint Surgery Am 2006; 19 B: 549-64.

IMJ 2017;63(1):73-77.