

COMPARISON STUDY OF BIMALLEOLAR ANKLE FRACTURE TREATED BY VARIOUS METHODS OF INTERNAL FIXATION

Sushil R. Shreshthi^A, Amol Gowaikar^A, Dhanish V Mehendiratta^B, Kshitij Soni^B, Nishitkumar Bipinkumar^B, Virbhadrasingh J.N^B

^A - Associate Professor, Department of Orthopaedics, Dr. D. Y. Patil Hospital And Research Centre, Kolhapur.

^B - Junior Resident, Department of Orthopaedics, Dr. D. Y. Patil Hospital And Research Centre, Kolhapur.

Orthopaedics

Manuscript reference number
NJMDR_5212_17

Article submitted on: 17 March 2017
Article accepted on: 27 March 2017

Corresponding Author

Dr. Sushil R. Shreshthi
Associate Professor,
Dr. D.Y. Patil Hospital and
Research Centre,
Kolhapur - 416003.
Email: orthoshreshthi@gmail.
com

Abstract:

Ankle fractures are one of the most common fractures in orthopedic traumatology. Ankle injuries gained importance because body weight is transmitted through it and locomotion depends on stability of this joint. The treatment options with open reduction and internal fixation technique available for malleolar fractures, to attain a proper anatomical alignment and stability of ankle joint, can lead to rewarding outcome for the patient. This study was conducted to assess the efficacy of open reduction and internal fixation of bimalleolar ankle fractures according to functional end results, period of recovery, mobilization of joint and complete recovery and complications following open reduction internal fixation of ankle joint.

Material And Methods: Study Population: 40 patients with fresh bimalleolar fractures of ankle who attended the tertiary centre from 2013 to 2016 were studied. Case selection was done on the criteria of history, clinical evaluation and radiological examination in standard AP and lateral views. Soon after admission, clinical data was recorded as per the proforma.

Inclusion Criteria:

- Patients aged 21 years or older
- Patients with fresh bimalleolar fractures of ankle.
- Patients who are fit for surgery.

Exclusion Criteria:

- Patients aged 20 years or lesser
- Patients with compound fractures
- Patients unfit for surgery or anaesthesia.

Conclusion:

Among the methods of treatment Type A-2 fracture treated by both methods i.e. group I (A) (Lateral malleolus: semi-tubular plate and Medial malleolus: tension band wiring) and group II (B) (Lateral malleolus: malleolar screw+ tension band wiring and Medial malleolus: tension band wiring) gave excellent results with respect to pain and activities of daily living. Type B-2 fracture treated by group I (B) (Lateral malleolus: semi-tubular plate and Medial malleolus: malleolar screws) gave excellent results and those treated by group VII (B) (Lateral malleolus: rush pin and Medial malleolus: tension band wiring) gave poor results with respect to pain and activities of daily living. Type C-1 fracture treated by any methods does not have same function as before injury. Type C-2 fracture treated by group I (D) (Lateral malleolus: semi-tubular plate and Medial malleolus: malleolar screws) gave excellent results with respect to pain and activities of daily living.

Keywords: Bimalleolar Ankle fracture, internal fixation, ankle injuries

Introduction

Ankle fractures are one of the most common fractures in orthopedic traumatology. Ankle injuries gained importance because body weight is transmitted through it and locomotion depends on stability of this joint. There has been an increase in the prevalence of fractures about the ankle¹ as well as an increase in the severity of fractures in elderly individual. Injuries around the ankle joint cause destruction of not only the bony architecture, but also often the ligamentous and soft tissue components.² As with all intra-articular fractures, malleolar fractures necessitate accurate reduction and stable fixation, when malleolar fractures are not reduced accurately they may lead to post-traumatic painful restriction of motion or osteoarthritis or both.³ The treatment options with open reduction and internal fixation technique available for malleolar fractures, to attain a proper anatomical alignment and stability of ankle joint, can lead to rewarding outcome for the patient. This study was conducted to assess the efficacy of open reduction and internal fixation of bimalleolar ankle fractures according to functional end results, period of recovery, mobilization of joint and complete recovery and complications following open reduction internal fixation of ankle joint.

Material And Methods

Study site: Tertiary centre

Study Population: 40 patients with fresh bimalleolar fractures of ankle who attended the tertiary centre from 2013 to 2016 were studied.

Case selection was done on the criteria of history, clinical evaluation and radiological examination in standard AP and lateral views. Soon after admission, clinical data was recorded as per the proforma.

Inclusion Criteria

- Patients aged 21 years or older
- Patients with fresh bimalleolar fractures of ankle.
- Patients who are fit for surgery.

Exclusion Criteria

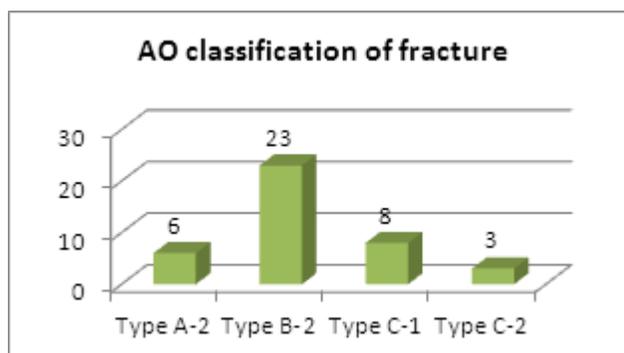
- Patients aged 20 years or lesser
- Patients with compound fractures
- Patients unfit for surgery or anesthesia.

The fractures were classified using Lauge-Hansen's and AO/OTA classification. Patients were examined for other bony injuries and visceral injuries and were given below knee POP slab with strict limb elevation till the time of surgery. All the fractures were rigidly fixed with different implants using AO principles. Lateral malleolus was fixed one third semi tubular plate, lag screw, rush nail and cannulated cancellous screw. Medial malleolus was fixed with tension band wiring, malleolar screw k-wires and cannulated cancellous screws.

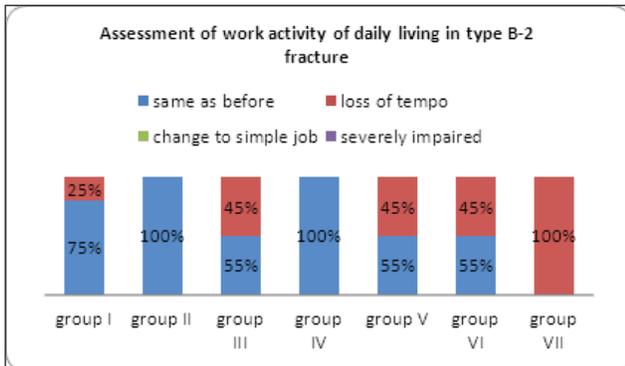
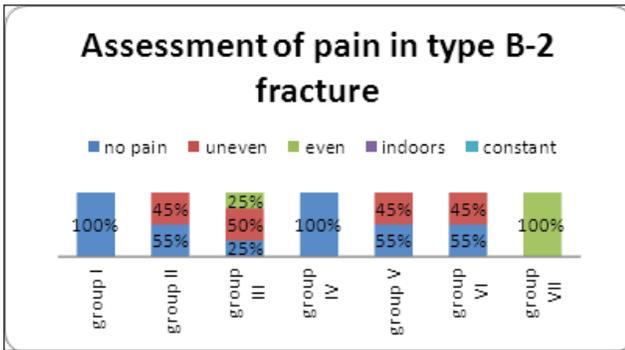
The wound was closed and below knee plaster slab was given. First dressing and drain removal if present was done after 48 hours. Suture removal was done after 12-14 days and the patient was started non weight bearing walking with crutches or walker for 6 weeks. Functional assessment was done in follow-up visits in terms of pain, stiffness, swelling, work, activities of daily living, running, stair climbing, squatting and evaluated using OLERUD and MOLANDER'S criteria.

Results

1. The mean age of patients in the study group was 52.45 years.
2. Majority of the patients (60%) were male.
3. 57.5% of the fractures were found to be Type B-2 followed by Type C-1 (20%).

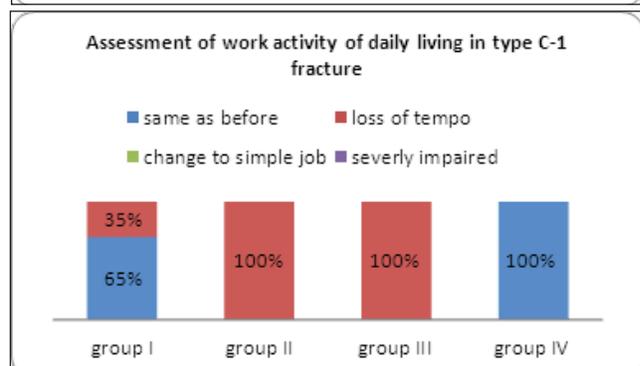
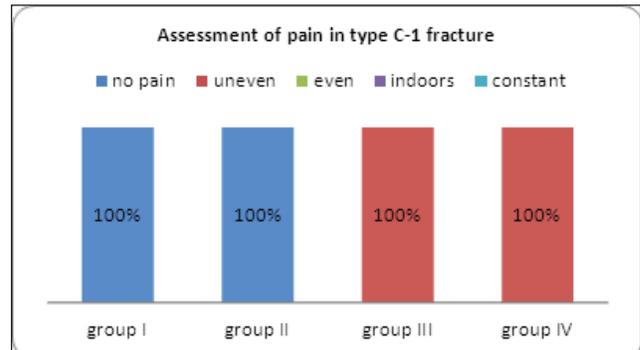


4. The assessment of pain and work activity of daily living in type B-2 fracture treated by various methods is characterized below:



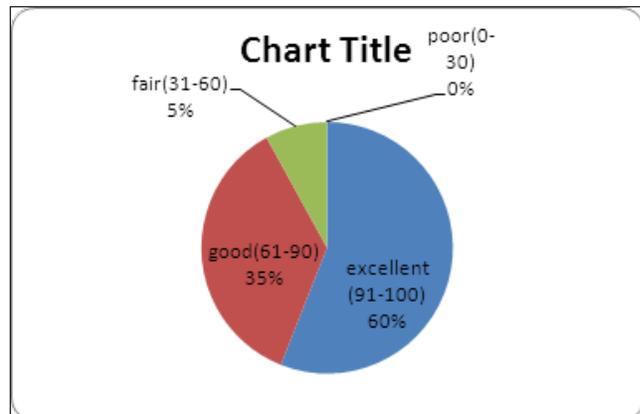
Group I	Lateral malleolus : semitubular plate Medial malleolus : malleolar screw
Group II	Lateral malleolus : cannulatedcancellous screw Medial malleolus : cannulatedcancellous screw
Group III	Lateral malleolus : semitubular plate Medial malleolus : tension band wiring
Group IV	Lateral malleolus : lag screw Medial malleolus : malleolar screw
Group V	Lateral malleolus : semitubular plate Medial malleolus : cannulatedcancellous screw
Group VI	Lateral malleolus : semitubular plate Medial malleolus : k- wire
GroupVII	Lateral malleolus : rush pin Medial malleolus : tension band wiring

5. The assessment of pain and work activity of daily living in type C-1 fracture treated by various methods is characterized below:



Group I	Lateral malleolus : semitubular plate Medial malleolus : cannulatedcancellous screw
Group II	Lateral malleolus : lag screw Medial malleolus : malleolar screw
Group III	Lateral malleolus : semitubular plate Medial malleolus : tension band wiring
Group IV	Lateral malleolus : lag screw Medial malleolus : cannulatedcancellous screw

6. 60% patients showed excellent results while 35% and 5% patients showed good and fair results respectively



Discussion

Ankle fractures are one of the most common fractures in orthopedic traumatology. In the present study 40 patients

with bimalleolar fractures were compared between the various methods of treatment and fractures. The patients comprised of 24 males and 16 females and their age varied from 21 to 65 years. The modes of injury in these patients were twisting injury, fall and Road Traffic Accidents (RTA). This is similar to the study of Motwani GN et al⁴ where the mean age of the patients was 39.28 years and men were more commonly involved with M:F ratio of 5:1. Road traffic accident was the most common mode of injury involving 45% cases followed by 37.5% cases of fall and 17.5% cases of twisting injury. In the present study, the group was classified on type of fracture as per AO classification as:

- A. Type A-2 fracture = 6 patients
- B. Type B-2 fracture = 23 patients
- C. Type C-1 fracture = 8 patients
- D. Type C-2 fracture = 3 patients

A. Type A-2 Fractures:

- Group I (A): Lateral malleolus: Semi-tubular plate
Medial malleolus: Tension band wiring
- Group II (A): Lateral malleolus: Malleolar screw +
Tension band wiring
Medial malleolus: Tension band wiring

Type A-2 fractures corresponded to supination-adduction type of injury according to Lauge-Hansen's classification. In our study, according to Olerud and Molander score, we found that Type A-2 fracture treated by both the groups had excellent results in 100% of cases with respect to pain, stiffness, swelling, squatting and work activity of daily living with an ankle scores of 100.

Our study is comparable to the study of Lee SY et al⁵, who analyzed these type of injuries and showed satisfactory results in 89% of the cases according to Meyer's criteria. In another study Ma J et al⁶ evaluated these type of fractures in 8 cases. The patients were evaluated by Baird- Jackson scoring system which showed that excellent and good results were 89.4%. They concluded that proper internal fixation and correct fracture pattern estimation are of importance to achieve and gain better long term results. It was observed in the present study that Type A-2 fractures treated by group I (A) method (Lateral malleolus: semi-tubular plate and Medial malleolus: tension band wiring) and Group II (A) method (Lateral malleolus: malleolar screw + tension band wiring and Medial malleolus: tension band wiring) had excellent results with ankle scores of 100.

B. Type B-2 fractures:

- Group I (B): Lateral malleolus: Semi-tubular plate
Medial malleolus: Malleolar screws
- Group II (B): Lateral malleolus: Cannulated cancellous screws
Medial malleolus: Cannulated cancellous screws
- Group III (B): Lateral malleolus: Semi-tubular plate
Medial malleolus: Tension band wiring
- Group IV (B): Lateral malleolus: Lag screw
Medial malleolus: Malleolar screw
- Group V (B): Lateral malleolus: Semi-tubular plate
Medial malleolus: Cannulated cancellous screw
- Group VI (B): Lateral malleolus: Semi-tubular plate
Medial malleolus: K-wires
- Group VII (B): Lateral malleolus: Rush pin
Medial malleolus: Tension band wiring

Type B-2 fractures correspond to Supination-adduction and Supination-external rotation type of injury according to Lauge-Hansen's classification. In our study, Type B-2 fractures treated by Group I (B) method (Lateral malleolus: semi-tubular plate and Medial malleolus: malleolar screws) 25% of the cases had swelling in evening time and 25% of the patients had constant swelling. Work, Activity of daily living in 25% of the cases showed loss of tempo as before injury. Pain, stiffness and squatting were not affected. According to Olerud-Molander score the results were graded as good to excellent with ankle scores ranging from 85-100.

Type B-2 fractures that were treated with Group II (B) method (Lateral malleolus: Cannulated cancellous screw and Medial malleolus: Cannulated cancellous screw) showed pain while walking on uneven surfaces in 45% of the cases and swelling was present in evening time in 100% of the cases. Stiffness, squatting, and work, activity of daily living were not affected. According to Olerud- Molander score the results were excellent with ankle score of 95.

Type B-2 fractures who were treated with Group III (B) method (Lateral malleolus: semi-tubular plate and Medial malleolus: Tension band wiring) showed pain while walking on uneven surface in 50% of the cases, pain while walking on even surface in 25% of the cases, stiffness was present in 25% of the cases, swelling was constantly present in 50% of the cases, 45% of the cases showed loss of tempo with respect to work and activity of daily living. In 25% of the cases squatting was impossible. According

to Olerud-Molander score the results were fair to excellent with ankle scores ranging from 40-100.

In cases that were treated with Group IV (B) method (Lateral malleolus: Lag screw and Medial malleolus: malleolar screw) only swelling was present during evening time. The Olerud-Molander score was 95 showing excellent results.

Type B-2 fractures who were treated with Group V (B) method (Lateral malleolus: semi-tubular plate and Medial malleolus: Cannulated cancellous screw) showed pain while walking on uneven surface in 45% of the cases, stiffness was present in 55% of the cases and 45% of the cases had loss of tempo in work and activity of daily living. The Olerud-Molander ankle score was from 90-100 showing excellent results.

Type B-2 fractures that were treated with Group VI (B) method (Lateral malleolus: semi-tubular plate and Medial malleolus: K-wires) 45% of the cases had pain while walking on uneven surface along with stiffness. 100% of cases had swelling which was present during evening time and in 45% of the cases work and activity of daily life was affected. The Olerud-Molander ankle score ranged from 85-95 giving good to excellent results.

Type B-2 fractures treated by Group VII (B) method (Lateral malleolus: Rush pin and Medial malleolus: Tension band wiring) pain were present while walking on uneven surface along with stiffness and constant swelling. Work and activity of daily living was also affected in these cases. The Olerud- Molander ankle score was 50 giving fair result.

Hemanth HPetal⁷ analysed the functional outcome following operative treatment of ankle fractures using subjective as well as objective criteria. The authors concluded that Operative treatment for ankle fractures results in good functional outcome postoperatively. Anatomical reduction of the fracture is associated with better functional outcome. Early treatment without delay, anatomic reduction and fracture fixation, stringent post operative mobilization and rehabilitation should help improve outcome in an operated ankle fracture. The study when compared with the study by Muhammad AK et al⁸ who treated similar fractures showed excellent to good results in 93.4% of the cases.

Thus we conclude that in our study, type B-2 fractures treated by Group I (B) method (Lateral malleolus: semi-

tubular plate and Medial malleolus: malleolar screws) had excellent results while that treated by Group VII (B) method (Lateral malleolus: Rush pin and Medial malleolus: Tension band wiring) had poor results.

C. Type C-1 fractures:

Group I (C): Lateral malleolus: Semi-tubular plate
Medial malleolus: Cannulated cancellous screw

Group II (C): Lateral malleolus: Lag screw
Medial malleolus: Malleolar screw

Group III (C): Lateral malleolus: Semi-tubular plate
Medial malleolus: Tension band wiring

Group IV (C): Lateral malleolus: Lag screw
Medial malleolus: Cannulated cancellous screw

Type C-1 fracture corresponds to pronation-external rotation and pronation abduction type of injury according to Lauge-Hansen's classification. In our study, Type C-1 fractures treated by Group I (C) method (Lateral malleolus: semi-tubular plate and Medial malleolus: Cannulated cancellous screw) showed no pain while walking, stiffness was present in 15% of cases, and swelling was present during evening time in 45% of cases and constantly present in 15% of cases. Squatting was impossible in 15% of cases and in 35% of cases there were loss of tempo in work and activity of daily living. According to Olerud-Molander score the results were grade from good to excellent with ankle scores of 65-100.

Type C-1 fracture treated by Group II (C) method (Lateral malleolus: Lag screw and Medial malleolus: malleolar screw) showed swelling was present during evening time and there was loss of tempo in work and activity of daily living.

Type C-1 fracture treated by Group III (C) method (Lateral malleolus: semi-tubular plate and Medial malleolus: Tension band wiring) showed pain present on uneven surface, along with stiffness and swelling during evening time. Squatting was impossible in these cases and there work and activity of daily living was affected.

Type C-1 fracture treated by Group IV (C) method (Lateral malleolus: lag screw and Medial malleolus: Cannulatedcancellous screw) there was pain present while walking on uneven surface along with stiffness and

swelling during evening time.

This is similar to the findings of Kulloli SS et al⁹, who evaluated the results of surgical treatment of similar fracture patterns. The results in their study were excellent in 25% patients, good in 35% of patients, fair in 25% patients and poor in 15% of patient's according to subjective evaluation. Thus we conclude that Type C-1 fracture treated by any groups does not have same function as before injury.

D. Type C-2 fractures:

Group I (D): Lateral malleolus: Semi-tubular plate
Medial malleolus: Malleolar screws

Type C-2 fracture corresponds to pronation-external rotation type of injury according to Lauge-Hansen's classification. In our study, Type C-1 fractures treated by Group I (D) method (Lateral malleolus: semi-tubular plate and Medial malleolus: malleolar screws) showed that swelling was present during evening time. According to Olerud-Molander score the results were excellent with ankle score of 95. This is comparable to the study of Ma J et al⁶ who evaluated these type of fractures in 8 cases. The patients were evaluated by Baird- Jackson scoring system which showed that excellent and good results were 89.4%. Thus we conclude that Type C-1 fracture treated by Group I (D) method (Lateral malleolus: semi-tubular plate and Medial malleolus: malleolar screws) gives excellent results without problems in pain, stiffness, squatting, and work, activity of daily living.

Turhan Eet al¹⁰ conducted a study to translate and culturally adapt the Olerud-Molander Ankle Score (OMAS) into Turkish and to assess its reliability and validity. The Turkish version of the OMAS (OMAS-Tr) was administered to one hundred patients with malleolar fractures. The OMAS-Tr was completed twice by each participant at 7- to 10-days intervals to assess test retest reliability based on the interrater correlation coefficient, whereas Cronbach's alpha evaluated internal consistency. The external validity was evaluated with correlations between the Turkish version of the Foot and Ankle Ability Measure (FAAM) and the Turkish version of the SF-12 questionnaire. The internal consistency and the test-retest reliability were excellent. There was a strong correlation between the OMAS-Tr and the FAAM subscales on activities of daily living and sports. The OMAS-Tr displayed very good to good correlation

with the SF-12 physical component score and the SF-12 mental component score.

Conclusion

Ankle fractures are one of the most common fractures in orthopedic traumatology. This study was conducted to assess the functional outcome and results of surgical treatment of malleolar fractures. Among the methods of treatment Type A-2 fracture treated by both methods i.e. group I (A) (Lateral malleolus: semi-tubular plate and Medial malleolus: tension band wiring) and group II (B) (Lateral malleolus: malleolar screw+ tension band wiring and Medial malleolus: tension band wiring) gave excellent results with respect to pain and activities of daily living. Type B-2 fracture treated by group I (B) (Lateral malleolus: semi-tubular plate and Medial malleolus: malleolar screws) gave excellent results and those treated by group VII (B) (Lateral malleolus: rush pin and Medial malleolus: tension band wiring) gave poor results with respect to pain and activities of daily living. Type C-1 fracture treated by any methods does not have same function as before injury. Type C-2 fracture treated by group I (D) (Lateral malleolus: semi-tubular plate and Medial malleolus: malleolar screws) gave excellent results with respect to pain and activities of daily living.

Understanding the mechanism of injury is essential for good reduction and fixation. Sound surgical principles should be followed during open reduction and internal fixation. Early mobilization produces faster rehabilitation. Long term follow-up study is required for functional evaluation of ankle's treated for bimalleolar fractures.

References

1. Beris AE, Kabbani KT, Xenakis TA, Mitsionis G, Soucacos PK, Soucacos PN. Surgical treatment of malleolar fractures- a review of 144 patients. ClinOrthop Related Research, 1997 Vug; 341: 90-98.
2. Weber MJ. Ankle fractures and dislocations. In: Operative orthopaedics, Chapter-50, 2nd edition, Vol.3, Ed. Chapman MW, Madison M. Philadelphia; j.b. Lippincott Company, 1993; 731-748pp.

3. Geissler WB, Tsao AK, Hughes JL. Fractures and injuries of ankle. In: Rockwood and Green's fractures in adults. Chapter-31, 4th edn., Vol.2, ed. Rockwood CA, Green DP, bucholz RW, Heckman JD. Philadelphia: Lippincott Raven, 1996; 2201-2266pp.
4. Motwani GN, Shah HD, Chavli VH, Daveshwar RN, Parmar H, Suthar PP. Results of open reduction and internal fixation in closed bimalleolar Pott's Fracture of Ankle in Adults. *Int J Med Sci Public Health* 2015;4:893-900
5. Lee SY, Park, MS, Kwon, SS, Sung KH, Jung HS, Lee KM. Influence of ankle fracture surgery on glycemic control in patients with diabetes. *BMC Musculoskeletal Disorders*. 2016;17:137.
6. Ma J, Li Y, Wang Z: ZhongguoXiu Fu Chong Jain WaiKeZaZhi. Surgical techniques of open reduction and internal fixation for ankle fractures. *2008;22(4): 456-8.*
7. Hemanth HP, Patil A, Darshan MS. Functional outcome of ankle fractures treated surgically: A prospective study. *J. Evid. Based Med. Healthc*. 2016;3(42):2073-2085
8. Muhammad AK, Muhammad Shafiq, Ahmad Sohail Sahizada: *J Postgrad Med Inst*. 2005;19 (2):162-5.
9. Kulloli SS, Magdum PB, Naik NP. Evaluation of Management of Malleolar Fractures of Ankle Joint. *IOSR Journal of Dental and Medical Sciences (JDMS)*. 2012;3(3);27-31
10. Turhan E, Demirel M, Daylak A, Huri G, Doral MN, Celik D. Translation, cross-cultural adaptation, reliability and validity of the Turkish version of the Olerud-Molander Ankle Score (OMAS). *ActaOrthopaedicaetTraumatologicaTurcica* 2017;51;60-64