Systematic Review

Effectiveness and outcome of early weight bearing in ankle fracture. A systemic review

Abstract:

Introduction: Ankle fractures are claimed to affect 70-185 patients out of 100,000 people each year. There is currently no unanimity among surgeons throughout the world on early versus restricted weight bearing in surgically treated trauma patients with fractures. The aim of this study was to review the effectiveness and outcome of early weight bearing in ankle fracture as well as quality of life and pain. **Methods:** An electronic search was conducted of the databases EMBASE, PubMed, and The Cochrane Library, as well as Medline, Google Scholar, and some more relevant articles published after 2006 and eligible records were selected with high precision. Initially, 2434 records were identified. **Results:** Initially, 2434 records were identified. Due to similarity and duplication, 1308 records were eliminated, and 1126 records were kept. Following the screening of the records and their subjects, 921 further unconnected records were eliminated. Then, 205 qualified full-text articles were selected, and 10 articles were included in qualitative analysis. **Discussion:** There have been few studies on weight gain following surgery, although it has been demonstrated that overweight patients return to work before underweight ones and external talar rotation. As a result, early weight bearing after active ankle stabilization should be promoted. Studies on weight gain after surgery are scarce, but it has been shown that overweight patients return to work before underweight patients. **Conclusion:** According to the findings of this study, surgical therapy, both aggressive and minimal, appears to be a safe alternative for the elderly. Short-term advantages of early weight-bearing include a decreased incidence of thromboembolic disease. Active movement reduces joint stiffness while maintaining muscle mass. Post-operative mobility, quality of life, and post-operative early weight bearing status are considered as significant outcome indicators. Unsafe weight as tolerated after ankle surgery might be a safe and encouraging option. As a result, future research should include this possibilities.

Key words: Ankle, Fracture, Weight, Ankle Fracture, Effectiveness, Outcome, Weight bearing

Introduction:

Ankle fractures are the most prevalent type of lower extremity fracture in the globe.[1] Ankle fractures are claimed to affect 70-185 patients out of 100,000 people each year.[2,3] The prevalence was found to be 57 out of 100,000 persons in 1970, and it is anticipated to rise to almost 270 out of 100,000 by 2030. Women have a higher incidence (0.3 % per year) than men, and the incidence increases with age (0.1 % per annum).[2- 4] Ankle fractures most commonly found under age of 50 in older women and young men, nonetheless, ankle fractures in men are the most common.[5] Because of anatomical shape and often injured

during daily activities ankle joint considered as the most unstable parts of the body. Most ankle fractures occur second to low, but regardless of the nature of the injury, fracture features often require the need for functional stability.[6]

When body rotates with the injured foot Multiple ankle fractures or minor injuries may occured , whether during sports or daily walking. Stable ankle fractures can usually be treated without surgery, whereas fractures are frequently treated with limited surgery and correction, if the indications are well-defined and previously published.

An ankle fracture is distinct in that it can result in insufficient mobility when using casts or other types of external splints. Patients were traditionally not allowed to bear weight until the fracture showed signs of healing by developing callus. [7] Whether there is callus or not, most surgeons will allow you to carry a monitored weight after six weeks. Several studies have looked at a wide range of post-operative management strategies, including full weight bearing, partial weight bearing, and paralysis. [7] The findings of these studies were inadequate to provide any benefit in the short term. However, some studies found no significant differences in consequences after one year. [7-8]

The forced use of walking aids, increasing dependency, and/or prolonged hospital admissions are all consequences of this weight-bearing restriction on patients and health services. [9,10] Patients also report significant time away from work, with the resulting personal and societal costs. [9-12] Most patients would prefer to be free of weight limitations if there was a little possibility of damage. There have been a number of systematic reviews published on various parts of postoperative care medicine.[13-16] However, because there are different regimens for ankle protection, ankle mobility, and weight bearing, none of these examinations can provide exact advice on post-operative care for ankle fractures.

There is currently no unanimity among surgeons throughout the world on early versus restricted weight bearing in surgically treated trauma patients with fractures.The aim of this study was to review the effectiveness and outcome of early weight bearing in ankle fracture as well as quality of life and pain.

Methods

Literature search:

A systematic review of scientific literature concerning effectiveness and outcome of early weight bearing in ankle fracture was done in the manuscript. This systematic review was conducted following the PRISMA guidelines[17] was used to develop inclusion criteria and search terms per intervention. All types of ankle fracture and early weight bearing were included. Outcome was based on the effectiveness and outcome of early weight bearing.

As a consequence, four major medical databases were analyzed, including The EMBASE, PubMed, and The Cochrane Library, Medline, Google Scholar databases, and some more relevant journals, and eligible records were selected with high precision. Initially, 2434 records were identified. Due to similarity and duplication, 1308 records were deleted, leaving 1126 records. Following an examination of the records and their themes, 921 further unrelated records were eliminated.Then, 205 qualified full-text articles were selected (Figure 1). The outcome and effectiveness of early weight bearing ankle fracture was the frontline discussion part of this study and less or more daily activity in contest to being active and living on your own.

Eligibility criteria

Inclusion criteria: Article published after 2006 were included and the Patients must have one of the following fractures: Lateral malleolus fracture, Medial malleolus fracture, Bimalleolar ankle fracture, Bimalleolar equivalent fracture, Trimalleolar fracture, Posterior malleolus fracture, Maisonneuve fracture, Distal tibia fracture, Distal fibula fracture.

Exclusion criteria: Article published before 2006 were excluded and the patients having fracture like Lower leg fractures, Distal tibia shaft fracture, Studies about multiple fracture sites, pathological fractures and Multi trauma patients.

Study selection

Two different independent reviewers were completed the study selection in two steps. In first step the inclusion criteria were screened. In second step both reviewers assessed the full text of the studies.

Prisma flow chart

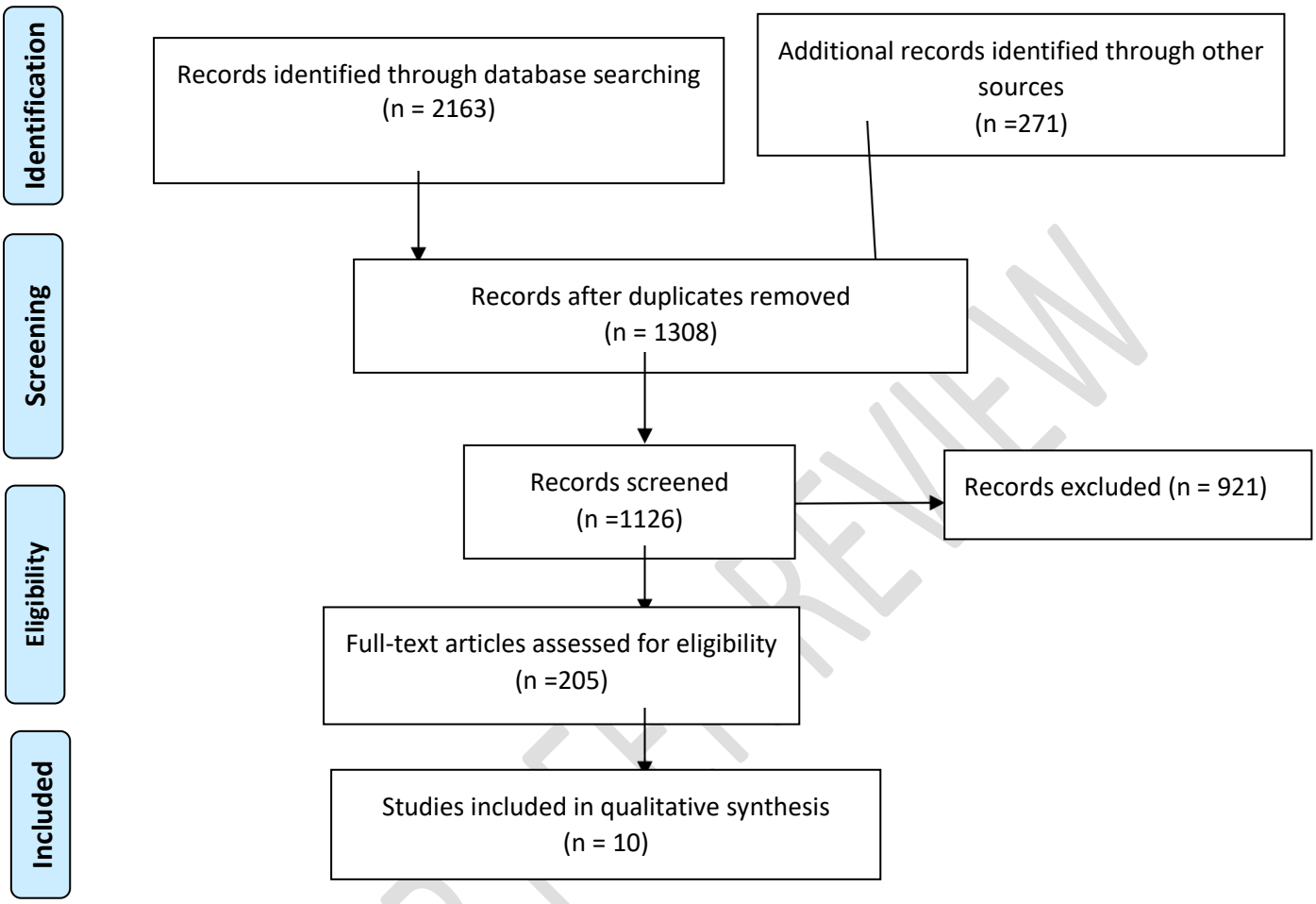

Figure 1. The selection mechanism schedule of records relevant to the present study in accordance with the PRISMA technique

Results

Literature selection

Initially, 2434 records were identified. Due to similarity and duplication, 1308 records were eliminated and 1126 records were kept. Following the screening of the records and their subjects, 921 further unconnected records were eliminated. Then, 205 qualified full-text articles were selected (Figure 1).

The selected study characteristic were studied and compared in table 1. Types of fracture and treatments were discussed in the same table 1.

Effect of weight-bearing

The impact of weight-bearing on postoperative recovery has been studied in many studies comparing early versus late weight-bearing. [12,27-30] Wetzler et al. did not give appropriate data for analysis, but Honigmann et al. and Laarhoven van et al. found median scores. As a result, these three researches were ruled out of the study. [30-32] The Olerud Molander score in the short term could not be assessed. Despite the fact that the long-term Olerud Molander score was published in four different studies, only Simanski et al. reported the SD values, making long-term score analysis impossible. [11]

Outcomes

Trauma, comorbidities, complications, mortality, wound healing, post-operative post-traumatic stress disorder, and fracture segregation are all effect factors seen in different studies. The OMAS score will be compared between treatment groups as variables based on the regression model of the mixed outline model for primary analysis and correction of stratification and baseline (preinjury) OMAS scores. A random impact will be added to follow any variance in response due to the hiring center. Consistent impacts will be included to accommodate participant age and gender. The treatment difference will be based on a modified approach and 95% confidence intervals. Severe functional recovery is predicting age, female gender, obesity, diabetes, syndesmotic injury, major ASA segmentation, trimalleolar fractures, the presence of open fractures or fracture fractures, type C fracture, and inability to walk for a long time.

Discussion:

The major goal of surgical therapy for ankle fractures is to establish stable correction through open reduction and internal correction, allowing for painless and effective ankle movements as well as a return to work and normal activities. [33,34] The initial weight after surgical treatment for an ankle fracture can be measured in a variety of methods. [11,33,34]

Two separate system reviews were obtained, which support initial weight bearing after ankle fracture correction compared with late or non-weight bearing six weeks after surgery. These revisions did not find significant adverse effects on the first weighted groups, while they did return to previous activities and return to previous work.[35,36] Furthermore, Assal et al. demonstrated that bearing the initial weight in older patients (over 70) with Weber B ankle fractures was a safe and satisfactory form of postoperative treatment with better adjustment.[37]

There have been few studies on weight gain following surgery, although it has been demonstrated that overweight patients return to work before underweight ones and external talar rotation [37] As a result, early weight bearing after active ankle stabilization should be promoted.

Studies on weight gain after surgery are scarce, but it has been shown that overweight patients return to work before underweight patients.[11,36] According to biomechanical research, axial loading stabilizes the ankle joint and inhibits both translational and external talar movement. [38] As a result, early weight bearing after ankle stabilization surgery should be recommended.[36-39]

Wound complications are the most commonly seen complications, with deep infection having the most destructive implications (Soohoo et al. 2009, Schepers et al. 2013).[40,41] As a result, the current investigation emphasized on deep SSI following ankle fracture procedures. Study I discovered significant patient- and surgery-related risk factors for deep SSI, while Study IV looked at the outcome of patients who had a deep infection with hardware exposure and were treated with flap reconstruction. In Study II, the major factors that predispose to treatment failure after a deep infection were found. In contrast to the other studies, Study III did not focus on postoperative infection. Rather, the study's purpose was to identify the most common surgical errors that lead to early reoperation after ankle fracture repair. The most serious consequence of ankle fracture surgery is deep infection. Although reconstructive treatments can successfully correct soft-tissue defects with exposed hardware, treatment failure is common. We depend mostly on preventative measures in the absence of a cure for postoperative infections. As a result, identifying risk factors is critical for designing measures to avoid potentially devastating repercussions.

Previous research revealed that full load weight-bearing should be given six weeks to three months following surgery to avoid problems or implant failure.[42-45] Early weight-bearing with ankle fractures enhanced short-term results and allowed for a rapid resume normal work and activities, according to recent studies.[46-48] With 115 patients, Smeeing et al[47] conducted a multicenter randomized control experiment. The group that practiced unprotected weight-bearing had much better short-term functional effects. Dehghan et al[46] observed that early weight bearing increased ankle range of motion, Olerud/Molander ankle function scores, and the 36-item short-form health survey scores in 110 patients in another randomized control trial. In the case of calcaneal fractures, it is widely accepted that three months of nonweight-bearing has been the conventional standard of care after open reduction internal fixation. Both Hyer et al. and Kayali et al. conducted retrospective studies of early weight bearing after open reduction and internal fixation of calcaneal fractures with locking plate fixation, and their findings were significant for no negative effects of early weight bearing.[49,50] Park et al. evaluated 86 patients with acute fifth metatarsal base fractures, categorizing them as conservatively treated or operatively treated, and then further categorizing them as early weight-bearing or late weight-bearing. They looked at bone resorption, clinical union, and AOFAS and VAS scores, and found no changes in AOFAS or VAS ratings, fewer incidences of bone resorption, and earlier bony unions in the early weight-bearing groups. Their conclusion was early weight-bearing may help this population, regardless of surgical or conservative treatment.[51]

Taking into consideration the life expectancy of this age group, we believe that quality of life is an essential outcome component in addition to the regularly utilized characteristics. Despite this rise in life expectancy, this age group still has a restricted life duration. As a result, in this figure, the functional effect may be more clinically relevant than the radiological / anatomical effect. However, there have been few studies that employ quality of life as a consequence of the outcome. The current thesis' findings can be used to fine-tune treatment algorithms in individuals undergoing surgical therapy for ankle fractures.

Conclusion:

One of the most prevalent types of lower leg fractures is an ankle fracture. Complications from surgery include wound infections, pulmonary edema, implant or repair failure, death,

amputation, and reconstruction. Postoperative care may also include the application of cast plaster.[52] This was not achievable, however, due to a paucity of literature for this demographic. Based on the available evidence, we may conclude that surgical therapy for the elderly, both aggressive and minimal, appears to be a safe option. The authors argue that post-operative mobility, quality of life, and post-operative weight bearing status should all be used as significant outcome measures in this society. Unsafe weight gained after ankle surgery could be a safe and promising option. As a result, this possibility should be investigated more in the future.

References:

1. Court-Brown CM, Caesar B (2006) Epidemiology of adult fractures: A review. Injury37: 691–697. S0020-1383(06)00323-8 [pii]; doi: 10.1016/j.injury.2006.04.130 PMID: 16814787
2. Kannus P, Palvanen M, Niemi S, Parkkari J, Järvinen M (2002) Increasing number and incidence of low-trauma ankle fractures in elderly people: fnnish statistics during 1970–2000 and projections for the future. Bone 31(3):430–433
3. Van Staa TP, Dennison EM, Leufkens HGM, Cooper C (2001) Epidemiology of fractures in England and Wales. Bone 29(6):517–522
4. Thur CK, Edgren G, Jansson K-Å, Wretenberg P (2012) Epidemiology of adult ankle fractures in Sweden between 1987 and 2004. Acta Orthop 83(3):276–281
5. Singh, R. , Kamal, T. , Roulohamin, N. , Maoharan, G. , Ahmed, B. and Theobald, P. (2014) Ankle Fractures: A Literature Review of Current Treatment Methods. *Open Journal of Orthopedics*, **4**, 292-303. doi: 10.4236/ojo.2014.411046
6. Jensen SL, Andresen BK, Mencke S, Nielsen PT: Epidemiology of ankle fractures: a prospective population-based study of 212 cases in Aalborg, Denmark. Acta Orthop Scand. 1998, 69:48-50. 10.3109/17453679809002356
7. J.M. Muthuuri, East African Orthopaedic Journal: early weight-bearing after ankle fracture fixation: a prospective, randomized and non-blinded, outcome study. EAOJ; Vol. 7: September 2013
8. Goodsiff, S.P., Trakru, S., Kefer, G. et al. A comparative study of early motion and immediate plaster splintage after internal fixation of unstable fractures of the ankle. Injury. 1993; 24: 529-530.
9. McPhail SM, Dunstan J, Canning J, Haines TP. Life impact of ankle fractures: qualitative analysis of patient and clinician experiences. BMC Musculoskelet Disord. 2012;13:224.
10. McDonald MR, Sathiyakumar V, Apfeld JC, Hooe B, Ehrenfeld J, Obremskey WT, et al. Predictive factors of hospital length of stay in patients with operatively treated ankle fractures. J Orthop Traumatol Off J Ital Soc Orthop Traumatol. 2014;15(4):255–8.
11. Simanski CJ, Maegele MG, Lefering R, Lehnen DM, Kawel N, Riess P, et al. Functional treatment and early weightbearing after an ankle fracture: a prospective study. J Orthop Trauma. 2006;20:108–14.
12. Gul A, Batra S, Mehmood S, Gillham N. Immediate unprotected weight bearing of operatively treated ankle fractures. Acta Orthop Belg. 2007;73: 360–5.

13. Black JD, Bhavikatti M, Al-Hadithy N, Hakmi A, Kitson J (2013) Early weight-bearing in operatively fixed ankle fractures: A systematic review. Foot (Edinb). S0958-2592(13)00022-9 [pii];10.1016/j. foot.2013.05.002 [doi].
14. Nash CE, Mickan SM, Del Mar CB, Glasziou PP (2004) Resting injured limbs delays recovery: a systematic review. J Fam Pract. 53: 706–712. jfp_0904_5309i [pii]. PMID: 15353159
15. Smith T, Davies L (2008) When Should Open Reduction and Internal Fixation Ankle Fractures Begin Weight Bearing? A Systematic Review. Eur J Trauma Emerg Surg. 34: 69–76.
16. Thomas G, Whalley H, Modi C (2009) Early mobilization of operatively fixed ankle fractures: a systematic review. Foot Ankle Int. 30: 666–674. 50026187 [pii]; doi: 10.3113/FAI.2009.0666 PMID: 19589314
17. Moher D, Liberati A, Tetzlaf J, Altman DG (2010) Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Int J Surg (London, England) 8(5):336–341
18. Shivarathre DG, Chandran P, Platt SR (2011) Operative fxation of unstable ankle fractures in patients aged over 80 years. Foot Ankle Int 32(6):599–602
19. Lorente A, Palacios P, Lorente R, Mariscal G, Barrios C, Gandia A (2020) Orthopedic treatment and early weight-bearing for bimalleolar ankle fractures in elderly patients: quality of life and complications. Injury 51(2):548–553
20. Meijer RPJ, Halm JA, Schepers T (2017) Unstable fragility fractures of the ankle in the elderly; Transarticular Steinmann pin or external fxation. Foot 32:35–38
21. O'Daly BJ, Harty JA, O'Malley N, O'Rourke SK, Quinlan WR (2010) Percutaneous Gallagher nail stabilisation for fragility ankle fracture. Eur J Orthop Surg Traumatol 20(8):651–655
22. Schray D, Ehrnthaller C, Pfeufer D, Mehafey S, Bocker W, Neuerburg C et al (2018) Outcome after surgical treatment of fragility ankle fractures in a certifed orthogeriatric trauma center. Injury 49(8):1451–1457
23. Nilsson G, Jonsson K, Ekdahl C, Eneroth M. Outcome and quality oflife after surgical treated ankle fractures in patients 65 year or older. BMC Musculoskelet Disord. 2007;8:127.
24. Smith T, Davies L (2008) When Should Open Reduction and Internal Fixation Ankle Fractures Begin Weight Bearing? A Systematic Review. Eur J Trauma Emerg Surg. 34: 69–76.
25. Gul A, Batra S, Mehmood S, Gillham N. Immediate unprotected weight-bearing of operatively treated ankle fractures. Acta Orthop Belg. 2007 Jun;73(3):360-5. PMID: 17715727.
26. Armstrong L, Jackson J, Riddick A (2018) Tibiotalocalcaneal nail fxation and soft tissue coverage of Gustilo-Anderson grade 3B open unstable ankle fractures in a frail population; a case series in a major trauma centre. Foot Ankle Surg 24(4):347–352
27. Ahl T, Dalen N, Holmberg S, Selvik G (1986) Early weight bearing of malleolar fractures. Acta Orthop Scand. 57: 526–529. PMID: 3577722
28. Ahl T, Dalen N, Holmberg S, Selvik G (1987) Early weight bearing of displaced ankle fractures. Acta Orthop Scand. 58: 535–538. PMID: 3425284

29. Ahl T, Dalen N, Selvik G (1988) Mobilization after operation of ankle fractures. Good results of early motion and weight bearing. Acta Orthop Scand. 59: 302–306. PMID: 3132812
30. Finsen V, Saetermo R, Kibsgaard L, Farran K, Engebretsen L, et al. (1989) Early postoperative weightbearing and muscle activity in patients who have a fracture of the ankle. J Bone Joint Surg Am. 71: 23– 27. PMID: 2492286
31. Honigmann P, Goldhahn S, Rosenkranz J, Audige L, Geissmann D, et al. (2007) Aftertreatment of malleolar fractures following ORIF—functional compared to protected functional in a vacuum-stabilized orthesis: a randomized controlled trial. Arch Orthop Trauma Surg.; 127: 195–203. doi: 10.1007/s00402- 006-0255-x PMID: 17195934
32. Laarhoven van CJ, Meeuwis JD, van der Werken C (1996) Postoperative treatment of internally fixed ankle fractures: a prospective randomised study. J Bone Joint Surg Br. 78: 395–399. PMID: 8636173
33. Wetzler M, Whitelaw G, Lee P (1991) The post-operative management of ankle fractures with pneumatic braces versus short leg cast. Orthop Trans, Abstract only. 15: 719.
34. Dogra AS, Rangan A. Early mobilisation versus immobilisation of surgically treated ankle fractures. Prospective randomised control trial. Injury 1999; 30(6): 417-9.
35. Egol KA, Dolan R, Koval KJ. Functional outcome of surgery for fractures of the ankle. A prospective randomised comparison of management in a cast or a functional brace. J Bone Joint Surg Br 2000; 82(2): 246-9.
36. Smeeing DPJ et al. Weight-Bearing and Mobilization in the Postoperative Care of Ankle Fractures: A Systematic Review and Meta-Analysis of Randomized Controlled Trials and Cohort Studies. PLos One. 10(2): e0118320, 2015.
37. Black JDJ et al. Early weight-bearing in operatively fixed ankle fractures: A systematic review. The Foot. 23: 78-85, 2013.
38. Assal M et al. Augmented Osteosynthesis of OTA 44-B Fractures in Older Patients: A Technique Allowing Early Weightbearing. J Orth op Trauma. 25(12): 742-747, 2011.
39. Wukich D K, Kline A J. The management of ankle fractures in patients with diabetes. J Bone Joint Surg Am 2008; 90: 1570-8.
40. SooHoo N F, Krenek L, Eagan M J, Gurbani B, Ko C Y, Zingmond D S. Complication rates following open reduction and internal fixation of ankle fractures. J Bone Joint Surg Am 2009; 91: 1042-9.
41. Schepers T, De Vries M R, Van Lieshout E M, Van der Elst M. The timing of ankle fracture surgery and the effect on infectious complications; a case series and systematic review of the literature. Int Orthop 2013; 37: 489-94.
42. Strauss EJ, Egol KA. The management of ankle fractures in the elderly. Injury 2007;38(Suppl 3):S2–9
43. Porter DA, Jaggers RR, Barnes AF, Rund AM. Optimal management of ankle syndesmosis injuries. Open Access J Sports Med 2014;5: 173–82.
44. de-Las-Heras Romero J, Alvarez AML, Sanchez FM, Garcia AP, Porcel PAG, Sarabia RV, et al. Management of syndesmotic injuries of the ankle. EFORT Open Rev 2017;2:403–9.

45. Salai M, Dudkiewicz I, Novikov I, Amit Y, Chechick A. The epidemic of ankle fractures in the elderly–is surgical treatment warranted? Arch Orthop Trauma Surg 2000;120:511–3.
46. Dehghan N, McKee MD, Jenkinson RJ, Schemitsch EH, Stas V, Nauth A, et al. Early weightbearing and range of motion versus non-weightbearing and immobilization after open reduction and internal fixation of unstable ankle fractures: a randomized controlled trial. J Orthop Trauma 2016;30:345–52.
47. Smeeing DPJ, Houwert RM, Briet JP, Groenwold RHH, Lansink KWW, Leenen LPH, et al. Weight-bearing or non-weight-bearing after surgical treatment of ankle fractures: a multicenter randomized controlled trial. Eur J Trauma Emerg Surg 2020;46:121–30.
48. Al-Hourani K, Stoddart M, Chesser TJS. Syndesmotic fixation in unstable ankle fractures: does early post-operative weight bearing affect radiographic outcomes? Injury 2019;50:790–5.
49. Hyer CF, Atway S, et al. Early Weight Bearing of Calcaneal Fractures Fixated With Locked Plates. Foot Ankle Spec. 3(6): 320-323, 2010.
50. Kayali C, Altay T, et al. The effect of early weight-bearing on comminuted calcaneal fractures treated with locking plates. Eklem Hastalik Cerrahisi. 25(2): 85-90, 2014.
51. Park J-Y, Kim H-N, et al. Effect of Weight-Bearing in Conservative and Operative Management of Fractures of the Base of the Fifth Metatarsal Bone. Biomed Res Int. 2017: 1397252
52. Lin, C.W., Donkers, N.A., Refshauge, K.M., Beckenkamp, P.R., Khera, K. and Moseley, A.M. (2012) Rehabilitation for Ankle Fractures in Adults. Cochrane Database of Systematic Reviews, 11, Article ID: CD005595.

Table 1 : Characteristics of included studies

Reference	Type of study	Total patients	Type of Fracture	Treatments	Follow up time
Shivarathre et al. [18]	Single-center retrospective case series	92	Danis-Weber: Type B (77) Type C (14) Isolated lateral malleolus (4) Isolated medial malleolus (1) Bimalleolar (70) Trimalleolar (16)	Lateral malleolus 1/3 Tubular plates (83) DCP (4) Locking plates (4) Medial malleolus Two screws (45) One screw (5) Tension band wiring (25) Posterior malleolus Anterior–posterior screw fxation (4)	Average of 15 months
Lorente et al. [19]	A multicenter prospective cohort study	70	Bimalleolar non-displaced fractures	Closed cast: Immobilized patients (control group)(37) Weight-bearing activities (experimental group)(33)	2 years
Meijer et al. [20]	Single-center retrospective cohort study	15	Transarticular Stein- mann pin/External fxation Weber type B (8/3) Weber type C (1/3) Bimalleolar/Tri- (4/5)	Steinmann pin (9), External fxation (6)	No specific information about the follow-up time
O'Daly et al. [21]	Single-center retrospective case series	9	Bimalleolar fractures (5) Trimalleolar fracture (3) Fracture dislocation of the ankle (1)	Gallagher nail fxation	Mean of 34 months
Schray et al. [22]	Single-center retrospective observational cohort study	58	Most frequent fracture type (AO type) 44 B (72%)	External fxation converted to ORIF External fxation as fnal treatment Open reduction and internal fxation	Mean of 16 +/- 8.5 months

J.M. Muthuuri et al.[7]	A prospective, randomized and non-blinded, outcome study	70	Supination-External Rotation (SER) injuries (63%), Pronation-Abduction (PA) injuries (18%), Supination-Adduction (SA) fractures (11%), Pronation-External Rotation (PER) (8%)	Lateral malleolus was fixed with a well contoured 6-8 hole 35mm DCP and the medial malleolus with two lag screws (35-45 mm malleolar screws). Weight-bearing activities,	Mean of 6 month
Nilsson et al[23]	case-series a descriptive study	65	Low-energy trauma 44 (88%) were bi- or trimalleolar, post-operative reduction 23 (46%).	Internal fixation, percutaneous fixation, surgical treatment of the fracture	6-12 months
Smith T et al[24]	A systemic review	366	Bimalleolar fractures, Trimalleolar Fractures, Fracture dislocation of the ankle	open reduction and internal fixation	Average of 6-8 months
Gul Arif et al[25]	Single-center observational study	25	Rigidly internally fixed fractured ankles, Weber A/B/C fractures	Surgical treatments of Weber A/B/C fractures	Mean : 91.3 +/- 20.2 vs. 54.6 +/- 15.5 days)
Armstrong et al.[26]	Single center retrospective case series	20	Gustilo–Anderson grade 3B open ankle fracture	Tibiotalocalcaneal nail fxation, T2 ankle arthrodesis nail (10/1) Versanail (9/5), Titanium cannulated hindfoot arthrodesis nail (2/1)	The duration of follow up is short-term.