Original Article

Radiological and Functional Outcome of Open Reduction in Danis-Weber Type-C Closed Ankle Fracture in Elderly Patients

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ABSTRACT

The Danis-Weber classification system categorizes ankle fractures based on the location and appearance of the fibular fracture, with type-C fractures commonly treated with open reduction, particularly in younger individuals. However, there is limited research on outcomes for patients over 60 with these fractures. This study aimed to evaluate the radiological and functional outcomes of open reduction and internal fixation (ORIF) in patients over 60 with Danis-Weber type-C closed ankle fractures, which was conducted at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR) in Dhaka, Bangladesh, between May 2017 and August 2019. The study included 32 patients who underwent ORIF using a small dynamic compression plate (DCP) for fibular fractures and a 4mm cancellous screw for medial malleolus fractures. The average follow-up period was 24 weeks, and outcomes were assessed using the American Orthopaedic Foot and Ankle Society (AOFAS) score. Results showed that 84% of patients achieved satisfactory outcomes, with 15 classified as excellent and 12 as good. Radiological healing occurred in an average of 13.34 weeks, with no reports of talar shift, deep infection, non-union, or implant failure. Superficial infections were observed in 6% of patients, and significant correlations were found between dorsiflexion, plantarflexion, and pain scores at 12- and 24-week follow-ups. Overall, ORIF using a small DCP proved to be a safe and effective treatment for Danis-Weber type-C closed ankle fractures in older patients, with favorable outcomes, minimal complications, and short treatment durations.

Keywords: *Type-C Danis-Weber closed ankle fracture, Radiological healing, Functional outcome, Open reduction, AOFAS pain score.*

Mugda Med Coll J. 2024; 7(2): 66-71
https://doi.org/10.3329/mumcj.v7i2. 78672

INTRODUCTION

Ankle fracture is a very common lower limb fracture and it can be classified or divided purely along anatomical lines (as mono-malleolar), bimalleolar, and/or tri-malleolar. There are several surgical modalities in treating ankle fractures like a malleolar screw, fixation with cancellous screws (leg), tension band wiring technic for the medial malleolus and semi-tubular plate, one-third tubular plate, fixation with the rush pin, fixation with a small DCP for the lateral malleolus[1]. The Lauge-Hansen classification system attempted to associate the specific fractures with the mechanism of injury and proposed a detailed form of classification with each broad classification

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subdivided into 4 groups[2]. On the other hand, the Danis-Weber classification system is one of the most commonly applied classification methods[3]. It classifies ankle fractures into 3 categories: type A B and C[4]. Ankle fracture is a very common injury presenting to ORIF and is one of the first procedures targeted in early orthopedic training[5]. In this subcontinent, road traffic accidents (RTA) are the most common mechanism of injury for such cases[6]. In all ankle fractures, a definitive diagnosis procedure must be made based on the mode/ mechanism of injury, clinical evaluation of patient history, degrees of immediate disability, and obtaining the proper radiograph to demonstrate the exact lesion[7]. Most ankle fractures are usually associated with ligament injuries and the magnitude as well as the direction of the force of deforming applied to the ankle joints directly correlate to the fracture pattern[6]. Usually, external rotation types of injuries result in an anterior tibiofibular diastasis that proceeds the disruption from the anterior to the posterior[1]. On the other hand, in total tibiofibular diastasis, the disruption proceeds from the distal to the proximal and can result from either abduction/external rotation injuries[8]. Some recent studies have found a significant increase in the incidence as well as the severity of ankle fractures in the elderly population[9]. The treatment of these fractures for elderly patients is still a very challenging task because of a fairly high risk of wound complications, sepsis as well as hardware failures [10.] The objective of our study was to evaluate the radiological and functional outcomes of open reduction in Danis-Weber type-C-only closed ankle fracture in elderly patients (aged over 60).

METHODS

This prospective, cross-sectional study was conducted at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh, between May 2017 and August 2019. A total of 32 cases over the age of 60 years with Danis-Weber type-C ankle fractures were enrolled for open reduction & internal fixation (ORIF) with small DCP for fractured fibula and ORIF by 4mm (Four mm) cancellous screw for the fractured medial malleolus were enrolled as the study subjects. A purposive sampling technique was applied in sample selection. Cases were selected from the emergency department and different wards of NITOR having closed Danis Weber type C ankle fractures. After counseling for the surgery, pre-operative information was collected. Informed written consent was taken for performing the operation and using anesthesia after the proper pre-operative check-up. As per the inclusion criteria of this study, patients of either sex, over the age of 60 years with only closed 'Danis-Weber type-C ankle fracture injury of <3 weeks on either side were included. On the other hand, as per the exclusion criteria, cases with previous fractures in the same limb or with an open fracture, cases with associated fractures around the ankle joint except for medial malleolus, medically unfit cases, and those patients who were not willing to take surgery were rejected. In this study, the baseline variables were the side of injury, cause of injury, and mechanism of injury. The outcome variables were total hospital stay, complications like superficial infection, deep infection, nonunion, implant failure as well as skin necrosis and radiological outcomes, as described by Adams & Hamblen (1990)[11]. In this study, the average follow-up tenure was 24 weeks. The outcome was evaluated by the AOFAS score. Data analysis was performed by using SPSS version 22.0 programs. The significance of the results as calculated by 95% confidence interval and the P-value d"0.05 was considered to be statistically significant.

The study was approved by the Ethical Review Committee of the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh.

RESULTS

In this investigation, among the total participants, 23 (72%) were male, while the remaining 9 (28%) were female. The average age of the participants was 65.71 years with a standard deviation of 7.42 years. Out of 32 patients, 20 (63%) presented with right-sided ankle fractures, whereas 12 (37%) had left-sided fractures. The majority of injuries, constituting 22 (68.8%), resulted from road traffic accidents, followed by 8 (25%) cases due to twisting falls, and one case each (3.1%) from falling from height and physical assault. Regarding the mechanism of injury, 27 (84%) cases exhibited pronation-external rotation injury, while the remaining 16% showed pronation abduction. Hospital stays varied, with 12 (38%) cases staying for 3 weeks, 19 (59%) for 2 weeks, and 1 (3%) for 1 week, resulting in an average duration of hospital stay of 14±2.68 days (Table-I). Radiological evidence indicated healing in 18 (56%) cases at 12 weeks, 12 (38%) cases at 14 weeks, and 2 (6%) cases at 16 weeks, with an average duration of 13.34±1.56 weeks for radiological healing to appear (Table-II). The majority (53%) of participants reported no difficulty walking on any surfaces, although 47% experienced some difficulty on uneven surfaces. However, most participants (97%) reported no limitations in daily activities but faced restrictions in recreational activities (Table-III).

Table-I : *Distribution of participants as per the mode of injury (N=32)*

Characteristics	n	(%)
Side of injury		
Left	12	38%
Right	20	63%
Cause of injury		
RTA	22	69%
Twisting force	8	25%
Fall from height	1	3%
Assault	1	3%
Mechanism of injury		
Pronation-external rotation	27	84%
Pronation-abduction	5	16%
Hospital staying tenure (in days)		
0-7	1	3%
7-14	19	59%
14-21	12	38%

Table-II: *Radiological evidence of healing among participants (N=32)*

Healing time	n	%
12 weeks	18	56
14 weeks	12	38
16 weeks	2	6
Mean (±SD)	13.34 (±1.56)	
Range	12-16	

Table-III: *The ability to walk on different surfaces of the study subjects (N=32)*

Walking surfaces	AOFAS score	n	%
No difficulty on any surfaces	85	17	53
Some difficulty on uneven surfaces	45	15	47
Severe difficulty on uneven surfaces	0	0	0

Regarding dorsiflexion, 12-week follow-up showed varying degrees, with 6% exhibiting 0-06°, 59% with 0-08°, 22% with 0-10°, and 13% with 0-12° dorsiflexion. At 24 weeks, 13% exhibited 0-08°, 31% with 0-10°, and 56% with 0-12° dorsiflexion. Mean dorsiflexion increased from 8.81°±1.59 at 12 weeks to 10.87°±1.43 at 24 weeks, with a statistically significant correlation (P=0.0005). Similarly, plantarflexion showed improvement over time, with mean plantarflexion increasing from 43.18°±4.70 at 12 weeks to 51.25°±1.11 at 24 weeks, also with a statistically significant correlation (P=0.0005) (Table-IV).

Pain scores decreased from 29.21±6.18 at 12 weeks to 34.37±5.64 at 24 weeks, with a significant correlation (P=0.0005) (Table-V). Regarding foot alignment, the majority of participants exhibited good alignment at both 12 and 24 weeks, with insignificant changes over time (P=0.083) (Table-V). Complication rates were low, with only 6% of patients developing superficial infections. No cases of talar shift, non-union, deep infection, or implant failure were reported.

Table-IV: *Dorsiflexion movement and plantar flexion of the study subjects (N=32)*

Characteristics	12 weeks		24 weeks		P value
	n	%	n	%	
Dorsiflexion movement					
0-6°	2	6	0	0	
0-8^{O}	19	59	4	13	
0-10^{O}	7	22	10	31	
0-12^{O}	4	13	18	56	
Total	32	100	32	100	
Mean±SD	8.81±1.59		10.87±1.43		0.0005
Range	0-20°		0-20°		
Plantarflexion flexion					
0-40°	10	31	6	19	
0-46^{O}	17	53	3	9	
0-52^{O}	5	16	23	72	
Total	32	100	32	100	
Mean ± SD	43.18 ±4.70		51.25 ±1.11		0.0005
Range	0-55°		0-55°		

Data were analyzed by using the student's t-test

Table-V: *Outcome analysis among the study subjects (N=32)*

Characteristics	12 weeks			24 weeks			P value
Pain perception							
Pain	n	AOFAS score	%	n	AOFAS score	%	
No pain	5	200	16	15	600	47	
Mild	20	600	62	15	380	50	
Moderate	7	140	22	1	20	3	
Severe	0	0	0	0	0	0	
Mean ± SD		29.37±6.18			34.37±5.64		0.0005
Range		0-40			0-40		
Foot alignments							
Alignments	n	AOFAS score	%	n	AOFAS score	%	
Good	27	270	84	30	300	94	
Fair	5	25	16	2	10	6	
Poor	0	0	0	0	0	0	
Total	32	295	100	32	310	100	
Mean ± SD		9.21±1.84			9.68±1.22		0.083
Range		0-10			0-10		
Outcome comparison according to the AOFAS score							
Alignment	n	AOFAS score	%	n	AOFAS score	%	
Excellent (90-100)	5	470	16	15	1424	47	
Good (80-89)	18	1520	56	12	1003	37	
Fair (60-79)	9	634	28	5	357	16	
Poor (<60)	0	0	0	0	0	0	
Mean ± SD		82 ± 8.50			87 ±90		0.0005
Range		0-100			0-100		

Data were analyzed by student's t-test (paired, one-tailed).

According to the American Orthopedic Foot and Ankle Score (AOFAS), 84% of cases had satisfactory outcomes (15% excellent, 56% good), while 16% had unsatisfactory outcomes (5% fair, 0% poor). The average AOFAS score improved from 82 ± 8.50 at 12 weeks to 87 ± 90 at 24 weeks, with a statistically significant correlation (P=0.0005) (Table-V).

DISCUSSION

This study assessed the radiological and functional outcomes of open reduction in Danis-Weber type C closed ankle fracture in elderly patients, who are over 60 years. The study included 23 male patients (72%) and 9 female patients (28%). In terms of hospital stay, 37.5% of patients stayed for 3 weeks, 59.4% for 2 weeks, and 3.1% for 1 week, with a mean hospital stay of 14±2.68 days. This is consistent with other studies, including those by Lamontagne et al. (3.2 days)[12] and Alamgir et al. (4 days)[7]. The infection rate in this study was 6.25%, and radiological evaluations revealed no talar shift in any patient. Additionally, no patients developed non-union, deep infection, or implant failure, and all fractures ultimately healed. These results align with the findings of Tunturi et al. who reported a superficial wound infection rate of 4.86%[14]. In terms of radiological healing, 56.3% of patients showed evidence of healing at 12 weeks, 37.5% at 14 weeks, and 6.3% at 16 weeks. The mean duration of radiological healing was 13.34±1.56 weeks, which corresponds to the findings of Tejwani et al., who reported a delayed union rate of 30% and a mean

healing time of 12.73 weeks[15]. However, Siegel & Tornetta found fibular fractures in their study healed without displacement in approximately 10 weeks[16].

Functionally, 53% of our patients had no difficulty walking on any surface, while 47% experienced some difficulty walking on uneven surfaces. In comparison, another study[14] reported that 27% of patients experienced difficulty walking on uneven surfaces, primarily due to poor alignment of the fracture fragments. In terms of pain, 15.60% of patients reported no pain at 12 weeks, 62.50% had mild pain, and 21.90% had moderate pain. By the 24-week follow-up, 47% had no pain, 50% had mild pain, and 3% had moderate pain. The mean pain scores were 29.21±6.18 at 12 weeks and 34.37±5.64 at 24 weeks, which was statistically significant (P=0.0005). These pain perceptions align with the findings of another study[17].

According to the AOFAS score, outcomes were classified as excellent (>90), good (80-89), fair (60-79), and poor (<60). At 12 weeks, 16% of patients had excellent outcomes, 56% had good outcomes, and 28% had fair outcomes. At 24 weeks, 47% had excellent outcomes, 37% had good outcomes, and 16% had fair outcomes. The average AOFAS score was 82±8.50 at 12 weeks and 87±9 at 24 weeks, which was statistically significant (P=0.0005). These results were better than those reported by Siegel &Tornetta, who found an average AOFAS score of 82 at the last follow-up[16]. Hamid et al. also reported a score of 85.2% for the whole population[18]. Overall, 84.37% of cases in this study were considered satisfactory, while 15.63% were deemed unsatisfactory.

However, this was a single-centered study that was conducted with a small sample. Moreover, this prospective study was conducted over a very short period. Therefore, the findings of this current study may not reflect the exact scenario of the whole country. Nonetheless, the findings of this study may provide valuable insights for future research in this area.

CONCLUSION

Based on our findings, we conclude that open reduction and internal fixation (ORIF) using small dynamic compression plates (DCP) for Danis-Weber type C closed ankle fractures in patients over 60 yields promising outcomes. This treatment approach is associated with a shorter recovery period, minimal complications, low non-union rates, excellent radiological results, and satisfactory AOFAS scores. Further research involving larger sample sizes across different locations is recommended to provide more comprehensive insights.

REFERENCES

1. Manjur M, Islam SS, Gani MAM, Haq Z, Debnath SC, Rob A, et al. Prospective study of radiological healing and functional outcome after open reduction and internal fixation of Danis-Weber type-C closed ankle fracture. Med Res Chronicles. 2023;10(1):122-31.
2. Bucholz RW, Heckman JD, Court-Brown CM, Tornetta P. Fractures of the ankle. In: Bucholz RW, Heckman JD, editors. Rockwood and Green's fractures in adults. 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2010. p.1990.
3. Marsh JL, Saltzman CL. Ankle fractures. In: Bucholz RW, Heckman JD, editors. Rockwood and Green's fractures in adults. 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2001. p.2147-8.
4. Khan MA, Shafique M, Sahibzada AS. Operative management of closed ankle fractures with AO technique. J Postgrad Med Inst. 2005;19:162-5.
5. Walsh AS, Sinclair V, Watmough P, Henderson AA. Ankle fractures: getting it right first time. Foot. 2018;34:48-52.
6. Singh R, Kamal T, Roulohamin N, Maoharan G, Ahmed B, Theobald P. Ankle fractures: a literature review of current treatment methods. Open J Orthop. 2014;4(11):292-303.
7. Alamgir MHM, Islam M, Islam MN, Kader A. Open reduction and internal fixation of displaced fractures of lateral malleolus by tension and wiring and plating in bimalleolar fractures in adults. J Shaheed Suhrawardy Med Coll. 2013;5(2):81-3.
8. Ebraheim NA, Mekhail AO, Gargasz SS. Ankle fractures involving the fibula proximal to the distal tibiofibular syndesmosis. Foot Ankle Int. 1997;18(8): 513-21.
9. Anderson SA, Li X, Franklin P, Wixted JJ. Ankle fractures in the elderly: initial and long-term outcomes. Foot Ankle Int. 2008;29(12):1184-8.
10. Asloum Y, Bedin B, Roger T, Charissoux JL, Arnaud JP, Mabit C. Internal fixation of the fibula in ankle fractures. A prospective, randomized and comparative study: plating versus nailing. Orthop Traumatol Surg Res. 2014;100(4)

11. Adams JC, Hamblen DL. Outline of orthopedics. Edinburgh: Churchill Livingstone; 1990. p.285-93.

12. Kukk A, Nurmi JT. A retrospective follow-up of ankle fracture patients treated with a biodegradable plate and screws. Foot Ankle Surg. 2009;15(4): 192-7.

13. Lamontagne J, Blachut PA, Broekhuyse HM, O'Brien PJ, Meek RN. Surgical treatment of a displaced lateral malleolus fracture: the antiglide technique versus lateral plate fixation. J Orthop Trauma. 2002;16(7):498-502.

14. Tunturi T, Kemppainen K, Pätiälä H, Suokas M, Tamminen O, Rokkanen P. Importance of anatomical reduction for subjective recovery after ankle fracture. Acta Orthop Scand. 1983;54(4):641-7.

15. Tejwani NC, Park JH, Egol KA. Supination external rotation ankle fractures: a simpler pattern with better outcomes. Indian J Orthop. 2015;49(2):219.

16. Siegel J, Tornetta P III. Extraperiosteal plating of pronation-abduction ankle fractures. J Bone Joint Surg Am. 2007;89(2):276-81.

17. Weening B, Bhandari M. Predictors of functional outcome following trans-syndesmotic screw fixation of ankle fractures. J Orthop Trauma. 2005;19(2):102-8.

18. Hamid N, Loeffler BJ, Braddy W, Kellam JF, Cohen BE, Bosse MJ. Outcome after fixation of ankle fractures with an injury to the syndesmosis: the effect of the syndesmosis screw. J Bone Joint Surg Br. 2009;91(8):1069-73.