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A study on functional outcome of surgically stabilised ankle fracture between diabetics and non diabetics in a tertiary care center

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Abstract
Background: Retrospective observational study of Ankle fracture fixation at Department of orthopedics at Railway hospital, Chennai, Tamil Nadu during the period 2006-2012.
Methods: Subjects are matched for age, sex, social factors and grouped into cases and controls based on diabetes. Out of total 74 traceable case details, 49 patients were studied in two groups as 27 non Diabetics and 22 diabetics. 1 patient in both the study groups was deceased and rest were lost to follow up or did not meet the inclusion criteria. Subjects were assessed clinically with Olerud Moleander score and complications were studied.
Results: In the study population, the diabetics had lower objective functional score - Olerud Moleander score (p=0.046), but similar subjective functional score (P=0.17), elder mean age (P=0.004), similar sex distribution (P=0.38), similar distribution of fracture pattern (P=0.95), similar time delay to surgery (P=0.12), similar follow up duration (P=0.38), similar incidence of complications (P= 0.15) compared to non-Diabetics. Association of time delay to surgery and complications could not be established.
Conclusion: In Patients with uncomplicated diabetes, following ankle fracture fixation, incidence of complications like arthritis & loss of fixation are marginally higher but not significant. (P=0.15). Regular follow up and screening for diabetes, reduce the incidence of complications among diabetics following ankle fracture fixation. Although the objective functional Olerud Moleander score was marginally less among diabetics (P=0.046), the subjective score was similar (P=0.17) in both groups.

Keywords: Ankle fractures, diabetic, webers, infection, complication

Introduction
Ankle fractures are one of the most common injuries in the lower extremity occurring at a rate of 107 fractures per 100,000 persons per year and has the propensity to double by the year 2020 [1]. Young athletic males and middle age women are most commonly affected [2]. Eversion fractures are the most common whereas pronation - dorsiflexion fractures are the rarest but more severe. Diabetes has become the most common epidemic with one third of world population being affected. India, second most populous country in the world, has large population of diabetics. Treatment of their ankle fractures and its complications is an emerging area of research to unravel better therapeutic strategies.
Ankle fractures are among the most common injuries treated by orthopedic surgeons. In the clinical setting, determination of ankle stability is critical when planning fracture management. Stable fractures can be treated nonoperatively with good results whereas unstable fractures require accurate anatomic reduction and stable fixation following the principles of periarticular fracture fixation by AO. Minimal soft tissue coverage over ankle makes surgical approach liable to infection and poor soft tissue healing. Diabetes is known to cause microangiopathy neuropathy, nephropathy, retinopathy, local osteoporosis and delay soft tissue healing [3]. This case control study was done to bring out the quantitative significance of functional outcome and complications in fixation of unstable ankle fractures among diabetics.

Materials and Methods

Study area

Study area includes patients who were employees, or their dependents, of Southern Railways from various regions of South India including Tamil Nadu, Kerala, Parts of Karnataka and Andhra Pradesh. Patients with closed displaced ankle fractures treated surgically by Department of Orthopedics, Railway hospital, Chennai, Tamil Nadu.

Sample size calculation

Sample size was calculated on the basis of possibility to detect statistically significant difference of 20 in Olerud Moleander score (Standard deviation = 24). With total consensus of 60 and 30 in two groups as cases and controls based on presence or absence of diabetes. (Sampling error Alpha = 0.05 and Beta = 0.1)

Study design

Retrospective observational study of displaced ankle fractures treated by surgery at department of orthopedic at Railway hospital, Chennai during the period 2006 - 2012. Subjects are matched for age, sex, social factors and grouped into cases and controls based on diabetes. Fractures were classified by AO system and treated according to AO principles of periarticular fracture fixation. Thorough preoperative assessment and preoperative planning was done. Surgery was done under image intensifier as when required. Strict post operative protocol was followed as mentioned below. Patients were reviewed by standard clinical, radiological assessment and advised on weight bearing under the supervision of senior orthopedic consultants. Careful monitoring of complications and their treatment was done. All surgically stabilized ankle fracture patient details were retrieved from department data and patients were called up for study. All documented details were analyzed, strict glycemic index and treatment in diabetics were confirmed.

Informed consent regarding the enrolment for the study was obtained.

Ethical committee clearance for the study obtained from Railway hospital management.

Patients were assessed with Olerud Moleander score [4], self assessed functional score and the previous history of incidence of complications in each group was noted.

Inclusion criteria

- Closed displaced ankle fractures
- Diabetic ankle fracture patients under regular follow-up with physicians
- Diabetic ankle fracture patients with HBA1C < 7 and urinary microalbuminuria within normal limits

Exclusion criteria

- Open fractures
- Fracture dislocations
- Associated tibial pilon fractures
- Ipsilateral tarsal, metatarsal fractures
- Pathological fractures
- Patients with IGT, Diabetes with established end organ damage such as neuropathy, nephropathy, retinopathy.

Data collection techniques and tools

Patient details were retrieved by their corresponding hospital records of IP number which is unique for each patient. Patients were called for study using personalized letters, post cards and phone calls. All the Diabetic patients were scrutinized whether they were under regular follow-up and screening tests by physicians. Diabetic patients in whom latest glycosylated Hb < 7.0, urinary microalbuminuria <150 microgram per dl were included in the study. Patients were thoroughly screened, and any history of documented complication was noted among each group after confirmation with senior orthopaedic surgeons.

Data analysis

Analysis of acquired data was done among two groups. Comparison was done on the basis of age distribution, sex distribution, mean time to surgery, mean follow up, fracture pattern distribution, functional outcome of ankle function using Olerud Moleander score, subjective functional score and incidence of complications in each group. Statistical analysis was done using statistical tests of significance such as Chi-Square test, paired T-test, Fischer Exact test and Mann Whitney test as when appropriate.

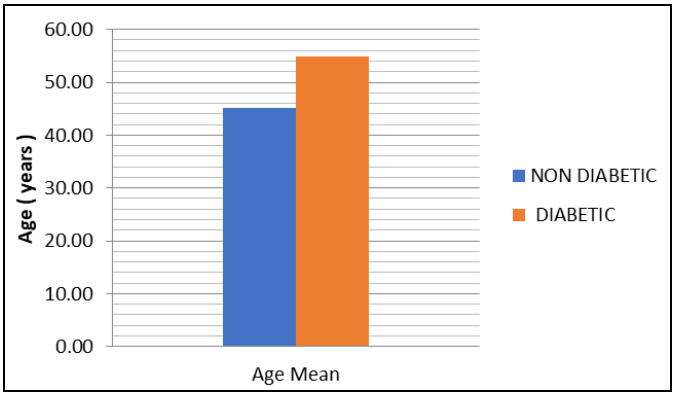
Table: Observation

Factors	Non-Diabetic	Diabetic	ALL	P value	Test of significance	Significance
N	26(1)	21(1)	47(2)	p-value	Test	$p < 0.05$ is considered statistically significant
Age Mean	45.23	54.86	50			
SD	12.85	7.82		0.004	Independent t-test	Significant difference in age between these groups
M : F	15:11	15:06	3 0 : 1 7			
Males (%)	57.69%	71.43%				
				0.38	Fisher Exact test	No significant difference in gender
Fracture Distribution						
WEBER A	6	4	10			
B	13	11	24			
C	7	6	14			
Frequency A	12.77%	8.51%				
B	27.66%	23.40%		0.95	Chi-square test	No significant difference in Weber
C	14.89%	12.77%				

Table: Observation

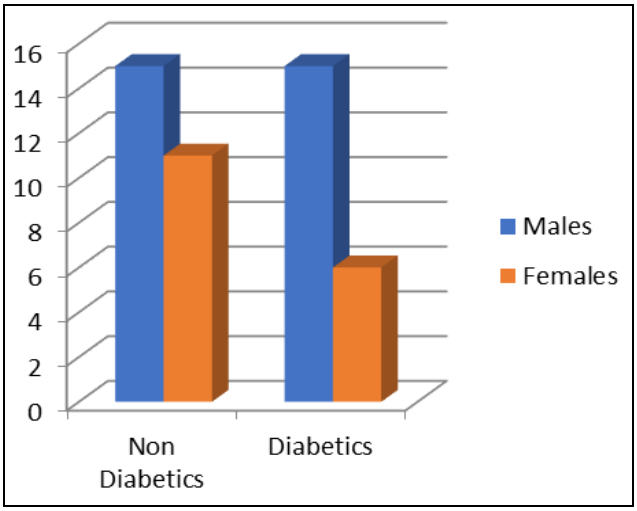
Factors	Non-Diabetic	Diabetic	All	P value	Test of significance	Significance
Average Delay in surgery	4.65	3.81	4.224			
Delay Median	4	2				
Inter-quartile range	2 to 6	1 to 4		0.12	Mann-Whitney test	No significant difference in Delay
Mean Follow up	889.08	750.10	824.4			
SD	552.37	492.34		0.38	Independent t-test	No significant difference in Follow-up

OM Score Median	90	85				
IQR	85 to 95	75 to 90		0.046	Mann-Whitney test	Significant difference in OM score
Self Assessed Score Median	90	80				
IQR	80 to 95	75 to 95		0.17	Mann-Whitney test	No significant difference in SA score
Complications	10	13	23			
Complications (%)	38.46%	61.90%		0.15	Fisher Exact Test	No significant difference in complications
Infection	2	2	4			
Loss of fixation	1	3	4			
Tendinitis	3	3	6			
Bursitis	1	0	1			
Non union	0	0	0			
Talar subluxation	1	1	2			
Arthritis	2	4	6			



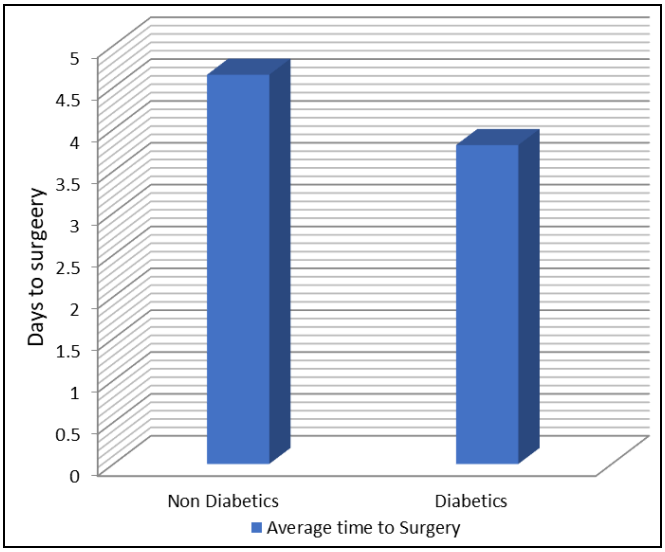
Graph 1: Comparison of Age distribution

	Non Diabetic	Diabetic
N	26	21
Age mean	45.23	54.86
Standard Deviation	12.85	7.82
	P = 0.004	



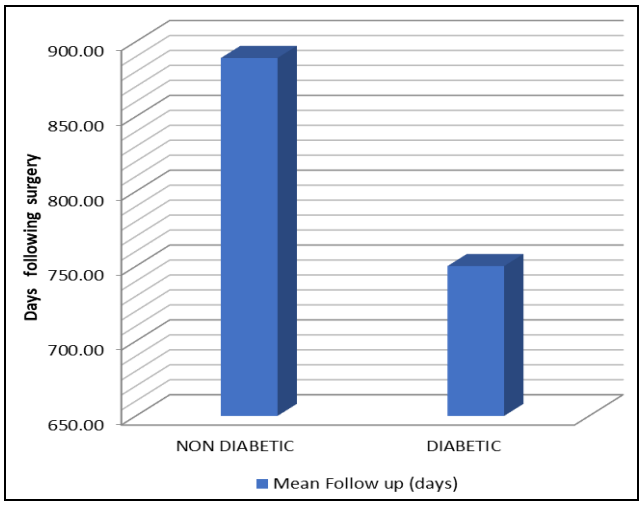
Graph 2: Comparison of Sex ratio

	Non Diabetics	Diabetics
M: F	15:11	15:06
Males (%)	57.69%	71.43%
Significance	P = 0.38	



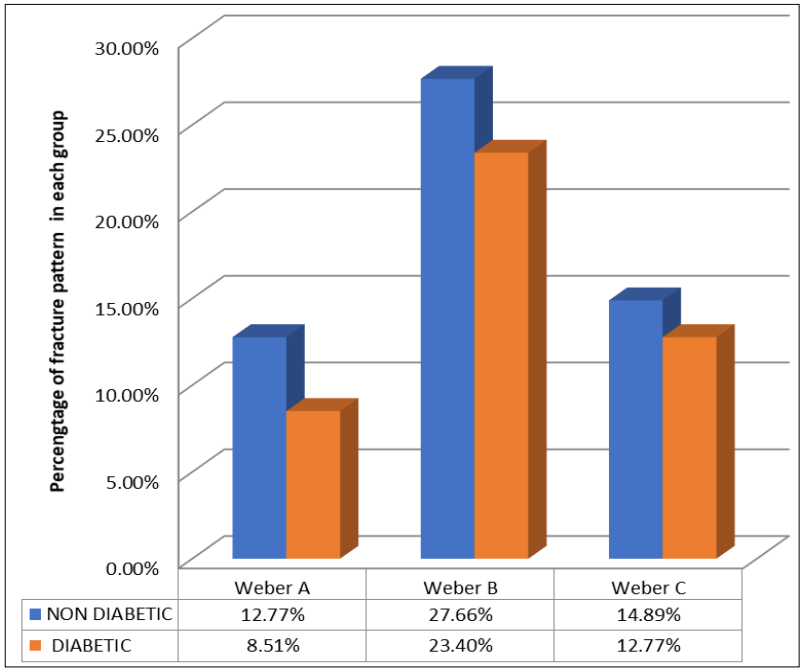
Graph 3: Comparison of Time to surgery

	Non Diabetics	Diabetics
Average time to Surgery	4.65	3.81
Delay Median	4	2
Inter Quartile range	2 to 6	1 to 4
Significance	P = 0.12	

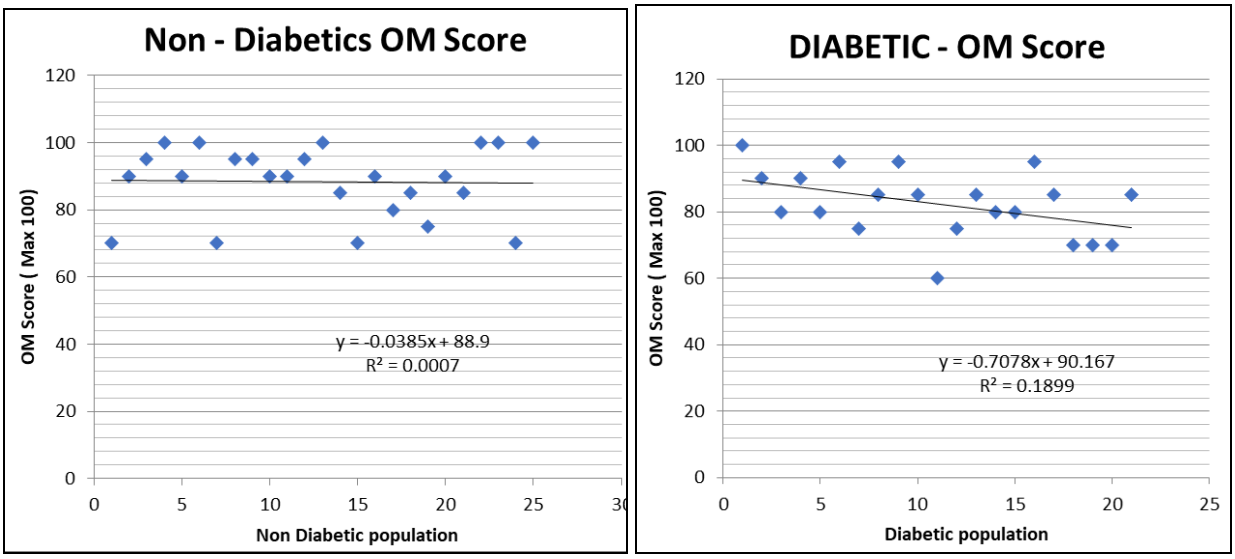


Graph 4: Comparison of Mean follow up

	Non-Diabetic	Diabetic
Mean follow up	889.08	750.09
Standard deviation	552.37	492.34
Significance	P = 0.38	

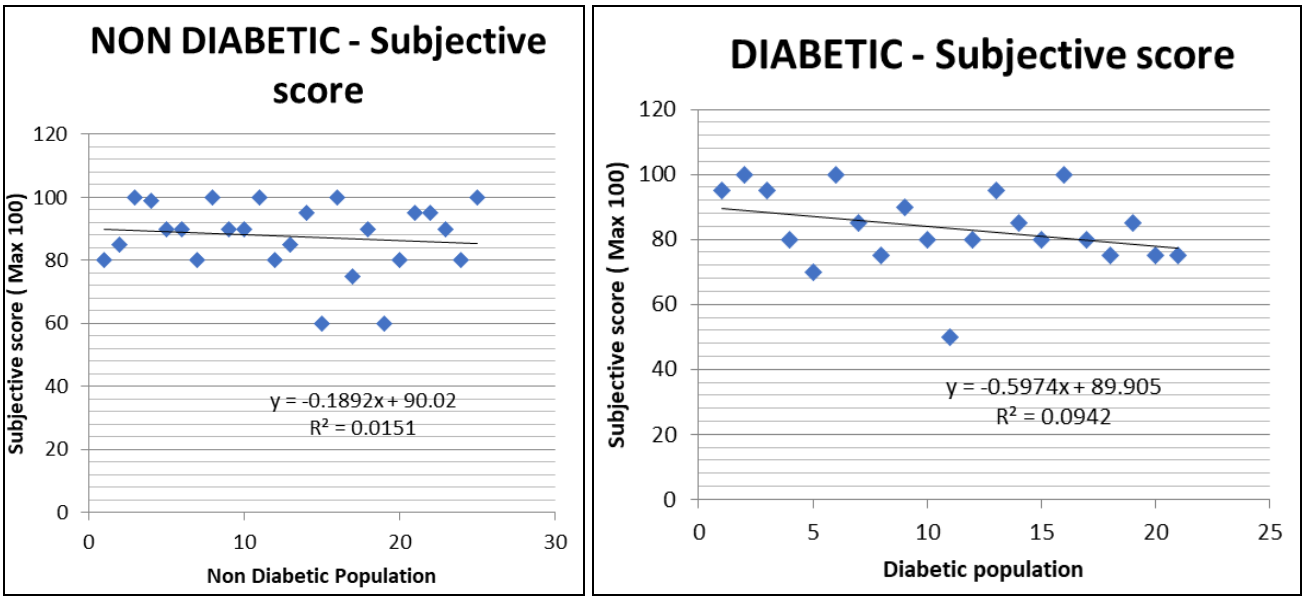


Graph 5: Fracture pattern distribution



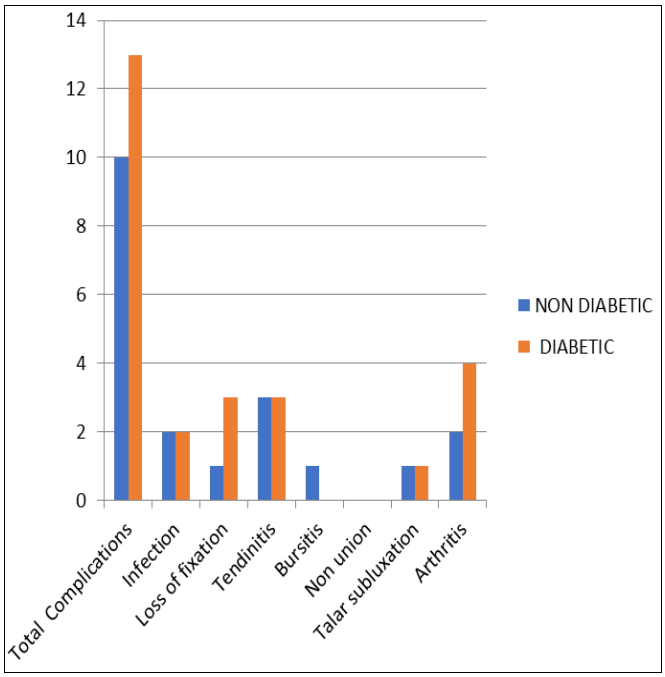
Graph 6: Comparison of functional outcome-OM score

	Non – Diabetics	Diabetics
OM Score Median	90	85
Inter Quartile Range	85 to 95	75 to 90
R x R (Slope)	0.000	0.189
	P = 0.046	



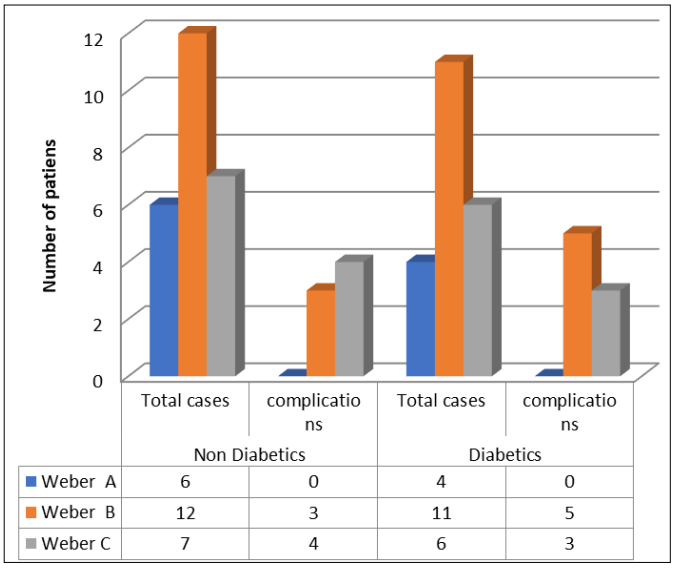
Graph 7: Comparison of Subjective functional score

	Non Diabetics	Diabetics
Self assessed score median	90	80
Inter Quartile Range	80 to 95	75 to 95
R x R	0.015	0.094
Significance	P = 0.17	



Graph 8: Comparison of incidence of complications

	Non Diabetics	Diabetics
Complication N	10 / 26	13 / 21
Infection	2	2
Loss of fixation	1	3
Tendinitis	3	3
Bursitis	1	0
Non union	0	0
Talar subluxation	1	1
Arthritis	2	4
	P = 0.15	



Graph 9: Distribution of Complication

Results

Of the total 47 patients 26 were non-diabetics and 21 were diabetics. The mean age of diabetic patients was 54.86 while the average age of non-diabetic patients was 45.23. Comparison of Age mean among diabetic and non-diabetic study populations show a statistically significant difference with P = 0.004. Of the total 26 non-diabetic patients 15 were male (57.69%) and 11were female (32.31%) and of the total 21 diabetic patients 15 were male (71.43%) and 6 were females (28.57%). Comparing the distribution of sexes between the groups was found to be statistically insignificant with P = 0.38. The average time to surgery in non diabetics was 4.65 while that in diabetic patients was 3.81. Comparing the mean delay to surgery in two groups was found to be statistically insignificant with p = 0.12 eliminating bias in time to surgery to establish glycemic control in diabetic subjects. Average follow up following surgery was around 889 days (28 months) in non-Diabetics and 750 days (24 months) in diabetics which was found to be statistically insignificant eliminating bias on days of follow-up. Distribution of fracture pattern Weber A,B and C among the diabetic and non Diabetic group was found to be statistically even and no significant difference exists between them. (P =

0.95). The median Olerud Moleander score for non-diabetics was 90 [85-95] compared with 85 [75-90] in diabetics. Comparison of functional outcome in each group using Olerud Moleander score revealed statistically significant difference P = 0.046. The median of subjective functional score was 90 [80-95] in non-diabetics as compared with 80 [75-95] in diabetics and it was statistically insignificant (p = 0.17). Difference of incidence of complications between two groups was statistically insignificant (P=0.15). Similar distribution of complications is confirmed. Distribution of complications is found to be similar among diabetic and non diabetic study groups across the fracture pattern similar to incidence. Type A fractures were associated with complications in both the study groups.

Discussion

In this study on functional outcome of surgically stabilized closed ankle fractures in diabetics & non-diabetics age distribution in both the groups was statistically significant. The diabetic group was elderly with a mean age of 54.86 than the control group of non-diabetics with a mean age of 45.23. The mean age of diabetic patients were comparable with study done by Costigan *et al*. [5] which was 49.3. Among the total study population, non-diabetic patients were relatively young including few patients in 3rd and 4th decade (P= 0.0004). The difference was statistically significant which could be attributed to relatively later onset of diabetes. Both the groups have statistically similar distribution of sex. Pathologies predominantly occurring in female sex such as post-menopausal osteoporosis, rheumatoid arthritis did not affect the outcome of study (P=0.38). The mean duration from trauma to surgery was observed to be shorter among diabetics than among non-diabetics. But the difference was found to be statistically insignificant and eliminated bias by time to surgery. Mean time to surgery was found to be significantly important in compound fractures but not in closed fractures. Contrary to common beliefs, the delay was found to be shorter among diabetics than non-diabetics. Usually delay in diabetics was longer due to varied reasons such as preoperative anaesthetic assessment, co morbidities, poorer glycaemic control. But in this study, the diabetic group had shorter delay correlating with the study by Jiong *et al*. [6]. Immediate surgical fixation of the closed ankle fractures in preoperatively neglected Type 2 Diabetes patients did not increase the risk of postoperative complication and showed similar results when compared to non-diabetics. Mean follow-up of patients since surgery among non-diabetics was 28 months and was 24 months among diabetics. Range of follow up was 6 months to 6 years. In comparison the mean follow-up period for diabetic ankle fracture patients undergoing fixation was 4.1 years in the study of Costigan *et al*. [5]. Between the study groups, the difference of mean follow-up was not statistically significant(P=0.38). Considering the distribution of fracture pattern that was surgically stabilized in both the groups, incidence of Weber A fractures was the least accounting for 20 percent in each group. Weber C fractures with syndesmotic injuries were the next with 30 percent in each group. Weber B fractures were the most common with incidence of 50 percent in each group. Using Chi square test, incidence of fracture pattern was found to be statistically similar (P=0.095).

The Olerud Moleander score considered various activities of daily living such as walking, running, jumping, squatting, and associated swelling and pain during such activities. Points were given according to pain and various grades of limitations. The Olerud Moleander score was significantly better (P=0.046) among non-diabetics at 2 year follow-up than that of diabetics at similar duration. This could be attributed to the factors common among the diabetic study population like elderly age, osteoporosis leading to suboptimal fixation, delayed healing of bone and soft tissues could attribute to poorer functional score than Non Diabetic study population. Though the objective functional score determined by Olerud Moleander score was statistically significant between the diabetic and non Diabetic population, their corresponding subjective functional score compared to the other uninjured ankle, was found to be similar and no statistically significant difference was observed between the groups. This could be attributed to factors that affect both the ankle in similar way in both the study population such as osteoporosis, restricted activities of daily living which did not require a high functional ankle. Among the diabetics the role of peripheral neuropathy, mono neuritis could not be ruled out as a cause for better subjective score than objective functional score. Complications since surgery were noted in both the study groups. Complications were grouped into infection, loss of fixation, tendinitis, bursitis, non-union, talar subluxation, ankle arthritis. Distribution of these complications were similar in both the study groups. Difference in incidence of complications studied by fisher exact test was statistically insignificant (P=0.15). Total incidence of complications was 10 out of 26 ankles among non-diabetics whereas it was 13 out of 21 among diabetics. Incidence of infection, bursitis, tendinitis was similar in both the study population. Incidence of loss of fixation and arthritis were higher among diabetics, but it was not a statistically significant difference. Jones *et al*. [7] in his study found that complications between diabetic and non-diabetics ankle patients undergoing surgery were comparable if there was no pre-existing comorbidity in diabetic patients which was comparable to the present study. Infection following operative treatment of ankle fractures could be a limb-threatening complication, especially in diabetic patients as per the study of Zalavras *et al*. [8]. In the study by Lanzetti *et al*. [9] diabetic patients had delay in wound healing compared with non-diabetic patients. Chaudary *et al*. [10] in their study on complications of ankle fractures in diabetic patients concluded that adherence to proper preoperative planning, meticulous soft tissue management, stable fixation could yield good functional outcomes. The risk of infection was found to be four time higher than that seen in non-diabetic ankle fracture surgery patients in the study by Flynn *et al*. [11]. The above study further added that conservative management in diabetic patients with pre-existing comorbidity like neuropathic disease, peripherovascular disease and severe swelling and ecchymosis were also at high risk of infection. Time delay to surgery was similar in both the study population. No statistically significant difference was identified between the study groups. But complications like arthritis, loss of fixation were more in patients in whom surgery was delayed due to varied reasons. Among the patients with complications, the mean time delay to surgery was 5.4 days in non-diabetics and 3.8 days in diabetics. Both of which is marginally higher than the group mean but is not statistically significant. Regan *et al*. [12] in a retrospective study concluded that patients with diabetics who were admitted to the hospital for ankle ORIF had more expensive hospital stays and higher in-hospital mortality rates than patients without diabetes. Tonnesen *et al*. [13] studied the influence of alcoholism on postoperative morbidity after osteosynthesis of malleolar fractures and

concluded that alcoholism increased early complications like infection and significant higher morbidity compared with control.

Among the diabetic population with complications, the mean diabetic age was 4.6 years which is higher than the group diabetic age mean of 4.095 years but not statistically significant.

All the trimalleolar fractures contributed the maximum complications in the study population. Out of total three patients, two being non diabetic, the incidence of loss of fixation, wound dehiscence, talar subluxation and arthritis was common to all the three patients indicating poor outcome of such fracture pattern.

Considering the distribution of complications with respect to fracture pattern, 40 percent of Type B weber fractures had one or more complication in both the groups and no significant difference existed followed by Type C Weber which had 40 percent complications among diabetics and 60 percent complications among non-diabetics. None of the Type A fractures had any complications in both the study groups. None of the complications required arthrodesis or amputation. On comparison Mak *et al*. [14] in his study of 116 cases of ankle fracture found that 90% of Weber type A and 70-80% of Weber type B and C had excellent to good results following surgery.

In a Closed ankle fracture, irrespective of the diabetic status, open reduction and internal fixation yielded similar functional outcome and complication rate. Earlier surgical stabilization of displaced unstable ankle fractures provided better results. In Ankle fracture fixation of patients with Uncomplicated diabetes, strict postoperative glycemic control, regular monitoring of glycemic index and screening for end organ damage significantly reduced the incidence of early and late postoperative complications. Though the objective ankle score was less among diabetic patients, they were minimally symptomatic evidenced by subjective ankle scores similar to non diabetics.

The limitations of this study were this was a retrospective observational study based on previous documentations and significant difference in mean age of study group, role of peripheral neuropathy in subjective functional score in diabetics were compounding the study result which could not be studied individually. Study population had free access to tertiary health care centre with all specialty departments and investigations. Best possible treatment was availed by patients including expensive drugs, investigatory procedures, expert opinions. Hence the study could be applicable only in highly compliant patients with adequate facilities to monitor diabetic needs.

Conclusion

In patients with uncomplicated diabetes, open reduction and internal fixation of ankle fractures, provide similar subjective outcome and incidence of complications compared to non diabetics. Following ankle fracture fixation in patients with uncomplicated diabetes, objective functional score - Olerud Moleander score is significantly better among non Diabetics (P=0.046). Whereas subjective functional score ankle is similar in both the groups (P=0.17). This could be attributed to elderly group of diabetic population, peripheral neuropathy which could not be quantified or studied individually. Time delay to surgery was statistically similar in both the study groups. (P=0.12) The role of time delay to surgery in complications needs to be evaluated with larger study group. The role of fracture pattern in poorer outcome could be established only with trimalleolar fractures with various confounding variables

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