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Original Research Article

A study of the efficacy of external fixation in healing large, deep and unstable diabetic foot wounds

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ABSTRACT

Background: Infection of a diabetic foot wound heralds a poor outcome, early diagnosis and treatments are important. The aim of the study was to study the efficacy of external fixation in healing large, deep and unstable diabetic foot wounds.
Methods: 50 patients with diabetic foot ulcer considered for the present study. Out of this 50 cases 25 are selected for external fixations (study group), after fulfilling the inclusion criteria and rest 25 cases are managed by posterior slab support. After reducing the infective load, the external fixator was applied as per application of external fixator procedure. The fixator is kept for 4 to 6 weeks. Daily dressings are done with advance dressing materials. Posterior slab group 25 patients are included having large, deep ulcers and unstable joints, to which posterior slabs were supported after proper and extensive debridement of wound under SA/LA.
Results: DFU predominantly affects right lower limb than left lower limb. Both lower limbs affected in 4% cases. Because of different working environment males are more vulnerable to foot ulcerations. Out of 50 cases 48 (96%) of DFU are unilateral and 32 no of cases (64%) are predominantly occurs in right lower limb (Table 2). Out of 50 cases 38 no. of patient are males and 12 no. of patient are females. External fixator in exposed joint decreases the wounds in 52 days where as by posterior slab support 59 days. The mean surfaces are of the wound after therapy in study group is 75 cm^2 and in control group it was 78 cm^2.
Conclusions: Large ulcers and exposed joints due to diabetic foot can be managed by external fixator for better prognosis than posterior slab method.

Keywords: Diabetic foot, External, Fixation, Ulceration

INTRODUCTION

Ulceration, infection, Gangrene and amputation, associated with the chronic complications of diabetes are a major source of morbidity and a leading cause of hospital admission for people with diabetes.[1] The patho-physiology of diabetic foot ulceration is multi factorial, but peripheral neuropathy is thought to be responsible for most cases. Foot ulcers are a common, serious, and costly complication of diabetes, preceding 84% of lower extremity amputations in diabetic patients and increasing the risk of death by 2.4-fold over diabetic patients without ulcers.[2,3] Despite advances in knowledge and treatments, as many as 12–25% of people with diabetes will develop foot ulceration at some stage of their disease, many of whom will require amputation.[4,5] Application of external fixator is a novel technique of stabilizing those wound thereby accelerating wound healing, closure of the wound and preventing amputation. External fixation is a device which provides a rigid immobilization through external fixation by means of rods attached to pins that are place in or through bone.

Treatment of diabetic foot ulcer patients is wound closure and finally a stable foot, which is determined by severity, vascularity and infection.[6] The present study was undertaken to study the efficacy of external fixation in healing large, deep and unstable diabetic foot wounds.

METHODS

Diabetic foot ulcer patients (DFU) attending to general surgery OPD, Endocrine Surgery OPD and admitted subsequently to the general surgical ward in SCB Medical College and Hospital, Cuttack during the period from August 2011 October 2013 was considered for the present study. 50 patients with diabetic foot ulcer considered for the present study. Out of 50 Patients, 25 patients were applied with external fixator and rest 25 patients were supported with posterior slab followed by conventional wound care. Ulcers involving the ankle and foot with loss of large amount of tissue with visible instability of joint considered as inclusion criteria whereas peripheral arterial disease with ABI <0.9, venous ulcer patients with above 80 years of age and non-compliance patients were considered under Exclusion criteria in the present study. Out of this 50 cases 25 are selected for external fixations (study group), after fulfilling the inclusion criteria and rest 25 cases are managed by posterior slab support. All patients are thoroughly examined with detail history including the diabetic status. Clinical examination both local and systemic are done with routine investigations like Hb%, DC, TLC, Sr-Urea, Sr-Cr,Sr-Na, Sr-K, HIV, HBsAg, HCV, fasting and PPBS, x-ray of the pathology foot is taken, endocrine and cardiac consultation are done for diabetics and cardiac status. Deep necrotic tissue from the death of the wound was sent for C/S study. All patients were subjected for pre-anaesthetic check-up for surgical intervention under LA/SA. Debridement of the wound was done either under LA/SA. Daily dressing of the wound was done with advance dressing material along with empirical IV antibiotics. After receiving the microbiological report the antibiotics are changed as per the sensitivity and wound was observed for development of healthy granulation tissue. After reducing the infective load, the external fixator was applied as per application of external fixator procedure. On 3rd, 7th, 14th and 21st day of application, wound was observed meticulously for any discharge, slough/granulation tissue, and decrease in size of the wound, pin site infection, loosening of the pins and other progress of the wound by comparing the size with initial status of the wound. The fixator is kept for 4 to 6 weeks. Daily dressings are done with advance dressing materials. X-ray of the foot and leg was done to know the proper application of fixator components. After development of good granulation tissue wound was planned for SSG under SA. The patient is prepared for the SSG by doing pre-anaesthtetic check-up, keeping the patient NPO from morning of the operation day, shaving of donor sites, controlling blood glucose level with insulin, broad spectrum anti-biotic ½ hr. of intervention. After SSG, patient is kept in the hospital to observe for proper uptake of graft site, or any other related complications. Posterior slab group 25 patients are included having large, deep ulcers and unstable joints, to whom posterior slabs were supported after proper and extensive debridement of wound under SA/LA. Daily dressing was followed by sending slough/pus at regular intervals for C/S study. Culture sensitivity antibiotics were advised to those patients. The progression of the wound gap and stability of the joint was observed & recorded. The wound which was well granulated and improved the joint stability was planned for SSG under SA. Consent was obtained as per human ethical guidelines S.C.B Medical College, Cuttack, Odisha (IEC No: 22/09.10.2013).

RESULTS

Out of 50 DFU cases, 31 cases (62%) belong to low, 17 cases (34%) belong to middle & 2 cases (4%) belong to high SES. Out of 31 cases of Low SES, 20 cases (62%) presents with late stage DFU (grade 3,4,5). Out of 17 cases of Middle SES, 11 cases (61%) presents with early stage DFU (grade 1,2). Thus DFU cases are more in Lower SES than Middle and High SES. Low SES presents with late stage disease and with more complications than middle and high SES. Middle and High SES patients presented with early stage disease (Table 1).

Table 1: DFU cases according to Wagner's grading and socio economic status.

Wagner's grade	Low SES	Middle SES	High SES
1			
2	11	11	1
3	14	4	1
4	6	2	0
5			
Total	31	17	2

Table 2: DFU cases distributed in affected lower limb according to Wagner's grading.

Wagner's grade	Right leg	Left leg	Both leg
1			
2	12	9	2
3	14	5	
4	6	2	
5			
Total	32	16	2

Maximum number of cases presented with Unilateral DFU 48 cases (96%). In 32 cases (64%), Right lower limb is affected and in 16 cases (32%) left lower limb is affected. Thus DFU predominantly affects right lower limb than left lower limb. Both lower limbs affected in 4% cases. Because of different working environment males are more vulnerable to foot ulcerations. Out of 50 cases 48 no. of cases (96%) of DFU are unilateral and 32

no of cases (64%) are predominantly occurs in right lower limb (Table 2).

Figure 1: Application of fixator in operation theatre.

Out of 50 cases 38 no. of patient are males and 12 no. of patient are females, so males are affected more than females in DFU patients. It is observed from the study that 48% of diabetic foot patient has the history of diabetes duration of <5 years, 39% have 5-10 years and 17% have >10 years (Table 3).

Table 3: DFU cases according to Wagner's grading & diabetes status and duration.

Wagner's grade	<5 yrs	5-10 yrs	>10 yrs
1			
2	7	8	1
3	6	6	1
4	12	9	0
5			
Total	25	23	2

Table 4: Duration of hospital stay.

	<50 days	50-60 days	>60 days	Total
External fixator (study group)	12	11	2	25
Posterior slab (control group)	5	7	13	25

Table 5: Study group data (external fixator).

Patient No.	Age	Sex	Initial wound surface area (cm^2)	Length of therapy (days)	Wound surface area after therapy (cm^2)	Final closure
1	73	F	94	54	50	STSG
2	64	F	108	55	72	STSG
3	60	M	118	48	102.5	STSG
4	62	M	192	49	155	STSG
5	72	M	62.5	62	44	STSG
6	69	F	292	55	256	STSG
7	77	M	82	49	66	STSG
8	71	M	78	45	62	STSG
9	54	F	66	56	49	STSG
10	68	M	72	45	52	STSG
11	66	M	98.5	70	70.5	STSG
12	58	F	46	43	40.5	Wound not closed
13	66	M	105	50	62.5	STSG
14	62	F	92.5	58	71.5	STSG
15	60	F	88	47	40	STSG
16	70	M	68	55	57.5	STSG
17	68	M	102.5	48	88	STSG
18	74	M	95.5	52	75.5	STSG
19	68	M	89	59	70.5	STSG
20	59	M	77.5	54	65	STSG
21	64	M	80	44	62	STSG (partial loss of graft)
22	62	M	104.5	47	62	STSG
23	65	M	98	44	70	STSG
24	66	M	104	46	71	STSG
25	64	M	98	65	60	STSG
Mean	65.68		100.46	52	75	
SD	5.48		47.944	7	44.14	
SEM	1.1		9.589	1.4	8.8	
N	25		25	25	25	

Table 6: Control group data (posterior slab).

Patient No.	Age	Sex	Initial wound surface area (cm^2)	Length of therapy (days)	Wound surface area after therapy (cm^2)	Final closure
1	67	F	82	58	74	STSG
2	60	M	98	62	89.5	STSG
3	62	M	118	65	99.5	STSG
4	60	M	106.5	71	94	STSG
5	70	F	112	55	102.5	STSG
6	68	F	57	54	56	Could not closed
7	74	M	109	73	98	STSG
8	68	F	122	68	108	STSG
9	59	M	64.5	55	57.5	STSG
10	64	M	106.5	62	104	Could not closed
11	62	M	68	60	64.5	STSG (partial loss of graft)
12	56	M	94.5	57	82	STSG
13	73	F	90.5	52	81	STSG
14	64	M	88.5	59	79	STSG
15	60	M	79.5	63	79	Could not closed
16	62	F	91	67	78.5	STSG
17	72	F	59.5	49	52	STSG
18	67	M	74.5	65	68.5	STSG
19	74	M	69	48	61.5	STSG
20	62	M	64.5	45	63	Could not closed
21	57	M	74	49	63.5	STSG
22	69	M	81.5	44	72	STSG
23	63	M	75.5	66	67.5	STSG
24	65	M	87	65	76	STSG
25	67	M	83	71	77	STSG
Mean	64.92		86.24	59.3	77.92	
SD	5.27		17.93	8.34	16.05	
SEM	1.08		3.58	1.67	3.2	
N	25		25	25	25	

Figure 2: SSG done 6 weeks after fixation.

External fixator in exposed joint decreases the wounds in 52 days where as by posterior slab support 59 days (Table 4). The mean surface is of the wound after therapy in study group is 75 cm^2 and in control group it was 78 cm^2 (Table 5 and 6). The p value of surface area of the wound after therapy is 0.001 which is statistically significant.

Figure 3: Parts of external fixator.

Figure 4: Diabetic foot wound with exposed joint managed by posterior slab support.

DISCUSSION

Adequate debridement, proper antibiotics, regular saline dressings, good glycemic control and application of external fixator increases the recovery and improves discharge rate of patients. Wound debridement is repeated and dressing is continued until the wound is clean with evidence of healing then only wound considered ready for reconstruction.[7] The most important is aggressive debridement of all infected tissue and bone, while sparing the healthy tissue for closure. Ulcer depth, severity of infection, ischemia, osteomyelitis and gangrene are considered as predictors of amputation in a diabetic foot ulcer. A diabetic foot wound exposing the bone was more likely to be associated with amputation.[8] The external fixator allows salvage of severely infected or traumatised bone or joints that required major amputation in the past and leaving large wounds to heal by granulation and secondary intention may take several months or years for complete closure.[9]

External fixator may be used in complex diabetic foot wounds. External fixation has an established role in the treatment of trauma and osteomyelitis.[10,11]

External fixation stabilizes the joint by decreasing the mobility at the site of joint and helps in approximating the wound margin which is closed by SSG Our data demonstrates that application of external fixator in exposed joint decreases the wounds sizes more effectively in 52 days as compared to the wound managed by posterior slab support 59 days, ulcer preventing complications and hence promising a better outcome. Potential indications for external fixator procedure include posterior foot wounds that require offloading, prevention of decubitus heel ulcerations, prevention of equinovarus deformity after partial foot amputation, and offloading of skin grafts or flaps.[12] The present study suggests that for the diabetic foot ulceration having large ulcers and exposed joints can be managed by external fixator better as compared to the conventional methods like posterior slab.[13]

CONCLUSION

The advantage of this treatment is to decrease mobility at wound site, approximation of wound margins, better joint stability and alignment, less hospital stay, cost effective, limb salvage and better quality of life.

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