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Effect of An Early Versus Late Ambulation Over Graft Take on the Lower Limb Autograft: A Comparative Study

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ABSTRACT

Background: Traditionally, patients who require lower extremity skin grafting remain on bed rest for several days. Despite the evidence advocating for early ambulation following split skin graft surgeries, studies reviewing plastic surgery departments nationwide have suggested that it has not been routinely practiced. The purpose of the study was to determine whether an early ambulation had any effect on a graft take as compared to the late ambulation in lower extremity autografts.

Methodology: A prospective comparative study was conducted involving 40 consenting patients in each group, treated between November 2015 to February 2017 in the Department of Burns and Plastic Surgery with a diagnosis of lower limb injury as per the inclusion and exclusion criteria was taken up for the study. One group was early ambulatory group (EAG) and another standard late ambulatory group (LAG). Size of the wound was measured using Graph sheet method. Various epidemiological and morbidity parameters were compared.

Statistical Analysis: was done using statistical software package SPSS v22.0.

Results: The mean duration of stay in hospital when compared was suggestive of significance of early ambulation. When graft take was compared between two groups, it was found that there is no significant difference in both groups. Pearson correlation coefficient analysis shows that subjects with greater wound size needed more number of days in resumption.

Conclusion: With this study one can conclude that immobilisation is not mandatory and mobilisation can be encouraged in lower limb autograft cases.

Keywords: Wound; Ambulatory; Immobilsation; Skin graft; Graft take.

Introduction

Traditionally, patients who require lower extremity skin grafting remain on bed rest for several days. It is a common practice to keep a patient immobile, who has undergone autografting in the lower extremity. Majority of the institutions keep their patients immobile for about 5 days whereas some other institutions immobilse the patient even longer.[1]

Determining when to ambulate the patient after a skin graft to a lower extrimity depends upon the establishment of circulation to the newly grafted area.[2] Typically majority of the revascularisation takes place between 4 to 6 days.[3] It has been presumed that before the revascularization, there is a risk of graft failure because of increase edema in the dependent limb, or as a result of shearing

forces to the graft itself.[4] For a minor injury it is a costly affair in terms of bed use. For elderly group of patients, prolonged immobilisation carries a significant risk of deep vein thrombosis and pulmonary embolism. In healthy subjects, short period of bed rest have been associated with loss of muscle strength, decrease in orthostatic tolerance, tachycardia, and decreased stroke volume and cardiac output.[5-7] Immobilization can lead to associated morbidity, such as decreased range of motion, reduced endurance, lack of independence in activities of daily living, prolonged hospital stay, increased costs associated with length of stay, and inhospital complications as well as inferior quality of life.

Patients who are ambulatory before autografting can safely ambulate on first postoperative day, without a fear of auto graft failure compared with those subjects who remain on bed for 5 days. These subjects have lesser pain, and are able to achieve independent ambulation faster.[4] Subjects who can remain ambulatory throughout their hospital stay, usually have less risk of acquiring the sequel which is associated with even short period of immobilisation.[4]

Some cases which are being done as a day care procedure, are advised for immobilisation. But residential condition of some of the patients, makes an ambulation unavoidable in them. Even then when patient comes for the dressing, surprisingly graft take is seen not hampered. This really seeds a doubt in the mind about the mandatory immobilisation for 5 days. Such doubt had encouraged us to start the study, where patient was made to ambulate within 24 hours of grafting.

There are number of studies that compare the graft take in early ambulatory and late ambulatory period and most of these studies have led to a conclusion that there is no difference in graft take between early and late ambulation group. But still, early ambulation has not been advised in most of the hospitals in India. The study had included previously ambulatory patients. Patients who were non ambulatory prior to the surgery such as patients with fractures and cellulities were ruled out. Patient with systemic co-morbidities had also been ruled out. Diabetes, malnutrition, cardiac pathology, steroid intake, all would intervene with the wound healing process and graft take.

Despite the evidence advocating for early ambulation following split skin graft surgeries, studies reviewing plastic surgery departments nationwide have suggested that it has not been routinely practiced.[8] The burn center follows a traditional ambulation protocol for the majority of its patients. Many of these patients are complex, with multiple comorbidities, systemic diseases, and are excluded from the studies on graftthealing. Wallenberg had included the subjects with questionable peripheral arterial circulation as well as diabetics, and had concluded that the graft failure was related to systemic diseases rather than ambulation protocols. More research into such patient population is needed to determine whether they too may benefit from early ambulation after grafting.[9]

The purpose of the study was to determine whether an early ambulation had any effect on a graft take as compared to the late ambulation in lower extremity autografts.

Materials and Methods

A prospective comparative study was conducted involving 40 consenting patients in each group, treated between November 2015 to February 2017 in the Department of Burns and Plastic Surgery with a diagnosis of lower limb injury as per the inclusion and exclusion criteria was taken up for the study. One group was early ambulatory group (EAG) and another standard late ambulatory group (LAG). Ethical clearance was obtained from Institutional Ethics Committee with Ref. No. TP(DM/M.Ch)(5/2015)/IEC/PGIMER/RMLH-7843/15.

Inclusion criteria

1. Patient between 18 yrs to 60 yrs of age
2. Post-traumatic raw area, post-burns raw area, post-infective raw area suitable for grafting

Exclusion criteria

1. Patients with diabetes mellitus
2. Patients with peripheral vascular disease
3. Patient with lower extremity pitting edema
4. Patient who had developed cellulitis before surgery
5. Patient who were non ambulatory before surgery(fractures)

Flow of the study

- All patients who were referred to the Burns and Plastic Surgery Department with the complaint of lower leg injury were included in the study as per the inclusion and exclusion criteria after taking informed written consent.

- All the patients were given the standard primary care as per the hospital treatment protocol.
- Size of wound was measured in surface area using graph sheet (**Fig. 3**).
- Impression of wound was taken on graph paper and the number of boxes within the impression gave the surface area of the wound
- Once the wound became fit for grafting, grafting was done taking opposite thigh as a donor area.
- Compression bandaging was done using crepe bandage of 6 inch (**Fig. 1**).
- Ankle splint was also applied 5days postoperatively (**Fig. 2**).

Fig. 1: Compression dressing given using crepe bandage.

Fig. 2: Ankle splint given using Plaster of Paris.

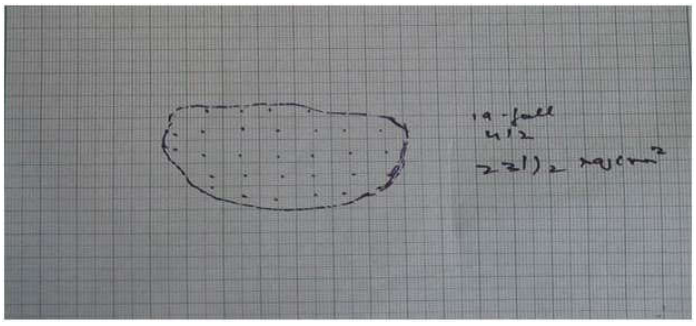

Fig. 3: Wound size measurement using graph sheet.

Study Treatment Protocol

A Standard treatment group

- Patients were seen on Postoperative days 1 to 4 for
  1. Positioning of the involved Lower leg.
  2. Correct fit of ankle splint.
  3. Patient was made ambulatory after 5 days.
  4. Pictures of graft sites were taken for all subjects on Post-operative day 5, 10 and 15.

B Early ambulation group

1. Beginning on Postoperative day 1, they were seen for ambulation.
2. Before ambulating, the grafted limb was wrapped with compression bandages (crepe bandage).
3. Minimum ambulation of 50 meters 4 times a day was advised. Each subject was asked to ambulate until the subject was determined for not to ambulate any further.
4. Subjects were discharged when they were able to mobilize independentlyand required only dressing change at home.
5. Pictures of graft sites were taken for all subjects on POD 5, 10 and 15

Follow up

- All discharged cases were followed up at POD 5, 10 and 15.

Outcome parameters

a Epidemiological parameters:

1. Age
2. Sex
3. Type of injury
4. Areas grafted

b Early morbidity parameters

1. Duration of stay in the hospital
2. Distance of ambulation on each day
3. Graft was assessed on following criteria:

- Percentage of successful graft 'take', by measuring the size of wound preoperatively and on POD15.
- Photographs were taken intraoperatively and then on post-operative day 5,10 and 15

Statistical Analysis

Statistical analysis was done using statistical software package SPSS v22.0. Data is represented as mean ± SD. Continuous variables were compared using *t*-test. Chi-square test was done to compare the nominal data. Pearson's correlation coefficient was used to compare correlation between two continuous data. p value < 0.05 was taken as significant.

Results

The study was conducted for 20 months. 40 patients each were enrolled in each of two groups. Out of 40 patients in early ambulatory group, 2 of the patients were lost during the follow up.

Age

The mean age in EAG group is 41.21 and in late ambulatory group is 36.83

T-test analysis had shown that there was no significant difference in mean age between the two groups of subjects.

Table 1: Comparison of Age (in years) Between the Two Groups

Group	N	Mean	Std. Deviation	Std. Error Mean	*p* value
Ambulated	38	41.21	16.82	2.73	0.213
Non-ambulated	40	36.83	13.92	2.29	

Gender

In EAG group 31 patients were male, 7 were female. In LAG 31 were male and 9 were female. Chi-square analysis had shown that there was no significant difference in gender distribution of subjects. The chi-square value was 0.199 and the p value was 0.781.

Table 2: Gender Distribution of Subjects Between the Two Groups

Ambulated		Group		Total
		Ambulated	Non-ambulated	
Sex	Female	7	9	16
	Male	31	31	62
Total		**38**	**40**	**78**

Side of Limb

Chi-square analysis had suggested that there was no significant difference in side involved between the two groups. The chi-square value was 0.844 and the p value was 0.375.

Table 3: Comparison of Side Involved Between the Two Groups

Ambulated		Group		Total
		Non-ambulated	Non-ambulated	
Side	Left	22	19	41
	Right	16	21	37
Total		**38**	**40**	**78**

Duration of Stay in Hospital

The mean duration of stay in hospital was 3.34 in EAG were as it was 7.68 in LAG.

The duration of stay in early ambulatory group had significantly reduced compared to the late ambulatory group, which was proved statistically.

T-test analysis had shown that there was significantly greater hospital stay duration in non-ambulated group of subjects. The *p* value was <0.05.

Table 4: Comparison of Duration of Stay (in days) in the Hospital Between the Two Groups

	Group	*N*	Mean	Std. Deviation	Std. Error Mean	*p* value
Duration of stay in hospital	Ambulated	38	3.34	4.64	0.75	<0.001***
	Non-ambulated	40	7.68	5.05	0.79	

Wound Size

The mean size of wound in early ambulatory group is 95.68 and 103.38 in late ambulatory group. *T* tests analysis had shown that there was no significant difference in wound size between the two groups. The *p* value was > 0.05.

Table 5: Comparison of Wound Size Between the Two Groups

	Group	*N*	Mean	Std. Deviation	Std. Error Mean	*p* value
Wound size (sq cm)	0	38	95.68	79.90	12.96	0.653
	1	40	103.38	70.45	11.13	

Fig.4: Pre-op: wound in middle 1/3rd of leg, which was grafted and made ambulatory.

Fig. 5: Post-op day 15: showing almost 100% graft take.

Graft Take (Figs. 4,5)

The most important result was the graft take comparison between the two groups. The average graft take in EAG was 87.47 and 90.90 in LAG. There was no statistically significance difference in the graft take between the two groups. *T* test analysis had suggeseds that there was no significant difference in graft taken at 15 days between the two groups. The *p* value was > 0.05.

Table 6: Comparison of Total Graft Takes (in %) at 15 Days

	Group	*N*	Mean	Std. Deviation	Std. Error Mean	*p* value
Graft take (%)	Ambulated	38	87.47	15.07	2.44	0.262
	Non-ambulated	40	90.90	11.54	1.82	

Resumption of work

Even though statistically there was no significant difference between two groups, the early ambulatory group had resumed the work 2 days earlier than the late ambulatory group. EAG patients resumed work by 14.03 days in average and LAG patients resumed their work by 16.18 days.

T test analysis had suggested no significant difference in number of days required to resume normal activity. The *p* value was > 0.05.

Table 7: Comparison of Return to Normal Day-to-day Activity

	Group	*N*	Mean	Std. Deviation	Std. Error Mean	*p* value
Return to activity in days	Ambulated	38	14.03	4.54	0.738	0.279
	Non-ambulated	40	16.18	11.31	1.78	

Ambulatory Distance

As advised patients were made ambulatory for about 50 meters on day 1. And then the distance was increased day by day according to the patients compliance. The mean ambulatory distance on day 1 was 50, day 2 was 199.34, day 3 was 342.76, day 4 was 510.53 and on day 5 was 648.68 meters. Pearson's correlation coefficient analysis had shown that subjects with greater wound size needed more number of days in resumption of work in ambulatory group of subjects. Correlation coefficient (*r*) value was 0.477 and the *p* value was 0.002.

Table 8: Comparison of Ambulation Distance (in Meters) of Subjects in Ambulatory Group

distance of ambulation (meters)	Pod 1	Pod 2	Pod 3	Pod 4	Pod 5
Mean	50.00	199.34	342.76	510.53	648.68
Std. Error of Mean	0.000	21.75	31.427	42.719	54.083
Median	50.00	200.00	325.00	500.00	600.00
Std. Deviation	0.00	134.12	193.72	263.33	333.38
Minimum	50	50	50	100	50
Maximum	50	600	700	1000	1500

Discussion

A doubt always remains in surgeon's mind when it comes to early ambulation in lower limb autograft. As in traditional way of postoperative therapy in the lower limb autograft, immobilization has been advised for 5 or more days. A consensus has been revealed in the literature supporting immediate ambulation following lower extremity split-thickness skin grafting, noting that early ambulation neither improves or jeopardizes graft take if external compression is applied.[10–14]

Despite evidence advocating for early ambulation following split skin graft surgeries, plastic surgery departments nationwide is not practicing it routinely. The trend of early ambulation in lower leg auto graft will primarily prevent complications like deep vein thrombosis, pulmonary embolism, joint stiffness and prolonged hospital stays. Prolonged hospital stay will be an economic burden for patients. Need not to explain, if the patient is alone working member of the family then it affect the life of dependents significantly.

In our study patient with leg (below knee) wound was included and randomized into two group. One group is of traditional immobilization group and another is early ambulatory group who are made ambulatory on the same day of surgery. Inclusion and exclusion criterias were considered while selecting the cases. We had excluded patients with systemic illness. Wallenberg included subjects with questionable peripheral arterial circulation as well as diabetics, and concluded that graft failure was related to systemic diseases rather than ambulation protocols.[9] More research into these patient population is needed to determine if they too may benefit from an early ambulation after grafting. We have excluded patients with bony injuries in both groups, as one cannot follow the ambulatory protocol in these patients.

In the study, 40 consenting patients in each group were randomly selected. Group 1 was early ambulatory group and Group 2 being the late ambulatory group. Patients enrolled in both the groups were clinically examined to rule out any peripheral vascular disease and bone fractures. Any other systemic morbidities like diabetes mellitus, chronic anemia were ruled out. Required investigation were conducted. If required X-rays of pertaining part were also taken. Wound swab for culture sensitivity were also taken.

After strictly following the protocol as devised, the required paramaters were compared in both the groups. In early ambulatory group out of 40 patients, 2 patients were lost to follow up for unknown reason.

The result of graft take at postoperative day 15 were compared in both group. It was found that there was no significant difference in graft take in both groups. Mean graft take in percentage in early ambulatory group was 87.47 and 90.90 in late ambulatory group. *p* value being 0.262 (>0.05). Statistically also there was no difference in graft take. This study is comparable with other studies, which says there is no significant difference in graft take in both groups.

Wallenburg[9] had performed a RCT in which 50 participants were allotted in either ambulation a day after surgery with a graduated increase over 3 days and in time spent bed rest for 5 days. Wound healing were assessed in both groups. There was no significant difference in wound healing in both the groups. 80% in early ambulatory group and 88% in late ambulatory group had completed wound healing by 2 weeks.

Talon *et al*.,[15] after conducting a RCT concluded that there was no difference in outcomes between two groups and hence early ambulation did not impede graft take.

Grube *et al*.,[16] had studied a largest case series. It was retrospective study, which reviewed 100 patients treated with split thickness skin grafts to lower extremities who were encouraged to ambulate as early as 4 hours postoperatively. Graft take was described excellent (>95% graft take) in 86% of patients, satisfactory (85-94% graft take) in 10% and 4% required regrafting.

Duration of hospital stay in our study in the early ambulation group has significantly reducedas compared to the late ambulatory group. In early ambulatory group the mean hospital stay duration was 3.44 days when compared to 7.68 daysin late ambulatory group. It was proved significant statistically also as the *p* value was < 0.001 (<0.05). Hence an inference can be made. Economic burden that we see in the late ambulatory group can be significantly reduced if the patient has made ambulatory as in our study group. This result of ours is comparable with studies done by other authors.

Wells *et al*.,[17] in their study had concluded that there was no significant difference in graft take between two groups but there was a difference in length of hospital stay. Hospital stay significantly was reduced to 1.4 days when compared to 12.9 days of non ambulatory group. It was also estimated that early ambulation and discharge saved approximately $10350 (1995CDS)/per patient. Another study by Budny *et al*.,[18] which was RCT also concluded that the length of hospital stay in early ambulatory group was 2.3 days as compared to 12.1 days in late ambulatory group.

Dean and Press[19] in their retrospective case series study found to have reduced length of hospital stay in early ambulatory group. The average length of stay was 0.9 days.

Resumption of work: In our study, early ambulatory group had returned to the activity within an average of 14.03 days as compared to 16.18 days in late ambulatory group.

Most of our patients were daily wage workers like painters, masons, auto drivers etc. Some were office workers and some were businessmen. Whatsoever is the occupation, every patient wants to resume to their work as early as possible. Patients in early ambulatory group was shown to resume to their work 2 days earlier then late ambulatory group.

In a study done by Grube *et al*.,[20] was largest retrospective case series study. In 43 patients out of 100 cases work resumption could be determined. The average days for work resumption was 4.7± 3 weeks.

This study of ours also gives us the information that greater the wound size longer the time for resumption of work. Pearson's correlation coefficient analysis had also shown that subjects with greater wound size needed more number of days in resumption of work in ambulatory group of subjects. Correlation coefficient (*r*) value was 0.477 and the *p* value was 0.002.

Conclusion

The purpose of this study is to know whether early ambulatory group jeopardise graft take as compared to conventional group of late ambulatory. The question which arises thereafter is, Is Immobilisation mandatory in lower limb autograft?

The results of this study suggests that immobilisation is not mandatory in previously ambulatory patients who are medically and psychologically stable. Early mobilization does not jeopardise or fasten graft take. Graft take in both the groups is comparable. In fact we can avoid secondary complications like deep vein thrombosis, pulmonary embolism due to immobilisation.

The economic burden over both patients and hospital can be reduced. This is proved with significantly decreased hospital stay in early ambulatory group when compared to conventional

late ambulatory group. This is of utmost significance in developing countries like us where health care insurance is yet to cover majority of population.

Patient in early ambulatory can also resume their work early when compared to conventional late ambulatory group. Hence early mobilisation in lower limb autograft can be advised, provided a good compression dressing is given in every case during ambulation.

With this study one can conclude that immobilisation is not mandatory and mobilisation can be encouraged in lower limb autograft cases.

Conflict of Interests: None

Funding Source: None

Ethical Approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards

Abbrevations:

EAG–Early ambulatory group.

LAG –Late ambulatory group.

POD–Postoperative day.

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