

## EARLY POST-OPERATIVE PROSTHETIC FITTING PROBLEMS AND SCOPE IN EARLY REHABILITATION

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### ABSTRACT

#### BACKGROUND

Limb loss is one of the most physically and psychologically devastating events that can happen in a person. Successful rehabilitation following amputation is complex and requires multiple medical, surgical and rehabilitation specialties. Early post-operative prosthetic fitting and independent ambulation are major goals in the rehabilitation of amputees, with early walking being extremely valuable in the physical and psychological rehabilitation of the amputee.

**Objective-** To study the functional outcome of early post-operative prosthetic fitting in transtibial amputees.

#### METHODS

**Study Setting-** Department of PMR, Government Medical College, Trivandrum.

**Study Population-** All transtibial amputees with early post-operative prosthetic fitting admitted in Physical Medicine and Rehabilitation ward during 1 year.

#### RESULTS

Transtibial amputees with early post-operative prosthetic fitting have good functional outcome.

#### CONCLUSIONS

Early post-operative prosthetic fitting is a feasible alternative to immediate post-operative prosthetic fitting for early rehabilitation.

#### KEYWORDS

Amputee Early Post-Operative Prosthetic Fitting, Rehabilitation.

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#### BACKGROUND

In this study, we are providing a low-cost temporary prosthesis in the early post-operative period which can be fabricated in very less time and needs little training for its application and can be re-used as the definitive prosthesis just by changing the socket. Their functional outcome is being assessed using Prosthesis Evaluation Questionnaire, one-minute walk test, time to healing, and occurrence of complications. Post-operative management of transtibial amputees vary from center to center.<sup>2</sup> Prior to the delivery of the prosthesis the residual limb has to meet certain criteria. The wound must have healed, the oedema must have been reduced, the residual limb should have a conical shape and residual limb maturation should be achieved. The two most commonly used post-operative strategies that are carried out to meet these criteria are elastic bandaging method and rigid casting method with plaster of Paris. In the

elastic bandaging method, the residual limb is wrapped with an elastic pressure bandage. This helps to reduce the oedema, to shape the residual limb and also in maturation of the residual limb.<sup>3</sup> In the other method the residual limb is covered with a rigid dressing. If a rigid dressing along with a pylon and foot attachment is given soon after the surgery in the operating room or recovery room, it is known as Immediate Post –operative Prosthetic Fitting (IPOP). An Early Post-Operative Prosthetic Fitting is similar except that it is put on 5-7 days after the surgery.<sup>4</sup> Early fitting of prosthesis can be delayed up to 3-6 weeks until much of the oedema is gone and the wound has started to heal. As most of the post-surgical pain has subsided patients are better able to tolerate weight bearing. The rigid dressing is usually made of plaster of Paris or fiberglass. In this study socket is fabricated using fiberglass and the temporary prosthesis is given at around 3-6 weeks. The temporary prosthesis is typically an endoskeletal system, consisting of a socket, suspension, pylon, and prosthetic foot. This device is usually unfinished cosmetically. This strategy permits interchanging of components and helps to minimize production costs during a time when many adjustments and adaptations to the socket and to alignment are anticipated. The size and shape of the residual limb begin to change once the patient is ambulating on the temporary prosthesis. While the residual limb shrinks the patient has to increase the number

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of sock plies to compensate for the loss of limb volume. The definitive prosthesis is fitted when the size of the residual limb stabilizes. The plaster cast is assumed to improve the wound healing.<sup>5</sup> Compared to elastic bandaging rigid dressings prevents oedema instead of reducing it.<sup>6</sup> Finally patients regain walking ability sooner, knee flexion contracture can be prevented more efficiently<sup>7</sup> and they suffer less general complications, because of a quicker mobilization.<sup>8</sup> Some authors report disadvantages of an early cast socket, such as increased risk for pressure ulcers because of tightness of the plaster and a delay in detecting wound problems.<sup>9</sup>

In this study functional outcome of transtibial amputees is assessed after early post-operative prosthetic fitting. The outcome measure used is Prosthesis Evaluation Questionnaire. The complications, one-minute walk test and the time to definite prosthesis is also been assessed.

### **Aim of The Study**

To study the functional outcome of early post-operative prosthetic fitting in transtibial amputees.

### **Study Setting**

The Ward and Artificial Limb Fitting Centre under the department of Physical Medicine and Rehabilitation, Government Medical College, Thiruvananthapuram.

### **Duration of Study**

1 year.

### **Study Population**

All transtibial amputees with early post-operative prosthetic fitting admitted in Physical Medicine and Rehabilitation ward during 1 year.

### **Inclusion Criteria**

- Unilateral transtibial amputees with early post-operative prosthetic fitting.
- Age between 18 and 80 years.
- Both males and females.
- Medically and psychologically stable patients.
- Patients with normal consciousness and cognition.

### **Exclusion Criteria**

- Age <18 and >80 years
- Bilateral transtibial amputees
- Patients with severe cardiopulmonary diseases, severe bilateral visual defects, illness affecting equilibrium, mental illness, or cognitive deficits.
- Patients who have not given consent.

### **Sampling Size**

All consecutive cases admitted in PMR ward for a period of 1 year.

### **Sampling Technique**

Census type of study.

### **Data Collection**

Clinical examination and interview method.

## **METHODS**

In our department the transtibial amputees are provided with a temporary prosthesis during early post-operative period. It has a socket which is fabricated using synthetic cast to which a pylon is attached through an adapter. The length of the pylon can be adjusted as needed and to this a SACH foot is attached. The supracondylar cuff suspension is used in this study for most of the patients. Some were given sleeve suspension and one patient with a short residual limb was given a supracondylar suprapatellar socket. The preparatory prosthesis can be fabricated in just two hours. Initially standing is attempted and then walking in parallel bars as tolerated by the patients. Once the patient is able to walk satisfactorily with the prosthesis, they are discharged and reviewed once in two weeks to assess the residual limb for any complications. A one-minute walk test was also done during the visits. After two months they are given the prosthesis evaluation questionnaire. When the volume of the residual limb stabilizes which indicates limb maturation, assessed by the number of sock plies used, a definite prosthesis was prescribed.

### **Tool**

Semi structured questionnaire and Prosthetic evaluation questionnaire.

### **Outcome Measures**

Residual limb healing the duration of residual limb healing will be determined by the number of days between amputation and fitting the regular prosthesis (measurements for the prosthesis can only be taken when oedema has resolved, and the wound has healed).

### **Prosthesis Evaluation Questionnaire**

Functional outcome assessed using Prosthesis Evaluation Questionnaire by Interview method. The questions of the PEQ will be explained to the patients; they have to give their response as a value in between 0 and 100, with 0 being the worst response and 100 the best one. PEQ is an 82-item questionnaire comprising 9 scales which was developed to assess function and prosthesis related quality of life Miller and colleagues subsequently combined the ambulation and transfer items of PEQ to form a 13-item mobility scale (PEQ-MS) which is been used in this study.

### **One Minute Walk Test**

Patients were made to walk in the corridor near the ward where a distance of 20 meters was measured and marked. If the patient completes a distance of 20 meters before one minute, then patient has to turn back and continue walking.

### **Statistical Technique**

Mean SD proportion.

### **Ethical Considerations**

The study was approved by both the Research and Human Ethical Committee of our institution. All subjects had signed

an informed consent form (available in the local language also) to participate in the study.

## RESULTS

The study group consisted of 19 transtibial amputees between 19 and 80 years of age with a maximum number of amputees within 61-80 group. Majority of the patients were males (89.5%). 73.7% of the study population was manual laborers. At the time of presentation no one was able to go for work. Majority (84.2%) were married. Majority of the patients were manual laborers. The commonest cause of amputation in the study group was diabetes mellitus (36.8%), second was trauma (31.6%). Next common cause was malignancy (21.1%) and then came POVD (10.5%). The number of amputees due to vascular conditions is less in this study in contrast to the general observation probably because such patients were mostly excluded from the study due to the presence of co morbidities like diabetic nephropathy, diabetic retinopathy, coronary artery disease and also amputation in the other lower limb.

Majority of the patients were diabetics (57.9%). 31.6% of patients were having hypertension. 10.5% were having POVD and 5% had dyslipidaemia. Out of 19 patients 18 were having adequate length for the residual limb. Only one patient who had a traumatic amputation had a short residual limb. The length of the residual limb was measured from medial tibial plateau to fleshy end. The ideal length of the residual limb is 5-6 inches calculated as 1 inch per feet of body height. 4 out of 19 patients (21.1%) in the study group were having impaired sensation over the residual limb. Among those patients 3 were having diabetic peripheral neuropathy and one patient was having grafted skin. 10.5% of patients have undergone skin grafting following amputation. This caused a delay in prosthetic fitting and also was a predisposing factor to ulcer formation during prosthetic fitting.

## DISCUSSION

Majority of patients were having a healed non-adherent scar. 26.3% had scar adherence. Amputation can include muscle-to-muscle (myoplasty), muscle-to-fascia (myofascial), and/or muscle to bone (myodesis) surgical fixations for stabilization of the remaining muscle. Scarring or adhesions can occur among any or all of these tissues. The presence of such adhesions can lead to tissue breakdown and/or discomfort. Scar massaging and soft-tissue mobilization techniques should be advised early in the rehabilitation process as limited soft tissue mobility of the residual limb may have an impact on prosthetic tolerance, comfort and use. 36.8% of the patients were having restriction of ROM at knee joint. After two months only 23.5% of patients were having restriction in ROM. In an immediate post-operative prosthetic fitting the socket extends from thigh level bracing the knee joint also it prevents knee flexion contracture. In this study removable rigid dressings were used along with stretching and strengthening exercises which actually resulted in improvement in ROM. Majority of patients were having

normal sensations over the opposite limb. Among 19 patients 4(21.1%) patients were having sensory dulling of the opposite limb. All four were having diabetic peripheral neuropathy. Among 19 patients 8(42.1%) patients were fitted with the temporary prosthesis within 6 weeks of amputation. The rest 11 patients (57.9%) were given the temporary prosthesis within 7-12 weeks of amputation. The prosthetic fitting was delayed in two patients due to presence of grafted skin over the residual limb. 5 patients had marked oedema for which rigid casting was done 2-3 times to control the oedema which caused delay in fitting of temporary prosthesis. Few patients were not regular with the follow up which also caused a delay. Among the 19 patients 5 patients were prescribed definite prosthesis at 2 months of gait training with preparatory prosthesis, 11 patients were given at 3 months. One patient who had amputation following squamous cell carcinoma died during and thus lost follow up. Rest two patients developed fracture and were not given definite prosthesis. Definite prosthesis was prescribed when the volume of residual limb became stable which was assessed by the number of sock plies. The healing time can be roughly estimated by the time from amputation to definite prosthesis. Time from amputation to prescription of permanent prosthesis was recorded. The mean number of days was 106. Usually our patients who are managed by soft dressings have to wait for 6 months to 1 year for a definite prosthesis due to the delayed maturation of the residual limb. 64.7% of patients were having phantom sensation once in a week. 23.5% were having such sensations 2-3 times in a week. Intensity of phantom sensation was assessed using a visual analog scale where higher score indicates extremely mild sensations and lower score indicates extremely intense phantom sensations. All patients are having scores more than 60 which indicates less intense phantom sensations. Majority of the patients were having phantom pain which was assessed after two months of gait training. Among 18 patients only 2(11.1%) patients were not having any phantom pain. 44.4% of patient had phantom pain 2-3 times in a week. 38.9% had about once in a week and 5.6% had several times every day. The patients were asked how intense their pain was and the response was recorded using a visual analog scale in which 0 means extremely intense and 100 means extremely mild. So a high score indicates a lesser pain. 50% of patients were having a VAS of 90 which indicates less pain. None among them were having extremely intense pain.

Phantom pain is a negative predictor for successful rehabilitation of amputees. In contrast to this both phantom sensations and phantom pain are not having any statistically significant correlation with the ambulatory scores or one-minute walk test in this study. Out of 19 patients one patient died. 8 patients were without any complications. 7 patients developed ulcer at the residual limb end following usage of temporary prosthesis. 2 patients had breakage of the prosthesis, one was at the junction of socket and pylon and other was at the foot. 2 patients developed fracture. One person developed rupture of tendo Achilles when standing was attempted with the prosthesis probably due to impaired

sensations and proprioception in the normal limb due to diabetic peripheral neuropathy. Tendo Achilles rupture was repaired from orthopaedics department following which he was bedridden for 2-3 months. After that patient attempted standing at home and developed a tibial condylar fracture. The other patient who was bedridden for few months even before amputation had a fall at the bathroom following which developed fracture femur at the amputated site. His radiographs revealed osteoporosis probably because he was bedridden for few months even before amputation due to the diabetic ulcer. These two cases suggest that patients who were bedridden for more than 1-2 months before amputation or before gait training are not good candidates for early prosthetic fitting. In such patients radiographs or DEXA scan may be taken to assess bone density. They should be started on controlled weight bearing with walking aids or prosthesis. This is supported by Seymour who suggested patients who had been bedridden for more than 45 days permutation, patients with expected delayed wound healing (such as those with diabetes mellitus, vascular compromise, and preoperative limb oedema) and frail patients as contraindications for early prosthetic fitting. Diabetic peripheral neuropathy with decreased proprioception also makes gait training and rehabilitation of amputees difficult. One-minute walk test was done during admission after giving the temporary prosthesis and also after one month. At admission the mean distance was 16.13 meters with a standard deviation of 6.927 and after one month the mean distance was 27.31 meters with a standard deviation of 11.643. There is a significant increase in the distance walked by amputees after using the temporary prosthesis after one month. Ambulatory scores of 17 patients were obtained using the motility scale in prosthesis evaluation questionnaire. The minimum score was 49.3 and maximum score was 68.7. Mean score was 58.4 with a standard deviation of 5.4. Higher the ambulatory score better the functional outcome.

Cause	N	Ambulatory Scores		F	p
		Mean	Sd		
Diabetes Mellitus	6	55.95	5.04	1.173	0.358
POVD	2	56.55	4.88		
Tumour	3	58.57	8.22		
Trauma	6	61.47	4.02		
Total	17	58.43	5.40		

**Table 1**

Traumatic amputees are having the highest ambulatory scores and those with amputation following diabetic foot are having the least score. There is no significant correlation between aetiology and ambulatory scores. The relatively high score in traumatic amputees is probably due to other factors like younger age, intact sensations and better proprioception in the residual limb and intact limb.

There is no significant correlation between cause of amputation and one-minute walk test.

Cause	N	One Minute Walk (2) Distance in m		F	p
		Mean	Sd		
Diabetes Mellitus	5	23.00	6.71	3.176	.063
POVD	2	35.00	14.14		
Tumour	3	15367	4.04		
Trauma	6	34.17	12.01		
Total	16	27.31	11.64		

**Table 2**

Though the one-minute walk distance is relatively higher in the amputees who started ambulation within 6 weeks when compared to those who started ambulation in 7-12 weeks, there is no statistically significant increase.

Prosthesis Fitting Time	N	One Minute Walk (2) Distance in m		F	p
		Mean	Sd		
Within 6 weeks	5	29.00	10.84	.380	.710
7-12 weeks	11	26.55	12.42		

**Table 3**

The ambulatory scores in amputees who were given prosthesis within 6 weeks is relatively higher than the same in amputees who were given the prosthesis within 7-12 weeks. But the difference is not statistically significant.

**CONCLUSIONS**

1. The removable rigid dressing is a useful means to facilitate wound healing, because the system reduces oedema and tissue tension.
2. Residual limb maturation is faster with rigid dressings when compared with soft dressings.
3. Early prosthetic fitting and gait training can prevent complications like deconditioning of muscles, knee flexion contractures, falls.
4. Reduced access for wound inspection, frequent changing of cast, and immobilization of knee joint are the disadvantages of IPOP which can be overcome in a removable rigid dressing.
5. Gait training of the patient is easier.
6. Psychological advantages like better acceptance of the amputation and restoration of the body image.
7. Traumatic amputees are having better ambulatory scores than those with amputations due to diabetes mellitus or vascular insufficiency.
8. Phantom sensations or phantom pain does not have any influence on the functional outcome of transtibial amputees.
9. Attending personal and aftercare for patients after EPOP is less when compared to IPOP. Rehabilitation of amputees is a team work. There should be active involvement of rehabilitation physicians, prosthetist and physiotherapist in the management of amputees.

In all elective cases of amputations, the patient should be seen by a physiatrist even before surgery, so that they can be educated regarding the exercises, ambulatory aids, and various prosthetic options. The patient is able to absorb and comply with a therapy programme during the preoperative period and hence can have a better outcome.

Lack of comprehensive rehabilitation centers and artificial limb fitting centers in major hospitals is a challenge for the early fitment of the prosthesis. Presently, orthopaedic and general surgeons are doing amputation surgeries. Amputation surgeries done by physiatrists are decreasing. Hence, in these circumstances IPOF is practically impossible and EPOF is a viable alternative. Though there is evidence in the literature regarding better outcome with rigid dressings and immediate post-operative prosthetic fitting, a more recent and comprehensive survey in 2001 shows a decline in the usage of the same probably because it requires a skilled team for its fabrication. Early prosthetic fitting is a practical solution to this problem if it can be given within 6 weeks of amputation. Till then preferably the patient can be given a removable rigid dressing and weight bearing can be started once most of the oedema is gone and the pain has also subsided. Within 2-3 months, the residual limb matures, and a definite prosthesis can be given using the same endoskeletal kit. Only the socket needs to be changed thus cost effective also. Hence it is suggested that in developing countries, simple, inexpensive temporary prostheses are essential. Delay in prosthetic fitment result in less daily use of the prosthesis, based on a study done in our center. Fabrication of BK prosthesis using the present endoskeletal transtibial kit requires only 2 hours to complete the fitting. Hence prosthetic fitment can be made without delay resulting in a better rehabilitation outcome. The artificial limb fitting center should be modernized with newer machines, adequate funding and cheaper and effective prosthetic kits so that timely delivery of prosthesis can be achieved. A proper disposal system should be encouraged in the artificial limb fitting center so that occupational hazards can be minimized, and an eco-friendly atmosphere can be established. The current literature is lacking sufficient studies regarding EPOP. Future randomized trials on transtibial amputees dressing and management strategies are clearly needed to collect the evidence needed to best guide clinicians with the decision.

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