

The Effect of Early Mobilization in Transtibial Amputees with an Unhealed Residuum—Detrimental or Beneficial to Patients: A Review of Literatures

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ABSTRACT

Objective: To systematically identify and summarize literatures on early mobilization of transtibial patient with unhealed wound or ulcers.

Setting: Published literatures up to and including December 2017 where transtibial amputee with unhealed wound or ulcers and the effect of mobilization on wound healing and rehabilitation were reviewed.

Participants: Lower limb transtibial amputees with primary or secondary wounds were followed up to see if mobilization was detrimental or beneficial to wound healing.

Results: A total of 1,250 literatures were identified from search database of MEDLINE, PubMed, Google Scholar, and Ovid. Duplicates were removed and 12 abstracts were screen. Seven full-text articles were assessed for eligibility, and two literatures were felt to meet the prescribed criteria. Both literatures were from the United Kingdom, and both literatures showed that there was no detrimental effect of early mobilization in patient with large unhealed wound or ulcers.

Strength and limitation of this study: Very few published literatures on the effect of early mobilization results in a small sample size. This highlights the need for more similar studies to be carried out. Only one reviewer performed the analysis, creating potential biasness.

Keywords: Amputee, Mobilization, Transtibial, Unhealed wound.

How to cite this article: Cheng L, Basu B. The Effect of Early Mobilization in Transtibial Amputees with an Unhealed Residuum—Detrimental or Beneficial to Patients: A Review of Literatures. *Indian J Phy Med Rehab* 2017;28(4):136-139.

Source of support: Nil

Conflict of interest: None

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INTRODUCTION

In the United Kingdom, the cause of 70 to 80% of lower limb major amputation is vascular insufficiency (Peripheral arterial disease, PAD, with or without Diabetes mellitus). Any amputation above the ankle level is considered “major”.^{1,2} The prevalence of transtibial amputation is slightly more than 50%, and higher than transfemoral level. In the United Kingdom, the national prevalence of lower limb amputation is 5/100 000, about eight times higher in diabetics than in non-diabetics, three times higher in men, higher in the Afro-Caribbean population, and lower in South East Asians. Smoking is the most important modifiable factor with a four-fold greater chance of developing intermittent claudication. The PAD with smoking has more chance of amputation and three times higher failure rate of surgical bypass graft.

The healing rates for below- and above-knee amputations vary considerably. It is thought that a total of 90% of above-knee major amputations heal, 70% primarily, whereas for below-knee amputations, primary healing rates range between 30 and 92% (about 1 in 3), with a re-fashioning rate of up to 30% (about 1 in 3).^{2,3}

Mobilization early post-surgery is known to be essential to aid the rehabilitation process and prevent complications, such as contractures (shortening due to secondary change) or deconditioning of muscle, which will make the rehabilitation process complicated in the future. In ideal situations, patients wound would heal around two weeks post amputation⁴ and the patient would be able to carry out his or her rehabilitation process by using early walking aids. There are, however, no set guidelines or protocol on when would be the ideal time to commence walking training, should the wound fail to heal at this set period of time.^{1,4} Ulcers are a recognized complication in new and established prosthetic limb users as a result of pressure on bony prominences and sheer forces.⁵ Concern arises among physicians when is the ideal time to mobilize both these groups of patients, especially among juniors, if the unhealed wound or ulcer is large. Therefore, most physicians tend to take the conservative approach of “watching and waiting” instead of mobilizing the patient, as this is very much part of traditional medical teaching and natural caution.⁴ The question is therefore

raised if early mobilization in transtibial amputee with an unhealed wound or ulcer is detrimental, leading to further wound breakdown, or would it promote wound healing and quicker recovery.

MATERIALS AND METHODS

Search Strategy

A systemic search of MEDLINE, PubMed, Google scholar, and Ovid was conducted up to and including December 2017. Search keywords include "transtibial", "amputee", "unhealed wound," and "mobilization". Only the top 50 papers on Google scholar were screened to see if it meets the inclusion criteria. Search results were limited to English language. References from the identified paper were further reviewed to see if they meet the inclusion criteria.

Inclusion and Exclusion Criteria

An unhealed wound was defined as anything more than 1 × 1 cm, 2 weeks post-surgery. An ulcer was defined as a break in the skin, which was previously healed or never healed with primary intention, in a new or established amputee. A healed wound was defined by complete closure of wound or ulcer. Smokers, vasculopathy and diabetics with associated microvascular disease, sensory neuropathy, or both, although recognized as factors which would delay wound healing, were included in the inclusion criteria as most amputees in the United Kingdom arise from these cohorts of patients. Literatures which included transfemoral amputees were included in view of the limited published data. Literatures which looked at the effect on early mobilization in post-amputee, but

did not have an unhealed wound or ulcer were excluded. Literatures which looked at the effect of different management of wound healing, such as different types of dressing or prosthesis, but not the effect of mobilization on wound healing, were not included.

Study Selection Process

The titles were independently examined by a single reviewer (LC). Abstracts from titles which meet the inclusion criteria were reviewed in which the full text was subsequently reviewed to see if the article meets all the inclusion criteria. The reference list was also examined with additional papers included by the same criteria. Literatures on the effect of early mobilization in below knee amputees with no wounds were rejected (Flow Chart 1).

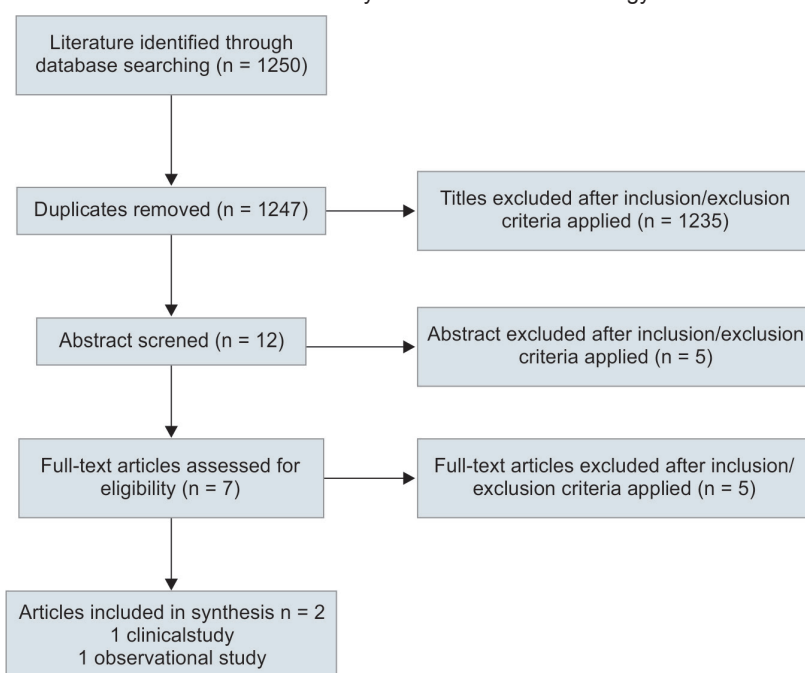
Quality Assessment

There was no suitable tool to grade the quality of included literature, and thus it was performed on an objective basis by the reviewer (LC), based on semi-objective assessment of factors influencing the generalizability, raising the risk of bias and reporting quality of included literatures.

RESULTS

The initial search revealed ten published papers on PubMed, twenty-four published papers on Ovid, zero relevant papers on MEDLINE, and 1,250 on Google scholar. Only the top fifty papers on Google scholar were screened and in which nine were identified as possibly relevant. Duplicated papers were removed, and after a full-text examination of five articles, only two were noted to be relevant.

Flow Chart 1: Study selection and methodology



Two studies from the United Kingdom were identified. A total of 168 transtibial and transfemoral amputees with an unhealed wound or ulcer were included (118 unhealed wound and 50 unhealed ulcers) with study sizes ranging from 66 to 102 patients (Table 1). Each paper used a different walking training aid: Van Ross et al⁴ used a Pneumatic Post-Amputation Mobility (PPAM) aid for approximately three weeks, before providing a transtibial prosthesis, while Salawu et al⁵ continued with the patient's own prosthesis, which was modified to reduce pressure on the ulcer.

The mean age of study participants ranged from 60 to 62.8. There was no age limit set in both papers. One study looked at unhealed wounds in new transtibial amputees only, while the second study looked at both unhealed wound and ulcers in both transtibial and transfemoral amputees.

Both study had a high completion rate (90 and 92.1%). Van Ross et al⁴ continued to follow up the group of patients that fell out from the study (10%). Salawu et al,⁵ however, did not continue to follow up on the group of patients that did not complete the study.

Smoking status which is a recognized factor to impair wound healing^{2,6} was considered by Van Ross et al,⁴ where the resting TcpO₂ and TcpCO₂ were measured. The effect of smoking was evident when the mean TcpO₂ levels for non-smokers were noted to improve after therapy (p < 0.01), whilst the level remained the same for the smokers. Van Ross et al⁴ also noted that time to heal was significant between smoker *vs* non-smoker. Salawu et al⁵ did not look at the impact of smoking on wound healing.

Both papers did not look at glycemic control of the group of patients with diabetes.

Van Ross et al⁴ showed that there was complete healing with no adverse effect to stump or general health noted in 74% of the participants over a mean of 141 days. There was also an increase of the stump TcpO₂ from 41.3 to 50.6 mmHg after a mean of 97 days' mobilization. Van Ross et al⁴ concluded that patients with large unhealed transtibial stump wound can simultaneously undergo walking training by using a suitable walking aid, which is essentially contrary to the traditional practice where patients are advised to not put pressure on the unhealed wound.

Salawu et al,⁵ in his observational study, found that 64% of participants with unhealed wounds or ulcers healed completely over a period of six weeks despite the continual usage of the prosthetic limb. In the group of patients with ulcers that did not completely heal, 25% of the ulcers reduced in size. Salawu et al⁵ unfortunately did not look at the confounding factors, such as smoking, dysvascularity, or the glycemic status of diabetics. Salawu et al⁵ acknowledge in his paper that further studies should be performed to review the group of patients who were advised to abstain from prosthetic limb usage as two of the patients' ulcer was noted to deteriorate.

Table 1: Suitable literature review

Reference	Conditions	Origin	Design	Patients included	Measures used	Results	Summary	Pros + and cons -
Van Ross et al	Primary wound breakdown	United Kingdom	Clinical trial on new TT amputees of dysvascular origin with unhealed wound mobilised using PPA Maid over 3-6 weeks	66 new TT amputees Mean age 62.8 ± 10.89 46% male 50% white 23% diabetic current smoker	1 Resting TcpO ₂ and TcpCO ₂ measured 2 Lead clinical regular wound review 3 Photos taken regularly	90% complete healing after 141 days (baseline stump wound 7.4 ± 3.2 cm x 3.5 ± 2.4 cm) 8% failed to heal, progressing to TF amputation Longer healing time in smokers (196 ± 142d vs 200 ± 123d)	Complete healing with no adverse effect to stump or general health 74% Healing rate in smokers almost double non-smokers	+ Effort made to take into consideration effect of smoking, emphasising on importance of MDT approach to rehabilitation + High completion rate + Patients who - Relatively small sample size - No clear definition/subjective measurement of wound healing
Salawu et al.	Primary and secondary wound breakdown	United Kingdom	Observational study on new and established prosthetic limb users with unhealed wound or ulcers divided into 3 groups: - Discontinue usage of prosthetic limb - Continue usage of limb with cotton socks - Continue usage of limb with silicon sleeve followed over a period of 6 weeks	102 new and established lower limb prosthetic users Mean age 60 71% male	1 Pre-existing and new area of skin breakdown measured and photographed 2 Results analysed using statistical Package for Social Sciences and Fischer's Exact Test	92.1% completion rate 85% of completed patients are TT amputees 90% of both TT and TF noted no change or improvement in wound	64% healed despite mobilising Healing better (p = 0.024) in mobile vs non-mobile group	+ Stepping stone for further studies to be conducted + Objective measurements of ulcer size - Subjective assessment by patients themselves if prosthetic limb usage has been "less", "more" or "as usual" - Did not look into smoking or vascularity status of patients - No follow up on patients who fell out of the study

DISCUSSION

Both studies showed that despite an unhealed wound or ulcer, early mobilization is not detrimental to the wound but highly beneficial in the transtibial amputees' rehabilitation process. This new method of management of unhealed wound would potentially lead to lower rates of muscle deconditioning, and contractures developing, as well as accelerated wound healing. Van Ross et al⁴ also showed that it improves early phantom pain and sensation relief as well as treat the edema of the residuum.

Both studies are relatively small in size and further studies should be undertaken to see the long-term effect of early mobilization on how patient's mobility improves in the long run. The frequency of physiotherapy and type of dressing should also be looked at. Factors which affect wound healing, such as smoking, dysvascularity, and glycemic status should be taken into consideration. The Specialised Ability Centre in Manchester, which is a sub-regional center for amputee and prosthetic rehabilitation in the United Kingdom, has considerable experience in

early mobilization protocol and in near future, we will publish our data.

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