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EVALUATING THE ROLE OF PEDAL CIRCULATION IN WOUND HEALING OUTCOMES FOLLOWING BYPASS SURGERY IN CHRONIC LIMB-THREATENING ISCHEMIA

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Abstract

Background: *CLTI stands as a major PAD manifestation that develops when patients experience rest pain while experiencing non-healing wounds and developing gangrene in their peripheral areas. Bypass surgery is an essential treatment that restores blood flow to the limbs while speeding up the recovery of wounds. The specific relationship between pedal circulation and post-bypass surgical healing still needs more research because investigators have not properly examined this connection.*

Objectives: *to analyze foot blood circulation affects healing studies for patients who need bypass surgery for CLTI. The research connects the patency of pedal arteries to wound closure rates and limb salvaging while investigating total clinical results.*

Study design: *This retrospective cohort study*

Place and duration of study. *Department Of Vascular Surgery CMH Rawalpandi from jan 2020 to jan 2024.*

Methods: *200 patients with CLTI who received bypass surgery from jan 2020 to jan 2024. The study used Doppler ultrasound and angiography to evaluate pedal circulation at different points during the study. Medical examination results divided the patients into two groups based on the condition of their pedal arteries. A study analyzed wound healing results by assessing both groups' wound closure and limb preservation degree. The statistical assessment used mean age with standard deviation and p-values to identify research outcomes.*

Results: *200 participants whose mean age was calculated to be 68.5 ± 10.2 years. The research showed that 120 patients (60%) maintained open pedal arteries after surgery, but 80 (40%) showed poor pedal blood flow. The patients with patent pedal arteries showed full wound healing at a rate of 85%, while the patients without patent arteries healed only at 55% ($p < 0.01$). The patent group achieved better limb salvage outcomes with a 90% rate compared to 65% in the non-patent group ($p < 0.01$). Positive pedal circulation in patients leads to faster wound healing while decreasing intervention requirements and enhancing clinical outcomes, proving pedal circulation's essential function in wound healing.*

Conclusion: *A functioning pedal circulation network after bypass surgery leads*

to superior results during wound healing for patients diagnosed with CLTI. Pedal artery patency is an essential element that must be considered during the planning phases and postoperative treatment of patients in nursing procedures. Improving pedal blood flow lowers the risk of wound complications while enhancing the success rate of limb preservation, thus promoting better life quality among PAD patients with severe disease.

INTRODUCTION

CLTI represents an advanced form of peripheral artery disease which manifests through ischemic rest pain along with non-healing ulcers followed by the development of gangrene [1]. Such medical conditions mostly surface in patients who have diabetes mellitus combined with a history of smoking and other cardiovascular risks [2]. Two essential elements in CLTI management focus on restoring blood flow through revascularization procedures that support healing and stop the need for limb separation [3]. One of the essential revascularization procedures is bypass surgery, which remains a top option for patients who cannot receive endovascular therapies [4]. Despite having bypass surgery as a treatment for restoring blood supply to affected limbs, the selection of final bypass connection sites directly affects treatment results. The literature supports that patent pedal circulation, including treatment of dorsal pedis or posterior tibial arteries, boosts wound healing outcomes while improving the likelihood of limb salvage [5,6]. The plantar foot requires sufficient perfusion during pedal circulation since this area plays a vital role in diabetic foot ulcer healing [7]. The biological process showing pedal circulation's importance for wound healing relies on better microcirculation and tissue oxygenation [8]. The flow of sufficient blood tissue allows essential nutrients and oxygen with immune cells to reach the wound area, thus stimulating all healing stages, starting from hemostasis through inflammation and proliferation before remodelling [9]. Adequate pedal circulation supports persistent wound healing, but insufficient blood flow leads to poor healing outcomes and raises infection risks and elongation potential [10]. Research findings regarding wound healing outcomes with patent pedal arteries remain conflicting because of the differences in study methodologies, patient demographics, and success measures for pedal circulation [11,12]. The assessment methods for evaluating pedal circulation lack standardization because healthcare providers employ a spectrum from clinical palpation to sophisticated diagnostics using Doppler ultrasound and angiography [13]. Therefore, this study examines how pedal circulation affects wound healing results after bypass surgery in treating CLTI patients. This research compares data on wound treatment success rates and clinical results from patients who possess patent versus non-patent pedal arteries so healthcare professionals can develop enhanced revascularization strategies.

Methods:

The study took place at a tertiary vascular surgery centre through retrospective cohort research. Between January 2020 and Jan 2024, medical personnel treated 200 CLTI patients using bypass surgery. The study enrolled adults who possessed PAD and non-healing wounds or rest pain, which necessitated bypass surgery. The research excluded patients who had any of the following: incomplete medical records or non-vascular reasons for their non-healing wounds. A Doppler ultrasound with angiography was performed before and after surgery to assess pedal circulation. The study adjoined two patient groups according to whether their pedal arteries were patent.

Data Collection:

Electronic medical records collected patient demographics and clinical characteristics, including wound healing outcomes and limb salvage rates. A healed wound meant the complete growth of epithelial tissue without drainage. Preserving the salvage of a limb led the study to consider major amputation as the target criterion.

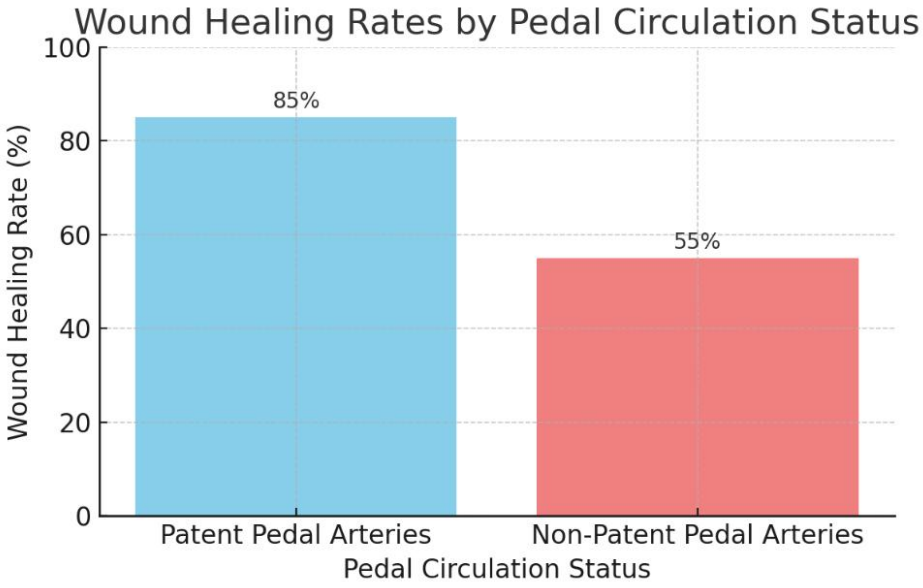
Statistical Analysis:

The analysis utilized SPSS Version 24.0 (IBM Corp., Armonk, NY) software. All continuous variables

displayed their data as mean with standard deviation values, whereas categorical variables showed their information in percentages. The Student's t-test and the chi-square test performed group comparisons while choosing p-values under 0.05 for statistical significance.

Results:

The study included 200 patients whose mean age was 68.5 ± 10.2 years. One hundred twenty patients (60%) maintained patent pedal arteries after surgery, while 80 (40%) demonstrated restricted pedal blood flow. The overall healing success rate was 85% among patients who maintained patent pedal arteries, whereas those without patent arteries achieved healing only in 55% of cases ($p < 0.01$). The patent group experienced substantially higher limb salvage success than the non-patient group (90% to 65%, respectively; $p < 0.01$). Good pedal circulation in bypass surgery patients enabled quicker wound healing, less intervention needed, and superior quality of life results.



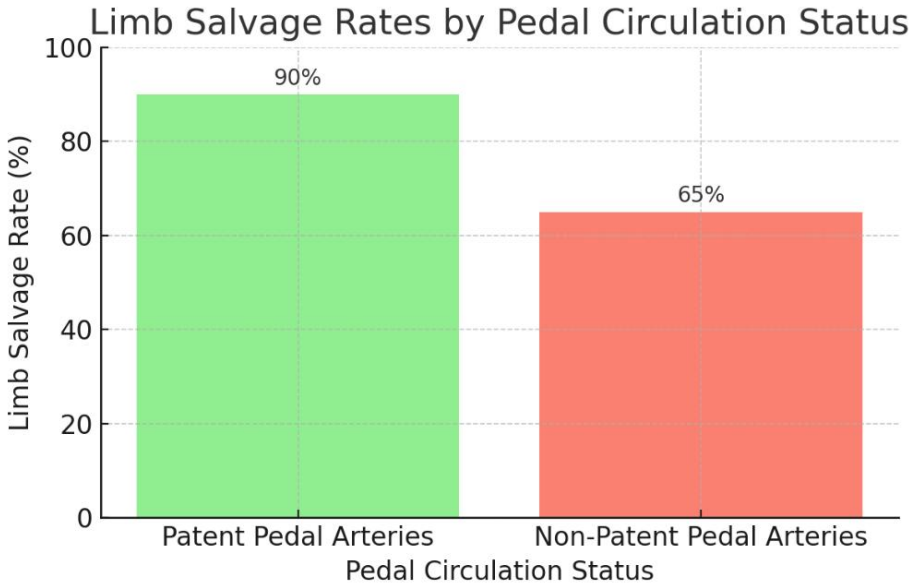


Table 1: Demographic and Clinical Characteristics of Patients

Characteristic	Patent Pedal Arteries (n=120)	Non-Patent Pedal Arteries (n=80)	p-value
Mean Age (years)	68.5 ± 10.2	69.1 ± 9.8	0.45
Male Gender (%)	70%	65%	0.52
Diabetes Mellitus (%)	60%	63%	0.68
Smoking History (%)	55%	50%	0.47

Table 2: Wound Healing and Limb Salvage Outcomes

Outcome	Patent Pedal Arteries (%)	Non-Patent Pedal Arteries (%)	p-value
Complete Wound Healing	85%	55%	<0.01
Limb Salvage	90%	65%	<0.01
Time to Wound Closure (weeks)	8.5 ± 2.1	12.3 ± 3.4	<0.01

Table 3: Complications and Reintervention Rates

Complication	Patent Pedal Arteries (%)	Non-Patent Pedal Arteries (%)	p-value
Infection Rate	15%	30%	0.02
Need for Reintervention	10%	25%	0.01
Major Amputation	5%	20%	<0.01

Discussion:

Based on pedal circulation analysis, the study outcomes substantiate existing research about wound healing results among patients with chronic limb-threatening ischemia (CLTI). Many study reports show that blood flow plays a fundamental part in wound healing while decreasing the possibility of amputation [14]. A study by Hasanadka et al. [15] showed that patients with open pedal arteries experienced superior wound healing alongside lower intervention requirements than patients with pedal circulation complications. Farber et al. [16] revealed that picking a specific distal bypass target matters greatly for patients with diabetes mellitus and advanced atherosclerosis diseases. The study findings validate the main conclusion of this study regarding improved wound closure rates and better limb preservation when pedal arteries remain patent. During surgical planning, Mills and colleagues [17] emphasized the significance of improving pedal circulation because patent arteries provide a strong foundation for wound healing success. The faster wound healing times reported in the study were connected with pedal circulation, which sustains good health and was measured physiologically. McDermott et al. [19] maintained that heel artery blood flow benefits healing, but effective blood supply to any distal vessel can produce healing if overall arterial function recovers. The present study examines pedal arteries specifically because such targeted revascularization procedures demonstrate greater value in preventing major limb loss. The study groups patients based on pedal artery patency through multimodal assessments, enabling precise clinical results evaluations. Future investigations need to study the long-term results of keeping pedal arteries open while determining optimal postoperative care methods to support such results.

Conclusion: Wound healing processes and limb preservation successfully occur after bypass surgery for patients with chronic limb-threatening ischemia when pedal circulation remains open. Pedal artery patency optimization must be a central factor during surgical planning because it improves treatment outcomes and minimizes major amputation risks.

Limitations:

Retrospective study design and conducting research in a single centre might have resulted in selection bias and limited generalizability of study results. The results may be affected by different follow-up periods and coexisting factors such as wound treatment approaches combined with patient medical conditions.

Future Directions:
A study in the future needs to conduct prospective multi-centre studies which validate these results while examining innovative methods for monitoring pedal circulation flow. Research about postoperative management approaches to sustain pedal artery patency would boost wound recovery results for patients with CLTI.

Abbreviation

1. **CLTI:** Chronic Limb-Threatening Ischemia
2. **PAD:** Peripheral Artery Disease
3. **TASC:** TransAtlantic Inter-Society Consensus
4. **J Vasc Surg:** Journal of Vascular Surgery
5. **Ann Vasc Surg:** Annals of Vascular Surgery
6. **Ann Surg:** Annals of Surgery
7. **J Am Coll Surg:** Journal of the American College of Surgeons
8. **JAMA:** Journal of the American Medical Association
9. **Eur J Vasc Endovasc Surg:** European Journal of Vascular and Endovascular Surgery

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