Does Early Postoperative Rehabilitation Affect Pain, Function, and Satisfaction for Patients Underwent Microvascular Lower Limb Free Flap?

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Abstract: Background: Microvascular free flap is an important to reconstructive tissue defects and restore anatomical structure and functional following disabling injuries. Aim of study: Evaluate the effect of early postoperative rehabilitation on patients' pain, function, and satisfaction. Patients and Methods: Sixty patients who attended the microvascular reconstruction unit and the trauma department with lower limb defects indicated for microvascular free flap were randomly selected, their age (18 to 65 years). Sample were randomized into two groups by using a shuffled deck of cards (even number = control group, odd number = study group). Patients of the study group received an early postoperative rehabilitation teaching booklet while those of control group received regular hospital care only. Tool I: Patient assessment sheet. Tool II: Numeric pain rating scale. Tool III: Lower extremity functional scale. Tool V: Surgical satisfaction questionnaire. Results: Statistically significant difference was found in both groups concerning postoperative pain, lower limb function, and patients' satisfaction during follow up (3 weeks, 3 months,6 months). Conclusion: Early postoperative rehabilitation protocol for patients who underwent microvascular lower limb free flap improved outcomes; significantly minimized pain level, improved lower limb function, and increased patients' satisfaction. Recommendations: Early postoperative rehabilitation protocol for study group had a favorable effect on patients' pain, function, and satisfaction. Patients who underwent microvascular lower limb free flap should receive careful early rehabilitation protocol to improve their outcomes.

Keywords: Early Postoperative Rehabilitation, Lower Limb Function, Microvascular Free Flap, Pain, Patients Satisfaction.

1. INTRODUCTION

Free flaps are a commonly utilized microsurgical approach for the restoration of defects in lower extremities following trauma, chronic infection, or oncological dissection. Microsurgical technology advancements in recent decades have significantly increased the feasibility of lower extremity reconstruction. It is a part of the tissue that can be anatomized, elevated, and inset in a non-anatomical position as a sequel of its vascular supply. It may consist of any incorporation of skin, muscle, fascia, and bone (Krijgh et al., 2020).

Microvascular free flap plays a crucial role in the reconstruction of high-energy lower limb trauma with accompanying soft tissue, bone, and muscle loss as a result of its capacity to offer adaptable healthy tissue that may cover defect area and improve the wound's vascularity. The reconstruction of tibia, ankle, and foot fractures benefits greatly through the use of free flaps. (Gage et al., 2016).

When planning a microvascular reconstruction for lower limb, it is necessary to consider that the lower extremity existing higher risk than another area. These are caused by the lower limb vascular network, which might be affected by a variety of diseases, including diabetes or peripheral vascular disease, as well as the nature of the region has responsibility for weight bearing. Most of the skin coverage in of the lower extremities is thin and tight over muscles and occasionally directly the bone (Shammas et al., 2018).

Rehabilitation is a process aimed at helping a person achieve higher levels of independence, quality of life, and functioning potential. The goals of rehabilitation are pain control, optimization of a range of motion and strength of

both lower extremity musculature, promotion of wound healing, limb pain/sensation management, functional mobility training, continued patient education, emotional support, and improvement in function. It is necessary to evaluate the pre-injury social circumstances and expected rehabilitation approaches. Successful early rehabilitation may also affect the patient's return to normal status (Jordan et al., 2014).

A rehabilitation nurse has an important role for patients undergoing microvascular free flap. The nurse should carefully perform routine postoperative care such as monitoring vital signs, in addition to specific care which include the following: monitoring peripheral circulation, close assessment of the flap (type and site of flap, color, temperature, and turgidity of skin, assess capillary refill) for early detection of any early perfusion alterations and immediately resolve any problems because of an interruption of flap perfusion due to complete or partial loss of flap and urine output, as well as nurses taking care of teaching patients about self-care, adequate nutrition, instructions and training about early mobilization, breathing, and lower limb exercises (Lazar et al., 2016, Gutenbrunner et al., 2021).

1.1. Significance of the Study

The incidence of microvascular lower limb free flap in microvascular reconstruction unit at Assiut University Hospitals, (2021), approximately 90 cases during the period from January 2021 to December 2021. From the experience of researchers, it has been noticed that patients with microvascular lower limb reconstruction are faced many problems postoperatively related to lack of knowledge about rehabilitation that is required to improve pain and functional recovery, and thus led to higher prolonged hospitalization and increased costs. So, this study focused on evaluating the effect of early postoperative rehabilitation protocol for patients who underwent microvascular lower limb free flap to improve pain, function and satisfaction.

1.2. Aims of Study

Develop and implement early postoperative rehabilitation protocol for patients who underwent microvascular lower limb free flap according to patients need.

Evaluate the effect of implementing an early postoperative rehabilitation protocol (teaching booklet) on the patients' pain, function, and satisfaction.

1.3. Research Hypotheses

The current study hypothesized that implementation of an early postoperative rehabilitation protocol for patients underwent lower limb free flap would provide beneficial benefits in the form of reducing pain, improving function, and satisfaction.

2. PATIENTS AND METHODS

2.1. Research design

This study was carried out using a randomized controlled trial.

2.2. Setting

This study was carried out at microvascular reconstruction unit and the trauma unit at Assiut University Hospitals.

2.3. Sample

This study involved 60 male and female patients who attended the microvascular reconstruction unit and the trauma department with lower limb defects indicated for microvascular free flap with age ranged from eighteen to sixty-five years. This study excluded patients with peripheral vascular disease or diabetes mellitus. This sample were randomized into two groups by using a shuffled deck of cards (even number = control group, odd number =

study group). Patients in the study group received an early postoperative rehabilitation teaching booklet while those of control group received regular hospital care only.

2.4. Sample size:

According to **Thompson, (2012)**, the study sample was selected 60 cases after utilizing the following equation to determine it with a 95% confidence level.

$$n = \frac{N \times p(1-p)}{\left[\left[N-1 \times \left(d^2 \div z^2\right)\right] + p(1-p)\right]}$$

N is the total number of patients (90 cases) who underwent microvascular lower limb free flap reconstruction at Assiut University Hospitals in 2021.

Z = confidence levels equals 0.95 and 1.96, D = error ratio equals 0.05, P = property availability ratio, and neutral equals 0.50.

3. STUDY TOOLS

3.1. Tool (I): **Patient Assessment Sheet**

Researchers developed this tool based on reviewing many literatures to assess the conditions of patients. It consisted of:

Part (1): Patients demographic data: Age, sex, educational level, occupation, and marital status.

Part (2): Medical data: It involved medical diagnosis, mechanism of injuries, comorbidities, personal habit including, neurovascular assessment, and wound assessment.

3.2. Tool II: Numeric Pain Rating Scale

It developed by **McCaffery et al., (1989)** to assess the severity of pain. Commonly used to measure pain severity using a 0–10 scale, with 0 being no pain at all and 10 being worst pain imaginable. Description intensity ranging from "zero" refer to no pain, " 1-3" refer to mild pain, " 4-6" refer to moderate pain, and "7–10" refer to severe pain.

3.3. Tool III: Lower Extremity Functional Scale (LEFS):

It developed by **Binkley et al., (1999).** It is a valid patient-rated outcome measure for the evaluation of the function with varied musculoskeletal disorders. The LEFS can be used to assess the initial function, continuous development, and outcome of patients as well as to establish functional goals. Impairment of function for patient with an injury to one or both limbs assessed by using LEFS. It was utilized to evaluate a patient's improvement and assess how well an intervention succeeded.

3.3.1. Score System

This scale includes 20- questions regarding a person's capability for carrying out every day regular tasks. A maximum score of 4 for each of the 20- items. Minimum of total score: 0 and maximum of total score: 80. Maximum function is equal (LEFS score 80/80) equal to 100% performance.

3.4. Tool IV: Surgical Satisfaction Questionnaire (SSQ-8):

This scale was developed by **Haff et al., (2010)** as a validated tool to measure post-operative patient satisfaction. It comprises 8 items regarding managing pain, returning to work, carrying out everyday tasks, performing daily

activities and exercising, surgical outcomes, as well as the chance of choosing the same treatment again, and the likelihood of recommending the surgery to others someone.

3.4.1 Scoring System

Surgical satisfaction questionnaire was graded by using a 5-point Likert scale and description ranging from 1 =very unsatisfied" to 5 = very satisfied" for the first six questions and from 1 = "never" to 5 = "yes" was used for the last two questions.

3.4.2. Early Postoperative Rehabilitation Protocol for Patients Who Underwent Microvascular Lower Limb Free Flap (Teaching Booklet):

This tool developed in simple Arabic language by the researchers in accordance with related literature Kohlert et al., (2019); Lin et al., (2012); Tyerman et al., (2022) according to the patient's demands and the opinions of medical and nursing experts. It was applied by the researchers and consisted of early rehabilitation for patients who underwent microvascular lower limb free flap to reduce pain, improve lower limb function, and increase satisfaction. It included:

- Definition of microvascular free flap.
- A brief description of free flap complications.
- Nursing instructions about signs and symptoms of flap failure, prevention of wound infection, treatment plan and follow-up care after leaving the hospital, site care of lower limb free flap, potential complications of microvascular free flap, care of donor site, postoperative mobilization after lower limb free flap surgery, pain control, strength of lower extremity musculature, pin tract care, infection prevention, warning signs and symptoms of pin tract infection, activity of daily living, and healthy diet.
- Relaxation techniques such as coughing and breathing exercises.
- Range of motion of the lower extremities.

3.5. Content Validity

The tools' validity were examined by five experts, involving four medical-surgical nursing staff and one orthopedic surgeon. It was tested for feasibility, clarity, accuracy, and relevance. The study content modifications were performed to ensure the visibility of sentences and the appropriateness of the study content.

3.6. Reliability of the Used Tools

The reliability for numeric pain rating scale (tool II) was evaluated by Pearson's correlation coefficient (0.96). Tool III: (LEFS) by intraclass correlation coefficient (0.88). Tool IV: (SSQ-8) by Cronbach's alpha was 0.79.

3.7. Pilot Study

Ten percent of the sample (6 participating patients) attended the trauma unit and the microvascular reconstruction unit with lower limb defects indicated for microvascular free flap at Assiut University Hospitals participated in a pilot study to measure the accuracy, appropriateness and relevance of the study tools. Sample size excluded any patients who involved in a pilot study.

3.8. Ethical Considerations

The ethical code number for the research proposal, 1120230297, was approved by the ethics committee of the Faculty of Nursing at Assiut University on 25-11-2021.

- During the implementation of the research, there is no hazard to the study patient. Common ethical guidelines for clinical research are followed in this study.
- All data was coded to ensure patient privacy and anonymity.
- After describing the study nature and aims to patients who agreed to participate, oral consent was obtained and also these patients have the right to withdraw their participation or refuse at any time.

4. DESCRIPTION OF WORK FIELD

Data collection in the present study started from February 2022 to October 2022, in addition to 6 months follow - up postoperatively ended in April 2023.

4.1. Preparatory Phase

Preparation of data collection tools and the early postoperative rehabilitation teaching booklet were done during this phase based on related literature. To facilitate and enhance the implementation of early postoperative rehabilitation for patients who underwent microvascular lower limb free flap, researchers assessed and prepared teaching place, teaching media and aids such as (pictures, videos, demonstration, booklet). This was followed by preparing early rehabilitation schedule depend on the contents of the early postoperative rehabilitation teaching booklet, time applicability, and availability.

4.2. Implementation Phase

- The researchers initiated the interview by introduced themselves to open lines of communication, described the study goals and nature for patients.
- The researchers individually communicated with each patient after obtaining their oral consent.
- The researchers met the selected patients and baseline data related to demographic characteristics and medical data were collected using tool I.
- They were randomly assigned to (even number = control group, odd number = study group).
- Postoperatively, regular hospital care was given to control group such as postoperative monitoring of vital signs, administration of medication, and site care of the lower limb flap.
- Patients in the study group received their regular hospital care in addition to an early postoperative rehabilitation teaching booklet; each patient received a copy of it in the simple Arabic language. Furthermore, the researchers utilized pictures to improve patients' understanding.
- Tools II, III, and IV were filled out by the researchers during follow up period in both groups of patients.
- Families of patients had been engaged to guarantee patients' support and enhance accomplishing the study aims.
- Researchers described and implemented the early postoperative rehabilitation protocol (teaching booklet) in 3 sessions. Each session lasted from 20 to 30 minutes, including 5 minutes for answers to inquiries.

- First session was conducted during the immediate postoperative period. It's content included brief introduction about microvascular lower limb free flap, definition, advantage, brief description of free flap complications, postoperative instructions: relaxation technique as coughing and breathing exercises, and particular attention care to the affected extremity. The session concluded with a discussion and answer any inquiry.
- The second session was conducted from the second to fifth postoperative days. It started by reviewing the topics covered in prior session and explaining the purpose of the current session. It included the following two topics: The first focus included flap care, which mostly concentrated on wound care and dressing, donor site care, time of dressing for flap and graft sites which varied according to the patient's condition. The second topic included instructions about nutrition, hygiene, rest, daily living activities, and range of motion, which the researchers enforce importance of exercises and trained patients to practice lower limb exercises, then observed them while practicing the

exercises. The session concluded with a discussion and answer any question. The majority of patients were interested, collaborative, and they also preferred to continuation their early rehabilitation.

- The third session was performed the day before hospital discharge. It started by overviewing the topics covered in the prior sessions. This session concerned with instructions regarding flap and graft site care, diet, medications, activity of daily living such as getting into and getting out of the bed, sitting and raising from chair, mobility by using assistive device such as crutches or walker, climbing stairs up and going down, and exercises. The session concluded with a discussion of its content and clarified answers to any questions.

- The researchers coordinated the time and location for follow-up with the patients and considered the connection with follow up visits in the outpatient orthopaedics clinic at Assiut University Hospitals. Additionally, through phone calls every week, the researchers confirmed the patients' commitment to carry out the early postoperative rehabilitation protocol.

4.3. Evaluation phase

During follow-up period, both groups were reevaluated for pain level, lower limb functions, and satisfaction at 3 weeks, 3 months, and 6 months postoperatively.

5. STATISTICAL DESIGN

SPSS version 26 was used for entry of data and analyses. The control and study groups demographic and medical data were compared using the chi- square and independent t- test. Data were utilized by number, percentage, standard deviation, and mean. The significance level for testing the research hypotheses was determined at a probability level of <0.05. Pearson correlation used to clarify the association between variables.

Table 1: Distribution of demographic data in both study and control groups (n=60)

Variables		Groups				P.value
		Study (n=30)		Control (n=30)		
		N	%	N	%	
Age group	18<30 years	17	56.7	17	56.7	**P=.137** NS
	30<40years	6	20.0	7	23.3	
	40<50 years	6	20.0	1	3.3	
	50<60 years	1	3.3	2	6.7	
	60<65 years	0	0.0	3	10.0	
Sex	Male	30	100.0	27	90.0	**P=.119** NS
	Female	0	0.0	3	10.0	
Marital status	Single	19	63.3	14	46.7	**P=.150** NS
	Married	11	36.7	16	53.3	
Education level	Illiterated	2	6.7	6	20.0	**P=.330** NS
	Read and write	3	10.0	1	3.3	
	Primary level	3	10.0	5	16.7	
	Secondary level	19	63.3	17	56.7	
	University level	3	10.0	1	3.3	
Occupation	Office work	2	6.7	1	3.3	**P=.046** NS
	Student	2	6.7	0	0.0	
	House wife	0	0.0	3	10.0	
	Manual work	21	70.0	18	60.0	
	Non worker	5	16.7	9	30.0	

Chi square Ns: non statistically significant difference P.value > 0.05

Table (1): Clarifies that non- statistically significant differences in two groups concerning demographic characteristic (P.value > 0.05). As regard age, more than half (56.7%) in both groups ranged from 18 < 30 years. Regarding sex, the majority of patients in the control group (90%) and all study group (100%) were males, and less than half (36.7%) in the study group patients and more than half (53.3%) in the control group patients were married. More than half in both groups [study (63.3%), control (56.7%)] had a secondary level of education, and [study (70%), control (60%)] manual work.

Table 2: Distribution of medical diagnosis, mechanism of injuries and comorbidities between the study and the control groups (n=60)

Variables		Groups				X2	P.value
		Study (n=30)		Control (n=30)			
		N	%	N	%		
Medical diagnosis	Open grade III fracture tibia and fibula	10	33.3	12	40.0	**4.182**	**0.840^{NS}**
	Open grade III fracture femur	0	0.0	2	6.7		
	Open grade III fracture femur and tibia and fibula	2	6.7	1	3.3		
	Open grade III tibia	5	16.7	5	16.7		
	Lacerated wound dorsum of foot, fracture ankle	1	3.3	0	0.0		
	Crush of dorsum of foot	5	16.7	5	16.7		
	Open grade III calcaneus	2	6.7	1	3.3		
	Open grade III fracture pilon	2	6.7	1	3.3		
	Lacerated wound of thigh	3	10.0	3	10.0		
Mechanism of injuries	Motor car accident	4	13.3	9	30.0	**4.622**	**0.464 ^{NS}**
	Train accident	2	6.7	1	3.3		
	Motor cycle accident	19	63.3	17	56.6		
	Solid object	3	10.0	2	6.7		
	Gunshot	2	6.7	1	3.3		
Comorbidities	No	30	100.0	30	100.0	**-**	**-**

Chi square NS: non statistically significant difference P.value > 0.05

Table (2): Shows that non-significant statistical difference was found among patients in both groups regarding the medical data (p. value > 0.05). More than third in both groups [study (33.3%), control (40.0%)] had open grade III fractures of mixed tibia and fibula. Regarding the mechanism of injuries, it was found that more than half in both groups [control (56.6%) and study (63.3%)] had motor cycle accidents.

Based on preoperative wound assessment, non- statistically significant difference in two groups (p.value > 0.05). The majority of patients in the study group (86.7%) and control group (90%) had classified as type IIIB (severe periosteal stripping, wound need for soft tissue covering).

Regarding neurovascular assessment, there was found non-statistically significant difference in patients of both groups (p.value > 0.05). All patients (100%) in both groups had pain felt only at the site of injury, an absence feeling of paresthesia, normal strong distal pulse, well perfusion in skin color, normal return capillary refill, and warm skin.

Regarding postoperative sensation assessment, non-statistically significant difference was found in two groups (p.value > 0.05). All patients (100%) in both groups had present sensation on the dorsal and plantar surfaces of the foot.

Regarding postoperative motor function assessment, a statistically significance difference found in two groups after 3 weeks (p.value 0.001). The capacity to dorsiflex and plantar flex the ankle and toes was greater in the study group compared to the control group following the implementation of early postoperative rehabilitation protocol (a

teaching booklet) after 3 weeks. But during follow-up at 3 and 6 months, a non-statistically significant difference was found in two groups.

Table 3: Comparison among patients in both groups regrading pain level (n=60)

Pain	Preoperative				Before discharge				3 weeks				3 months				6 months			
	Study group (n=30)		Control group (n=30)		Study group (n=30)		Control group (n=30)		Study group (n=30)		Control group (n=30)		Study group (n=30)		Control group (n=30)		Study group (n=30)		Control group (n=30)	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
No pain **(0)**	0	0	0	0	0	0	30	100.0	0.0	0.0	0.0	0.00	24	80.0	10	33.3	30	100.0	22	73.3
Mild (1-3)	0	0	0	0	8	16.7	4	13.3	25	83.3	11	36.7	5	16.7	10	33.3	0	0	8	26.7
Moderate (4-6)	22	73.3	27	90.0	22	73.3	26	86.7	5	16.7	19	63.3	1	3.3	10	33.3	0	0	0	0
Severe (7-10)	8	26.7	3	10.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P.value	P1 = 0.09 NS				P5 = 0.16 NS				P2 = 0.001**				P3 = 0.001**				P4 = 0.002**			

Chi-Square *Significant level at P. value < 0.05 **Significant level at P. value < 0.01 - NS: non statistically significant difference P. value > 0.05

Table (**3**): Demonstrates that, non-statistically significant difference in both groups concerning to preoperative pain and before discharge (P.value = 0.09, P.value = 0.16 respectively). A statistically significant difference was found in both groups concerning postoperative pain after 3 weeks, 3 months, and 6 months than the control group (P.value=0.001, P.value=0.001, P.value=0.002 respectively). Study group patients showed greater pain reduction than patients in the control group.

Table 4: Comparison between both study and control groups regarding total score of lower limb function scale (n=60)

Lower limb function scale	**Study group (n=30)**	**Control group (n=30)**	**Study group (n=30)**	**Control group (n=30)**	**Study group (n=30)**	**Control group (n=30)**
Total score (0-80)	**3 weeks**		**3 months**		**6 months**	
Mean±SD	21.53±5.10	13.13±3.96	49.26±8.12	25.96±5.12	62.43±5.15	41.83±6.10
X2	**T : 7.12**		**T: 13.27**		**T: 14.11**	
P.value	**0.001****		**0.001****		**0.001****	

T- test SD- standard deviation **Significant level at P. value < 0.01

Table (**4**): Demonstrates a highly statistically significant difference in two groups concerning the total score of LEFS (p. value= 0.001). Gradual improvement was present after 3 weeks, 3 months, and 6 months in the mean score of LEFS of patients in study group compared to patients in control group.

Table (5): Comparison between both groups regarding total score of surgical satisfaction questionnaire (n=60)

Surgical satisfaction questionnaire	**Study group (n=30)**	**Control group (n=30)**	**Study group (n=30)**	**Control group (n=30)**	**Study group (n=30)**	**Control group (n=30)**
Total score (0-100)	**3 weeks**		**3 months**		**6 months**	
Mean±SD	35.33±1.95	28.26±2.85	39.20±0.92	32.00±3.19	39.86±0.73	34.40±2.59
P.value	**0.001****		**0.001****		**0.001****	

T- test SD- standard deviation **Significant level at P. value < 0.01

Table (**5**): Shows that statistically significant differences in both the study and the control groups with regard to mean score of surgical satisfaction questionnaire after implementation of early postoperative rehabilitation protocol (teaching booklet) after 3 weeks, 3 months, and 6 months (p.value= 0.001). A statistically significant improvement was found in the study group compared to the control group patients.

Positive correlation was found between LEFS and SSQ-8 in both groups. Study group patients showed greater improvement in LEFS and satisfaction after implementation of an early rehabilitation protocol; whenever lower limb function increased, patients' satisfaction level increased (r=0.836, p.value=0.001). As regard control group whenever lower limb function decreased, patients' satisfaction level decreased (r=0.731, p.value=0.001).

Negative correlation was found between postoperative pain and SSQ-8 among study group patients. Statistical significant improvement was found in the study group compared to the control group patients after implementation of postoperative rehabilitation protocol (teaching booklet) during follow up (3 months, 6 months) (r= -0.841, p.value 0.001) indicating that whenever pain level decreased, patients' satisfaction increased. As regard control group showed that whenever pain level increased, patients' satisfaction decreased (r= -0.668, p.value 0.001).

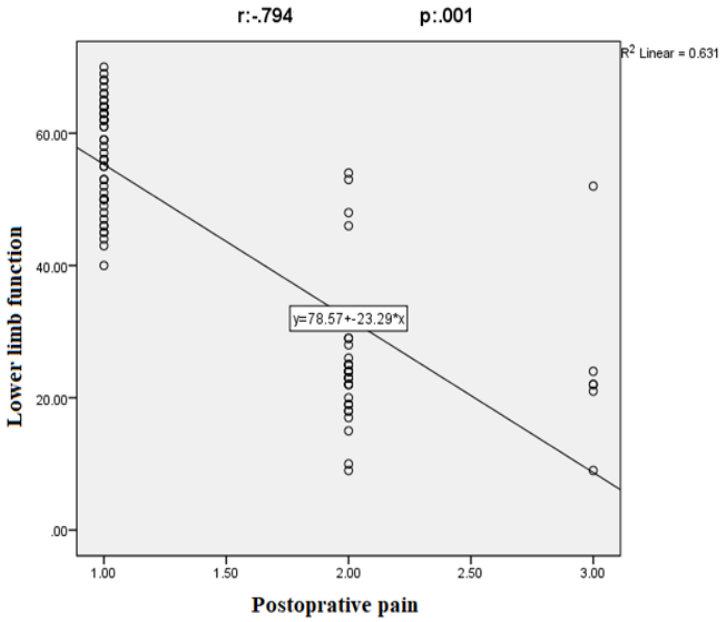

Figure (1): Correlation between postoperative pain and the lower limb function scale among the study group (n=30)

Figure (1): Illustrates that, negative correlation between LEFS and postoperative pain among patients of study group (r= -0.794, p.value 0.001) indicating that whenever pain level decreased, function of lower limb increased.

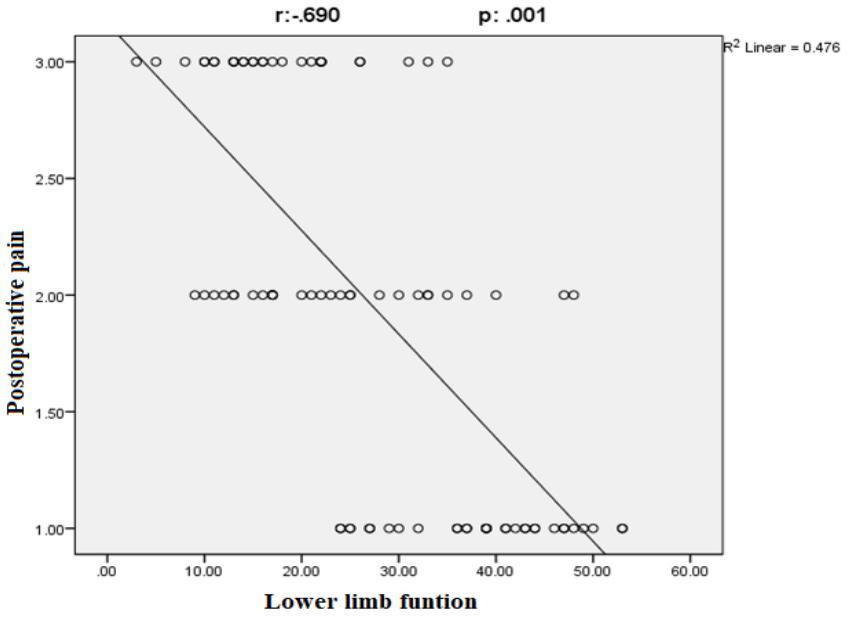

Figure (2): Correlation between lower limb function scale and postoperative pain among control group (n=30)

Figure (2): This figure illustrates that, negative correlation between postoperative pain and LEFS among control group patients (r= -0.690, p.value 0.001) indicating that whenever pain level increased, lower limb function decreased.

6. DISCUSSION

Free flaps are efficient and safe techniques for microvascular lower extremity reconstruction following trauma, oncological excision, or infection, although they significantly though they significantly decrease donor site morbidity, decrease susceptibility to postoperative infection, and provide greater satisfaction (Mégevand et al., 2022).

This study result clarified that more than half of the patients in two groups were age ranged from eighteen to under thirty years. From opinion of researchers, this could be referred to as the amount of time spent working and producing for those patients who need to be away from home for an extended period of time while performing manual work that raises their risk of exposure to trauma and occupational accidents. This study result was congruent with study conducted by Alam et al., (2020) who reported that the mean age of the studied patients was (34±11) years old.

The present study finding showed that the majority of the control group and all patients participant in study group were males. This study result was supported by Jahan et al., (2017) confirmed that more than half of studied patients were males. From the researchers' point of view, males are more likely to expose to occupational trauma when they are expected to support and meet the financial needs of their families in current society.

Similar to the present study Arslan & Demiroz (2019) revealed that free flap repair procedures were conducted for lower extremities reconstruction of patients twenty-nine males and six females. The mean age was thirty and half years.

The majority of the studied patients who participated in current study manually worker. This result was consistent with Khorais et al., (2018) who found that more than half of the studied patients were manual workers.

The current finding reported that more than a third in the two groups were diagnosed with open mixed fibula and tibia fractures grade III. This result was congruent with study of Mohammed et al., (2017) conducted study on seventy-three patients with open fracture found that open fracture tibia-fibular was the most frequently diagnosis among those patients.

Concerning the mechanism of injury, this result was found that fracture/ trauma caused by motor cycle accidents presented in about half in both the control and the study groups. The result of this study was in the same line with study conducted by Mahdian et al., (2017) who found that lower limb fractures were the most frequent fractures among motor bike accident.

Based on preoperative wound assessment, this present study result showed non-statistically difference among patients in both groups. The majority in both groups of patients were classified as type IIIB. The current result was matched with study by Fahmy et al., (2021) conducted on twenty-five patients which showed a non-significantly difference among studied patients as regards wound assessment, extensive soft tissue defects in the foot and leg which classified as type IIIB.

In the current study finding, there was a statistically significant difference between both groups concerning postoperative pain during three weeks, three months, and six months than control group. Study group patients showed greater reduction in pain level.

From the researchers' opinions this could be due to the effect of postoperative rehabilitation (teaching booklet) on study patients. This because commitment to lower limb exercise, early mobility, and practicing activities of daily living that improve muscle strength and promote circulation led to a reduction in pain level.

In agreement with the previous finding, a study was done by Dziadzko et al., (2022) concerning postoperative pain on four hundred -fourteen after orthopedic surgery stated that study group patients who received preoperative education had an enhanced postoperative pain level.

This previous finding was congruent with result of study performed by Pang et al., (2022) which reported that rehabilitation nursing intervention was significantly minimized the degree of postoperative pain in patients with open lower limb fractures.

The study finding of Zhao et al., (2021) confirmed the present result of the study, they conducted a study on one hundred-fourth patients undergoing free skin flap to evaluated the impact of implementation of nursing management which revealed that study group patients experienced lower pain levels.

The finding of this study demonstrated that a statistically significant difference in both groups concerning total score of LEFS. Gradual improvement was documented in the study group after three weeks, three months, and six months in mean score of LEFS after implementation of early postoperative rehabilitation (teaching booklet).

From the researchers' point of view, implementation of an early postoperative rehabilitation protocol (teaching booklet) significantly affect lower limb function. Additionally, the study group patients were continuously followed up through the researchers to ensure that they adhere to the instructions regarding lower limb exercises, early mobility by using assistive device such as a walker or crutches, and practicing activities of daily living as getting into and out of bed, sitting and rising from chairs, climbing stairs, and going down.

Study results of Grigor et al., (2022) supported the finding of this study, which showed that improved patients' physical health and lower limb function were obvious after lower limb free flap reconstruction.

In consistent with this study, study results of Yang et al., (2010) conducted on fifth-nine patients with lower limb free flap reported that postoperative rehabilitation training achieved higher level of lower extremity function for patients undergoing lower limb free flap.

The current finding was similar with study of Falola et al., (2018) documented that patients underwent microsurgical reconstruction for lower extremity achieved a higher level of function postoperatively.

In the same line with previous finding, the studies who conducted by Abdelsalam and Abdelmowla, (2023) and Wong et. al., (2010) reported that there was obvious improvement in capacity of physical functional and pain after implementation of the health teaching between the studied patients.

The finding of this study showed a statistically significant difference between both groups concerning mean score of surgical satisfaction questionnaire after implementation of the early postoperative rehabilitation three weeks, three months, and six months. Statistical significant improvement was found in study group compared to control group.

In agreement with this study findings, study of Dolan et al., (2012) indicated that patients who underwent lower limb surgical reconstruction were satisfied with their results.

Study results of Pang et al., (2022) confirmed the present study finding which revealed that rehabilitation nursing intervention was significantly improved satisfaction of patients with open lower limb fractures.

Similar to this study, study result of Khorais et al., (2018) conducted on sixty adult patients on trauma unit illustrated that there was obvious increased level of satisfaction for the studied patients after implementation of self-care educational program.

The current result found a positive correlation between LEFS and SSQ-8 among the study group in which indicated that as the functional status of the lower limb increased, patients' satisfaction increased.

From the researchers' opinions, this could be due to the effect of the early postoperative rehabilitation protocol (teaching booklet) of the study group. This because commitment to the lower limb exercise and practicing activity of daily living led to an increase in lower limb function and satisfaction level.

The finding was matched with Lv and Yang, (2021) reported that positive correlation between limb and joint function and patients' satisfaction; patients increased as increased in limb and joint function after the implementation of nursing rehabilitation.

The current result found that negative correlation between postoperative pain and LEFS among the study group patients in which indicated that whenever lower limb function increased, postoperative pain level decreased. The results of this study clarify the effectiveness of the early rehabilitation protocol (teaching booklet) and the patients' commitment to the instructions regarding lower limb exercises, early mobility, and therefore increased lower limb function and muscle strength led to a decreased pain level. This finding matched with study of Jordan et al., (2014) stated that negative correlation had been found between postoperative pain and lower limb function, indicated that whenever pain level decreased, function of lower limbs increased.

CONCLUSION

Based on the current result, it could be concluded that study group who received early postoperative rehabilitation protocol (teaching booklet) following microvascular lower limb free flap achieved significant reduction in pain, improvement in lower limb function, and satisfaction. These study findings support the research hypotheses.

Recommendations

According to the study findings of the current study, it recommends the following:

Simple written instructions booklet with clear and brief illustrations of preoperative and postoperative care should be available to patients is of great importance for patients who underwent microvascular lower limb free flap.

New nurses in the microvascular reconstruction unit and trauma department should be aware of early postoperative rehabilitation.

REFRENCES

[1] Abdelsalam, M. A., & Abdelmowla, R. A. (2023). Did COVID-19 restrictions affect post-operative rehabilitation of patients who underwent arthroscopic management of femoroacetabular impingement?. Journal of Musculoskeletal Surgery and Research.

[2] **Alam Atiq, M. M., Shahid, S., Ubaid, M., Rahman, M. F., & Shaikh, S. A. (2020).** Free flap reconstruction after lower limb trauma-outcome analysis using National Surgical Quality Improvement Programme (NSQIP) parameters. JPMA. The Journal of the Pakistan Medical Association, 70(2 (Suppl 1)), S113.

[3] **Arslan, H., & Demiroz, A. (2019).** Comparison of subacute and delayed free flap reconstruction in the treatment of open lower extremity fractures. Ulusal Travma Ve Acil Cerrahi Dergisi-Turkish of Trauma & Emergency Surgeryn, 25(2).

[4] Assiut University Hospitals Records, (2021). Microvascular Reconstruction Unit, Assuit, Egypt.

[5] **Binkley, J.M, Stratford, P.W, Lott, S.A, Riddle, D.L. The lower extremity functional scale (LEFS)., (1999).** scale development, measurement properties, and clinical application. Phys Ther 1999;79:371-383.

[6] **Dolan, R. T., Butler, J. S., Murphy, S. M., & Cronin, K. J. (2012).** Health-related quality of life, surgical and aesthetic outcomes following microvascular free flap reconstructions: an 8-year institutional review. The Annals of The Royal College of Surgeons of England, 94(1), 43-51.

[7] **Dziadzko, M., Bouteleux, A., Minjard, R., Harich, J., Joubert, F., Pradat, P., & Aubrun, F. (2022).** Preoperative Education for Less Outpatient Pain after Surgery (PELOPS trial) in orthopedic patients—study protocol for a randomized controlled trial. Trials, 23(1), 422.

[8] **Fahmy, M., El Habaa, G., Ayad, W., Elgohary, H., & Abdelmofeed, A. (2021).** Free Anterolateral Thigh flap for traumatic soft tissue defects of distal third leg and foot Comparative study between Subfascial and Suprafascial dissection. Benha medical journal, 38(3), 1009-1018.

[9] **Falola, R. A., Lakhiani, C., Green, J., Patil, S., Jackson, B., Bratescu, R., & Evans, K. K. (2018).** Assessment of function after free tissue transfer to the lower extremity for chronic wounds using the lower extremity functional scale. Journal of Reconstructive Microsurgery, 34(05), 327-333.

[10] **Gage, M. J., Yoon, R. S., Gaines, R. J., Dunbar, R. P., Egol, K. A., & Liporace, F. A. (2016).** Dead space management after orthopaedic trauma: tips, tricks, and pitfalls. Journal of orthopaedic trauma, 30(2), 64-70.

[11] Grigor, E. J., Bitoiu, B., Zeitouni, C., & Zhang, J. (2022). Patient Reported Outcomes following Free Flap Lower Extremity Reconstruction: A Systematic Review and Meta-Analysis. Journal of Plastic, Reconstructive & Aesthetic Surgery**.**

[12] **Gutenbrunner, C., Stievano, A., Stewart, D., Catton, H., & Nugraha, B. (2021).** Role of nursing in rehabilitation. Journal of Rehabilitation Medicine-Clinical Communications, 4.

[13] **Haff, R.E, Stoltzfus, J., Lucente, V.R, & Murphy, M. (2010).** Surgical satisfaction questionnaire (SSQ-8): A validated tool for assessment of patient satisfaction following surgery to correct prolapse and/or incontinence. J Minimally Invasive Gynecol 18:S49-S50.

[14] Jahan, A., Haseeb, M., & Wazir, F. (2017). Treatment of high energy tibial plateau fractures with hybrid external fixator: intermediate term outcome. International Journal of Research in Medical Sciences, 5(10), 4582-4587.

[15] **Jordan, D. J., Malahias, M., Hindocha, S., & Juma, A. (2014).** Suppl 2: M5: flap decisions and options in soft tissue coverage of the lower limb. The open orthopaedics journal, 8, 423.

[16] **Khorais, A., Ebraheim, M., & Barakat, A. (2018).** Self-care program: quality of life and satisfaction among patients with external skeletal fixation. IOSR Journal of Nursing and Health Science, 7(4), 71-83.

[17] **Kohlert, S., Quimby, A. E., Saman, M., & Ducic, Y. (2019).** Postoperative free-flap monitoring techniques. In Seminars in plastic surgery (Vol. 33, No. 01, pp. 013-016). Thieme Medical Publishers.

[18] **Krijgh, D. D., van Straeten, M. M., Mureau, M. A., Luijsterburg, A. J., Schellekens, P. P., Maarse, W., & Coert, J. H. (2020).** Postoperative care in microvascular free flap reconstruction of the lower extremity: a systematic review. Orthoplastic Surgery, 1, 21-26.

[19] **Lazar, H. L., Chipkin, S. R., & Fitzgerald, C. A. (2016).** Julian Pribaz, MD. Flaps and Reconstructive Surgery E-Book, 130(3), 331.

[20] **Lin, C. W. C., Donkers, N. A., Refshauge, K. M., Beckenkamp, P. R., Khera, K., & Moseley, A. M. (2012).** Rehabilitation for ankle fractures in adults. Cochrane database of systematic reviews, (11).

[21] **Lv, H., & Yang, N. (2021).** Clinical effect of application of nursing concept of rehabilitation surgery for improvement of quality of postoperative recovery in orthopedics. Journal of Orthopaedic Surgery and Research, 16(1), 1-7.

[22] **Mahdian, M., Fazel, M., Sehat, M., Khosravi, G., & Mohammadzadeh, M., (2017).** Epidemiological profile of extremity fractures and dislocations in road traffic accidents in Kashan, Iran: a glance at the related disabilities. Archives of bone and joint surgery, Vol.5, no.3, Pp. 186.

[23] **McCaffery, M., & Beebe, A. (1989).** The numeric pain rating scale instructions. In Pain: Clinic Manual for Nursing Practice. Mosby, St. Louis,9,1.

[24] **Mégevand, V., Suva, D., Mohamad, M., Hannouche, D., Kalbermatten, D. F., & Oranges, C. M. (2022).** Muscle vs. Fasciocutaneous Microvascular Free Flaps for Lower Limb Reconstruction: A Meta-Analysis of Comparative Studies. Journal of Clinical Medicine, 11(6), 1557.

[25] **Mohammed, R., Atinga, E., Sitati, F., & Gakuya, E., (2017).** Pin tract infection after uniplanar external fixation of open fractures at a national, teaching and referral hospital. East and Central African Journal of Surgery, 22(1), 42- 48.

[26] **Pang, Z., Shan, M., Li, Y., Zhang, H., Huang, A., Liu, Y., & Li, X. (2022).** The Efficacy of Rehabilitation Nursing Interventions on Patients with Open Lower Limb Fractures. Journal of Healthcare Engineering,7(2).

[27] **Shammas, R.L, Cho, E.H, Carney, M.J, Weissler, J.M, & Bauder, A.R. (2018).** Muscle versus fasciocutaneous free flaps in lower extremity traumatic reconstruction: a multicenter outcomes analysis. Plast Reconstr Surg; 9,141:191.

[28] **Thompson, S.K, (2012).** Sampling' 3rd ed, John Wiley & Sons, p59-60.

[29] **Tyerman, J., Cobbett, S., Harding, M. M., Kwong, J., Roberts, D., Hagler, D., & Reinisch, C. (2022).** Lewis's Medical-Surgical Nursing in Canada-E-Book: Assessment and Management of Clinical Problems. Elsevier Health Sciences.ch 65, p.p 1621:1640.

[30] **Wong, M..; Chan, W. and Chair, S. (2010).** Effectiveness of an educational intervention on levels of pain, anxiety, and self-efficacy for patients with musculoskeletal trauma, Journal of Advanced Nursing, 66 (5): pp. 1120–1131.

[31] **Yang, Y., Peng, X., Zhang, F., Li, N., Cui, J., & Zhao, C. Y. (2010).** Evaluation of lower limb rehabilitation training effects in the patients with free fibula flap. Zhonghua kou Qiang yi xue za zhi= Zhonghua Kouqiang Yixue Zazhi= Chinese Journal of Stomatology, 45(6), 363-366.

[32] **Zhao, L., Yang, J., & Liu, W. (2021).** Application and effect evaluation of nursing quality target management in free flap transplantation for hand injury. Plos one, 16(1), e0245097.

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