

Microvascular Free Tissue Transfer for Complex Soft Tissue Injuries in Lower Extremities: Brief Report of a Hispanic Population

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Objective: Microvascular free-tissue transfer (M-FTT) is a surgical technique for traumatic injuries that allows tissue reconstruction based on donor tissue composition. The aim of this study is to describe the surgical experiences of M-FTT for reconstruction of complex soft tissue injuries in the lower extremities of a Hispanic population.

Methods: This is a descriptive study of all M-FTT procedures performed by a single plastic surgeon from 2012 to 2016 at Puerto Rico Medical Center. Demographics, admission diagnosis, mechanism of trauma, type of free flap, co-morbidities, length of stay, donor site and complications were evaluated.

Results: Eight patients who underwent single M-FTT procedures at lower extremity were enrolled in the study. The average age at time of surgical reconstruction was 36.9 ± 13.2 years with six males and two females. The transfer procedures were performed using donor sites of six rectus abdominis flaps and 2 radial forearm flaps. Posterior tibial artery was used in 62.5% and popliteal artery were used in 37.5% as recipient arteries. Average surgical time was 4.4 ± 0.7 hours with an average length of hospital stay of 22.9 ± 20.1 days. Post-operative complications were reported in three M-FTT procedures: two cases who suffered venous thrombosis and one case who suffered partial necrosis.

Conclusion: The M-FTT offers an adequate surgical option for patients who present with complex soft tissue traumatic injuries at the lower extremities. [*PR Health Sci J* 2020;39:336-339]

Key words: Microvascular free tissue transfer, Complex soft tissue, Lower extremity

The reconstruction of complex soft tissue defects in traumatic lower extremity injuries is vital for the proper function of the musculoskeletal system (1,2). The management of these injuries are a constant challenge for surgeons due to defect size, location, irregular pattern or donor site tissue that may present each injury (1,3).

Microvascular free-tissue transfer (M-FTT) is a surgical technique for traumatic complex soft tissue defects in lower extremity injuries that allows tissue reconstruction based on donor tissue composition (4-6). The use of this microsurgical approach has been widely used with multiple magnification loupes; increasing post-operative success throughout a clear, and well-magnified field of vision for tissue transfer (7,8).

Factors such as sex, age, defect location, surgery time and ethnics; have played a major role toward the post-operative success in M-FTT technique. Hispanics have reported as a disabled population with an increased injury rate compared to other ethnicities (9).

Till the day, little is known about the surgical outcomes to correct complex soft tissue injury defects at the lower extremities of a Hispanic population using M-FTT. The aim of this study is to describe the surgical experiences of M-FTT

for reconstruction of complex soft tissue injuries in the lower extremities of a Hispanic population.

Patients and Methods

This is a retrospective descriptive study of all microvascular free tissue transfer (M-FTT) procedures performed from 2012 to 2016 at Puerto Rico Medical Center. All the M-FTT procedures were performed by a single board trained plastic surgeon with the guidance of 4.5x loupes (Design for Vision, Inc.; Surgi-Spec® Telescopes) and headlamps (Design for Vision, Inc.). Demographics, admission diagnosis, mechanism of trauma, type of free flap, co-morbidities, length of stay, donor

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site and complications were evaluated. Study was approved by the Institutional Review Board of the University of Puerto Rico, Medical Sciences Campus.

Patients with complex soft tissue trauma and no prior trauma wound related surgery intervention at the lower extremities, were included in the study. Wounds that could be closed without flaps; and patients under 21-years old were excluded from the study. The M-FTT soft tissue reconstruction was performed with rectus abdominis flap or radial forearm flap. The posterior tibial artery and popliteal artery were used as recipient artery; while all the venous anastomosis was performed to the venae comitantes. The use of vein grafts was not performed in any of the surgeries. Anastomosis of both arteries and veins were performed with an end-to-end interrupted suturing technique with a vascular diameter that ranged from 4-5mm. The vessels were mechanically expanded with a vessel dilatator, and the anastomoses were performed using 8-0 and 9-0 nylon.

A preoperative dose of aspirin 81mg and an intraoperative dose of heparin solution of 5000U diluted in 250ml of 0.9% saline solution; was given to all patients. A low dose heparin 400U per hour was given to all patients as postoperative anticoagulation therapy. Patients were then transferred to the intensive care unit (ICU) under the care of trained surgical staff for further free-flap monitoring and care management. Prior orientation was given to surgical ICU staff; to inform immediately if alarming signs such venous congestion or flap edema were noted, or if changes in doppler signal were detected. Clinical evaluation and implantable doppler were used to monitor arterial and venous blood flow for the first 48 hours after surgery. Physical findings such as skin color changes, turgor, blanching erythema, decrease pulse, dermal bleeding or any associated symptoms were considered part of post-operative complications. Patients were follow-up postoperative by the principal investigator at outpatient clinics for a six-months period, to evaluate possible complications. Descriptive statistics were used to evaluate demographics, surgical data and post-operative complications; using SPSS® 26.0 and Microsoft excel software.

Results

Eight patients who underwent single M-FTT procedures at lower extremity were enrolled in the study. The average age at time of surgical reconstruction was 36.9 ± 13.2 years with six males (75.0%) and two females (25.0%). The most common comorbidities among the sample data were two patients who suffered from hypertension (25.0%), one patient who suffered from diabetes mellitus type II (12.5%), and one patient who suffered from hypothyroidism (10.0%). A total of three patients were smokers (37.5%) and one patient had alcohol abuse problems (12.5%). Motor vehicle accidents were found as the

most common reason for the mechanism of trauma in the sample data with a total six patients (75.0%); followed by two patients who suffered fall from standing height (25.0%).

The transfer procedures were performed using donor sites of six rectus abdominis flaps (75.0%) and 2 radial forearm flaps (25.0%). Posterior tibial artery was used in 62.5% and popliteal artery were used in 37.5% as recipient arteries. Average surgical time was 4.4 ± 0.7 hours with an average length of hospital stay of 22.9 ± 20.1 days. None of the patients presented with intra-operative complications.

Seven out of the eight M-FTT flaps (87.5%) had a good acceptance survival rate. Post-operative complications were reported in three M-FTT procedures: two cases who suffered venous thrombosis (25.0%) and one case who suffered partial necrosis (12.5%). Surgical exploration was required in one of the cases with venous thrombosis that failed to conservative treatment; along with cleansing and debridement for the case with partial necrosis. The re-operation of venous thrombosis happened as a result of an underlying hematoma that could have been produced by the traumatic event of MVA, hitting the leg. Four days after surgical hematoma drainage, the leg developed partial necrosis of the rectus abdominis flap, subsequently failing the microsurgical reconstruction. In the other surgical revision, the radial forearm flap was used as cover for a chronic smoker who suffered a fall that resulted in an open tibia fracture Gustilo Type IIIb. See Figure-1. Multiple orthopedic procedures performed prior to the microsurgical FTT coverage lead to unstable soft tissue coverage with recurrent venous ulcerations. Despite several attempts, patient was unable to achieve smoking cessation postoperative; contributing to his non-healing ulcerations. The rectus abdominis tissue free flap underwent cleansing and debridement once and did not showed any visible vascular compromise. After cleansing and debridement, the skin graft was put in place after granulation developed without major complications. Finally, there were no cases of operative or postoperative infection, deaths, nor acute bleeding complications. See Table-1.



Figure 1. Microvascular free tissue transfer in a patient with open tibia fracture Gustilo Type IIIb at (a) preoperative, (b) intraoperative and (c) postoperative evaluation

Table 1. Demographic and Surgical data of Free Microvascular Tissue Transfer Procedure

| Patient | Sex | Age | Trauma mechanism | Defect location | Defect location | Tissue Free Flap Selected | Recipient vessels | Postoperative Flap complications | Reoperation | Surgery time (Hours) | Hospital length (Days) |
|---------|-----|-----|------------------|-----------------|-----------------|---------------------------|--------------------|-------------------------------------|-------------|----------------------|------------------------|
| 1 | F | 41 | MVA | Left Leg | Heel | RA | Posterior Tibial A | Venous thrombosis, Partial Necrosis | Yes | 4.5 | 27 |
| 2 | M | 57 | MVA | Right Leg | Ankle | RA | Popliteal A | None | No | 5 | 7 |
| 3 | F | 46 | MVA | Right Leg | Heel | RA | Posterior Tibial A | None | No | 4.7 | 12 |
| 4 | M | 21 | MVA | Left Leg | Heel | RA | Posterior Tibial A | Venous Thrombosis | No | 4.5 | 12 |
| 5 | M | 27 | MVA | Left Leg | Foot | RF | Popliteal A | None | No | 3.5 | 42 |
| 6 | M | 21 | FFSH | Left Leg | Ankle | RF | Popliteal A | Partial Necrosis | No | 3.5 | 63 |
| 7 | M | 47 | FFSH | Right Leg | Ankle | RA | Posterior Tibial A | None | No | 4.3 | 10 |
| 8 | M | 35 | MVA | Left Leg | Ankle | RA | Posterior Tibial A | None | No | 5.5 | 10 |

Legend: A = Artery, F = Female, M = Male, ILI = Industrial Labor Injury, MVA = Motor Vehicle Accident, FFSH = Fall from Standing Height, RA = Rectus Abdominis, RF = Radial Forearm

Discussion

The M-FTT technique offer the advantage of covering healthy muscle in a complex soft tissue at lower extremities; creating an ideal wound healing environment that prevents possible limb amputation (10-12). Factors such as single stage surgery, decreased hospital length-stay, decreased inflammation and improvement of vascularized surrounded wound tissue; are among the most common advantages of M-FTT described in literature (11,13).

The surgical outcomes of this procedure depend on multiple issue such as the recipient flap vessels, and the donor site flaps used (12). The rectus abdominis and radial forearm were the two M-FTT flaps used in this study due to high acceptance rate as reported in previous studies (14,15). In 2010, Demirtas et al; demonstrated that rectus abdominis muscle flaps were one of the most reliable tissue flaps for M-FTT technique due its ability to bring large vascular supply to bone fragments. (14). In addition, their study illustrated that the use of rectus abdominis muscle flaps were one of the best choices for soft tissue complex reconstruction in patients with Gustillo IIIb-c tibia fractures. In the same way, Musharrafieh et al demonstrated that the use of radial forearm flaps were also alternatives to be used for the reconstruction of M-FTT lower extremities (15). In our study, the use of both radial forearm and rectus abdominis flap had a good survival acceptance rate in sever out of the eight (87.5%) M-FTT procedures.

Limitations

Due to the limited cases, our study was unable to demonstrate statistical analysis on possible risk factors that could help predict the complication rate presented in our patients. In addition, the comparison with other surgical techniques along with long-term post-operative outcomes in patients undergoing this surgical technique could not be assessed. While this technique has proven to be very efficacious for

complex soft tissue injuries; it requires a specialized trained surgeon for the success of it.

Conclusion

This study describes the surgical outcomes of microvascular FTT for complex soft tissue in the lower extremities of a Hispanic population performed by a single plastic surgeon throughout a four-year period. Researchers in this study found that M-FFT offers an adequate surgical option for patients who present with complex soft tissue traumatic injuries at the lower extremities.

Resumen

Objetivo: La transferencia microvascular de tejido libre (M-FTT) es una técnica quirúrgica para lesiones traumáticas que permite la reconstrucción del tejido basado en la composición del tejido donante. El objetivo de este estudio es describir las experiencias quirúrgicas de M-FTT para la reconstrucción de lesiones complejas de tejidos blandos en las extremidades inferiores de una población hispana. Metodología: Este es un estudio descriptivo de todos los procedimientos de M-FTT realizados por un solo cirujano plástico de 2012 a 2016 en el Centro Médico de Puerto Rico. Se evaluaron los datos demográficos, el diagnóstico de ingreso, el mecanismo del trauma, el tipo de colgajo libre, las comorbilidades, la duración de la estadía, el sitio donante y las complicaciones. Resultados: Ocho pacientes que fueron sometidos a una M-FTT en la extremidad inferior, se inscribieron en el estudio. La edad promedio al momento de la reconstrucción quirúrgica fue de 36.9±13.2 años con seis hombres y dos mujeres. Los procedimientos de transferencia se realizaron utilizando sitios donantes de seis colgajos de recto abdominal y 2 colgajos radiales de antebrazo. La arteria tibial posterior se usó en 62.5% y la arteria poplítea se utilizó en 37.5% como arterias receptoras. El tiempo quirúrgico promedio fue de 4.4±0.7 horas con una duración promedio de la estancia hospitalaria de

22.9±20.1 días. Se reportaron complicaciones postoperatorias en tres procedimientos de M-FTT: dos casos que sufrieron trombosis venosa y un caso que sufrió necrosis parcial. Conclusiones: El M-FTT ofrece una opción quirúrgica adecuada para pacientes que presentan con lesiones traumáticas complejas de tejidos blandos en las extremidades inferiores.

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