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Interpolation sural flaps in acute traumatic defects

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ABSTRACT

Objectives: Distal lower leg wounds, regardless of cause, and acute trauma wounds, regardless of site, are difficult. Reconstruction of both situations are much more challenging. Interpolation sural flap is a good alternative for this type of reconstruction.

Methods: Fourteen interpolation sural flap were harvested to reconstruct for distal leg region wounds due to acute trauma. Ten male and four female patients aged from 10 to 59 years old were included this study.

Results: All flaps survived. No venous congestion and total flap necrosis was seen. There were 4 complications, and all of them were corrected with short interventions. After second stage, no complication was seen.

Conclusions: Interpolation sural flap modification has many advantages including reliability, no venous congestion, immediate reconstruction without a surgical team. However, it is a-two staged reconstruction and its donor site scarring can be serious.

Keywords: Acute trauma, distal lower leg defects, interpolation, sural flap, venous congestion

Distal lower leg wounds are difficult to reconstruct with local flaps due to the small amount of soft tissue being available. If the wound cause is acute trauma the tissue around the zone of injury has uncertain fate, whether it is viable or not. Edema is another serious problem associated with the acute trauma zone. The application of free flaps is a good choice for this area; however, teamwork and operational preparation are needed. Sural flaps are a good and frequently used approach for heel reconstruction, around the ankle and the distal lower leg. Sural flaps have a good axial blood supply, but partial or total necrosis related to venous congestion have complicated their use. Unfortunately, the distal tip of the flap, which is the area that is needed the most, is often the part that fails [1].

In this study we investigated the use of interpolation sural flaps for acute trauma patients, and we analyzed the outcomes and complications associated with this flap in the selected injury type.

METHODS

Between 2019 and 2022 ten males and four females patients underwent interpolation sural flap surgery to reconstruct the ankle and foot region with orthopedic surgeons immediately or within a week following trauma.

Surgical procedures were performed under spinal or general anesthesia. The patients were placed in the supine, prone, or lateral decubitus positions. All flaps

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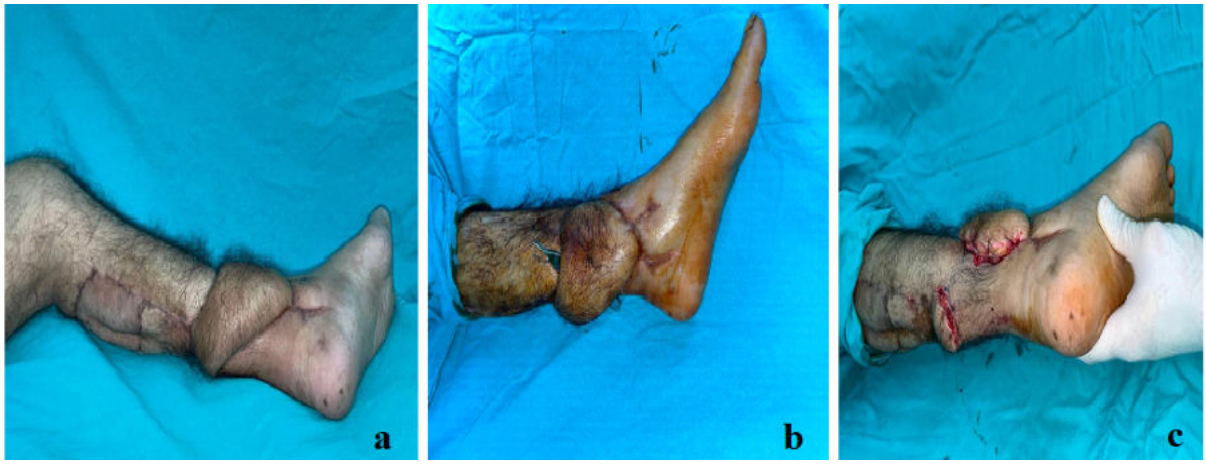

Fig. 1. a) Interpolation sural flap b) At the second stage, the flap can be divided with the help of a forceps. c) Raw surface was sutured.

were raised sub-facially and included the skin, soft tissue, sural nerve, sural artery, and lesser saphenous vein. We did not ligate small saphenous vein. The sural nerve was located at the center of the flap course. The flap width was designed to be at least 4 to 8 cm. The main peroneal perforator located about 5 cm above the lateral malleolus was checked with handheld Doppler ultrasound. However, the perforator was not dissected and the base of the flap with an intact skin was at the perforator level. Sutures were placed few and far between each other, as the flap would have had a natural edema process. The donor site of the flap was primarily sutured or skin-grafted. At the second stage, we found the skin bridge between the donor site and the reconstructed area with the help of a forceps (Fig. 1). Division was made and the sural nerve was sutured proximally and distally at the flap margins. The raw surfaces of the flap margins were then sutured loosely on the skin.

RESULTS

Mean age was 47 years. Nine patients had medial malleolus defect. Mean interval period between first and second stages was 7 weeks. All flaps survived and no total flap necrosis were observed; no venous congestion was observed either (Fig. 2). Only four of the patients had complications. Three of them needed an additional short time revisional operation under local anesthesia. These operations were flap readvancement and scar revision. The remaining patient had exposure

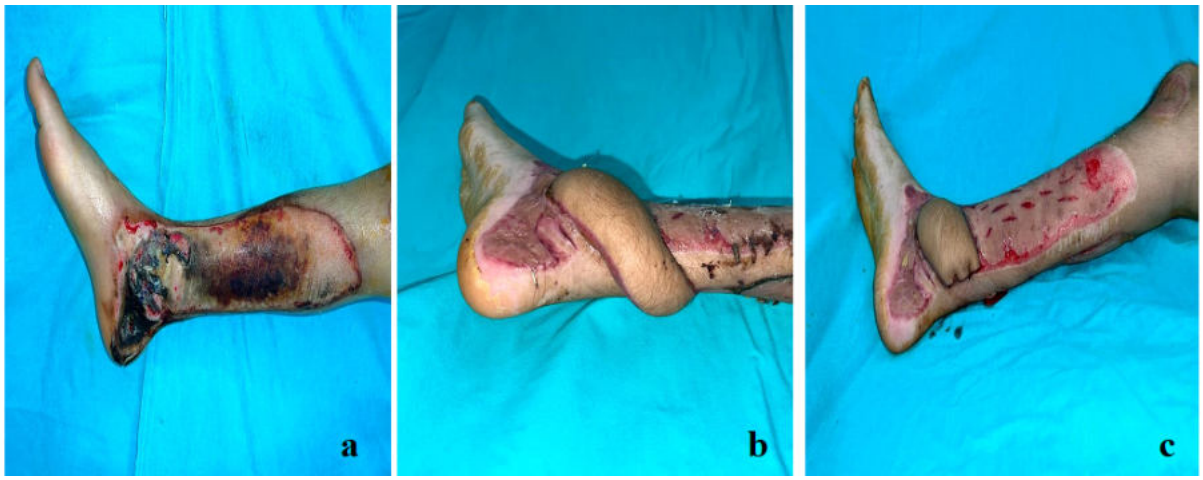

Fig. 2. a) The demarcation of the injury zone was clear at the end of a week b) An interpolation sural flap was inset on the exposed bone c) After 3 weeks, the interpolation sural flap was divided.

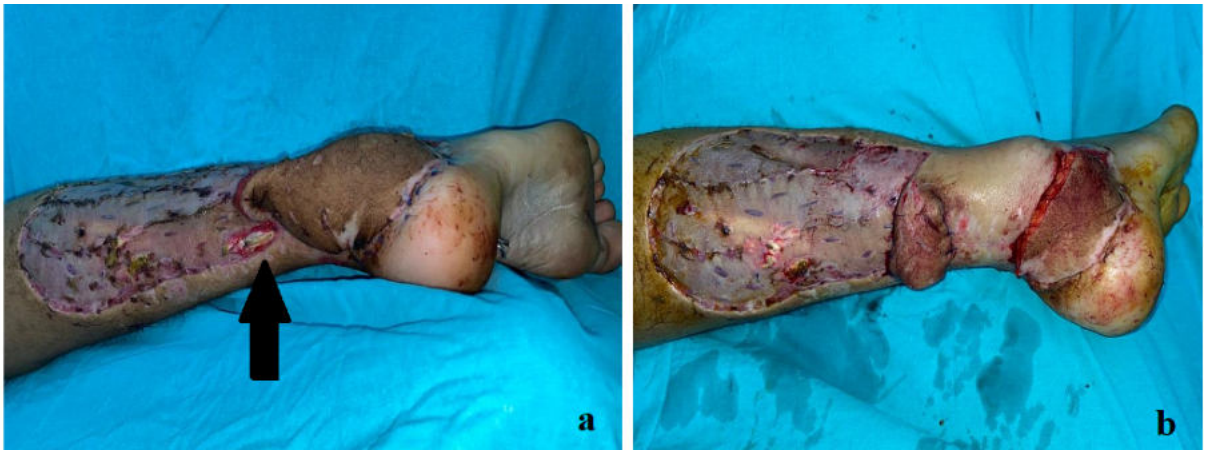

Fig. 3. a) The black arrow is indicated the exposed Achilles tendon b) The remnant of the interpolation sural flap was transposed to the iatrogenic defect when the flap was divided at the second stage.

of the Achilles tendon in donor site, and was reconstructed during division, the second stage of the interpolation flap procedure (Fig. 3). A summary of the patients is shown in Table 1.

For the first stage of the operation, all patients were advised to limit their mobility for a 7-day period. Postoperatively, the extremity remained elevated for a 7-day period as well. The planned second stage was at 3 weeks postoperatively, unless there was a complication or orthopedic surgery or the patient's compliance. For the second stage of the operation there were no limitations regarding mobilization and extremity elevation. No patient needed any custom shoes or flap debulking surgeries, and we did not see any complications after this stage.

Table 1. Patients' summary

Patient Number	Age	Sex	Defect Location	Complications after Immediate Reconstruction	Interval Period between First and Second Stages of Interpolation Flap	Follow up
1	47	F	Heel	-	3 weeks	14 months
2	59	F	Medial malleolus	-	4 weeks	12 months
3	10	M	Medial malleolus	-	3 weeks	12 months
4	49	M	Heel	-	4 weeks	10 months
5	43	M	Medial malleolus	-	7 weeks	9 months
6	42	M	Medial malleolus	Exposion of Achilles tendon	4 weeks	15 months
7	42	M	Heel	-	9 weeks	13 months
8	56	M	Medial malleolus	-	6 weeks	12 months
9	38	M	Medial mallelus	-	8 weeks	10 months
10	59	M	Lateral malleolus	Partial necrosis	10 weeks	16 months
11	54	F	Medial malleolus	-	6 weeks	8 months
12	59	M	Anterior side of tibia	Partial necrosis	12 weeks	15 months
13	56	F	Medial malleolus	-	8 weeks	12 months
14	48	M	Medial malleolus	Wound dehissance	16 weeks	9 months

DISCUSSION

Since 1981 there have been many studies on the anatomical basis of the sural flap [2-7]. Several modifications of this flap have also been reported in the literature, including interpolation, propeller, free, and turnover types [1, 8-11]. The main purpose of these modifications is the viability of the flap itself, aesthetic improvements in appearance, and the ability of the patient to wear their own shoes.

According to a systematic review, propeller flaps in lower extremities have 1.1% total flap necrosis, 11.3% partial flap necrosis, and 25.8% total complications [12]. On the other hand, interpolation sural flaps are reported in the literature to have fewer complications [1, 13]. In our study we also had very low complication rate, and total flap necrosis did not occur. All the complications we saw were related with hematomas, postoperative edema of the flap, and incompliance with the suggested positioning of the leg. Thus, in our experience, if tension and edema were minimized the flap survived.

Although sural flaps as a reverse flow have axial pattern and reliable perfusion, impaired venous outflow can be the most significant difficulty associated with this flap [14, 15]. Veins are compressible structures. We therefore designed the flap with supplying dermal circulation without cutting the skin base. Following this approach we did not face complications associated with venous congestion.

In one patient, we saw exposure of the Achilles tendon in the donor site ten days after the first stage of the interpolation sural flap procedure, which should had been covered by the flap. In that case we waited for the second stage, and we transposed the remnant of the interpolation flap after division.

Although a 2-stage reconstruction procedure is a limitation associated with this flap, secondary debulking surgeries are usually needed after free flap reconstruction of the lower extremities. [16, 17]. In the second stage of the interpolation sural flap procedure we also made the debulking of the flap, and reshaped the flap as well as possible.

The interval period between the first and second stage of the interpolation sural flap procedure varied in our study. Many studies have suggested that this time ranges between 3 weeks to 20 months [18-20]. In our study we preferred the interval between the first and second stage operation to be at least 3 weeks only in healthy, non-complicated patients. Generally, this interval depended on complications, orthopedic surgery, and on the patient's compliance with the treatment.

Selecting the right donor site for lower extremity reconstruction is associated with many uncertainties. Although the treatment of choice is often a free flap harvesting, there are some questions including the laterality of the lower extremity and duplex ultrasound result [21, 22]. On the other hand, sural flaps have several advantages compared to free flaps: constant vascular anatomy, and the same skin features with the defect. However, the donor site of the interpolation sural flaps is usually grafted skin and the aesthetic appearance of the leg may not be as good. For this reason, the patients' concerns about the donor site should be considered preoperatively.

CONCLUSION

Interpolation sural flap is a reliable, versatile, and quick solution for patients with acute trauma. Although this technique requires a 2-stage procedure, the second stage is simple and not associated with complications. Finally, the patients' expectation and concerns about the donor site should be reviewed preoperatively.

Authors' Contribution

Study Conception: MT; Study Design: MT; Supervision: YEŞ, TCZ; Funding: MT; Materials: MT, YEŞ, TCZ, AEK; Data Collection and/or Processing: MT, AEK; Statistical Analysis and/or Data Interpretation: MT, AEK; Literature Review: MT; Manuscript Preparation: MT and Critical Review: ÖÖ, ÖÖ.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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