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ORIGINAL ARTICLE

A Comparative Study between Outcomes of Random Pattern *vs* Axial Pattern Local Fasciocutaneous Flap for Tendoachilles Region Defect of Small and Medium Size

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ABSTRACT

Introduction: Tendoachilles region defects are challenging to reconstruct due to their anatomical peculiarities like limited vascularity and mobility of the skin. Trauma due to falls or RTAs, wound dehiscence post tendoachilles repair, pressure ulcers, burn injuries, excision of tumors, etc., are the various causes leading to tendoachilles region defects. These defects can be small (<30 cm^2), medium (30-90 cm^2), or large (> 90 cm^2). For medium and small defects, there is no better flap. In this study, we compare axial pattern and random pattern fasciocutaneous flaps for tendoachilles region defects of small and medium size.

Materials and methods: A prospective interventional study of 8 patients was conducted from 1st January 2022 to 31st May 2023 between two groups: axial pattern and random pattern for coverage of tendoachilles region defects. Random flap included bipedicle and v-y advancement flaps, whereas perforator (axial pattern) flap included peroneal artery perforator-based propeller and pedicled flap and reverse sural artery perforator flap.

Results: Age ranged from 18 to 60 years with the majority being middle-aged men (37.5 %).The most common cause for tendoachilles region defect is trauma due to fall or RTA. We found out that there is no significant difference in the length of hospital stay or duration of procedure between random pattern or axial pattern local fasciocutaneous flap. Our series demonstrated a low complication rate and good functional outcomesfor patients.

Conclusion: Local fasciocutaneous flaps are reliable and simple solutions for covering small to moderate soft tissue defects overlying the Achilles Tendon, with acceptable functional and cosmetic outcomes. There is no difference in outcome whether a random pattern or axial pattern flap is used.

Keywords: Tendoachilles region, Small to medium defect, Random pattern flaps, Axial pattern perforator flaps
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INTRODUCTION

Achilles tendon is the largest and strongest of all tendons. It is formed by confluence of two muscles namely soleus and gastrocnemius. Its contraction leads to plantar flexion of foot at ankle joint. Reconstruction of defects that expose achilles tendon is challenging because of its anatomic peculiarities being limited vascularity and limited mobility of skin. For good function and aesthetic outcome reconstruction that leads to stable and thin coverage with good contour and gliding surface.

Trauma due to fall or RTA, wound dehiscence post tendoachilles repair,pressure ulcer, burn injury,and excision of tumor,[1]etc., are the various causes leading to tendoachilles region defect. These defects can be small (<30 cm^2), medium (30-90 cm^2), or large (> 90 cm^2)[2]. Soft-tissue defects range from minimal tendon exposure to severe infected bone exposure, in which there is likely to be simultaneous tendon loss that requires repair to guarantee plantar flexion[3]. For large and complex defects, its known that free flaps yield good results. But for medium and small defects there is no better flap. We did a comparison between axial patternand random pattern fasciocutaneous flap for tendoachilles region defects of small and medium size. Random flaps included bipedicleand v-y advancement flaps whereasaxial pattern flaps included peroneal artery perforator-based propeller and pedicled flap and reverse sural artery perforator flap.

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MATERIALS AND METHOD

A prospective interventional study of 8 patients was conducted from 1st January 2022 to 31st May 2023 at our institution in the Department of Burns and Plastic Surgery. It comprised a comparison between two groups: axial pattern and random pattern for coverage of tendoachilles region defects. Selected patients were evaluated in terms of age, gender, and general conditions. After assessing the area of the defect and surrounding tissue available, the flap to be used was selected as either a random pattern flap or a perforator-based axial flap. Intraoperatively, the size of the flap harvested, harvest time, total operation time, postoperatively flap survival, recipient site complications, donor site morbidity, and hospital stay were analyzed. Cosmetic results of the two groups were documented. Inclusion criteria involved age group between 18-65 years and soft tissue defect over the tendoachilles region due to any etiology like trauma, chronic ulcers, etc. We excluded large defects requiring free flap reconstructions, patients with advanced diseases, and associated Achilles tendon defects.

Primary objective(s)

- To compare the outcome of different techniques used to cover tendoachilles defect.

Secondary objective(s)

- To evaluate the total duration of the procedure (total procedure duration, duration of harvesting flap), total hospital stay, and donor site morbidity.

OPERATIVE TECHNIQUE

After general or spinal anesthesia and proper positioning as per requirement (Supine, prone, or lateral position). The debridement of necrotic tissue was done and defect measured and flaps were planned, accordingly, and outlined. Peroneal artery perforator flap in two cases one pedicled another propeller, Reverse sural artery flap in two cases, bipedicle flaps in two cases, and local v-y advancement flaps in two cases were performed as outlined in individual case illustrations. The donor site is closed primarily, or by STSG.

Post-operative rehabilitation

Post-operative limb elevation and flap monitoring were done 6 hourly, then 12 hourly for 48 hours, then once a day. Stitch removal was done after two weeks andthe plaster slab for four to six weeks. Guarded mobilization was started after 3 to 4 weeks.

RESULTS

There were 4 participants in each group, comprising two peroneal artery-based flaps, one pedicled, and another propeller, two reverse sural artery perforator (RSAP) flaps in the perforator flap group, whereas two bipedicle flaps and two random pattern v-y advancement flaps in the random pattern flap group. The age of patients ranged from 18 to 60 years, with the majority being middle-aged men, accounting for 3 out of 8 participants (37.5%). The most common etiology for tendoachilles region defects was trauma due to falls and RTAs. The time interval between injury and presentation ranged from 1 to 36 months. Male patients comprised 62.5%, and female patients comprised 37.5% of the total. Defect size ranged from 45 cm to 57 cm for the perforator flap group and 24 cm to 35 cm for the local flap group.

Table 1: Demographic data

S.No.	Sex/ Age	Etiology	Defect size (cm. sq.)	Reconstruction	Time interval (months)
1	M/19	Post RTA	4*5	Peroneal artery perforator-based pedicled flap	3
2	M/45	Post RTA	5*6	Peroneal artery perforator-based propellar flap	1
3	M/60	Post-traumatic (fall)	4*6	RSAP	1
4	F/50	Unstable burn scar	5*7	RSAP	36
5	M/40	Wound de-hiscence	3*5	Bipedicle	1
6	F/30	Post-traumatic (fall)	4*5	Bipedicle	4
7	M/35	Wound de-hiscence	3*3	V-Y advance-ment	5
8	F/18	Post-traumatic (fall)	3*4	V-Y advance-ment	6

The flap size ranged from 3*7 cm to 5*20 cm as shown in Table 2. Apart from peroneal artery-based pedicled flap and bipedicle flap where STSG was done all donor sites were closed primarily.A Fischer exact test was conducted between axial and random pattern fasciocutaneous flap and total duration of procedure(TDP) as expected cell frequencies were less than five in all 4 cells. There was no statistically significant association between type of flap and TDP, $\chi 2(2) = 4.80$, $p = 0.143$. Similarly, Fischer exact test was conducted between type of flap and length of hospital stay (LHS) as expected cell frequencies were less than five in all 4 cells. There was no statistically significant association between type of flap and LHS, $\chi 2(2) = 4.80$, $p = 0.143$.

Table 2: Intraoperative and postoperative findings

Serial no	Flap size (cm. sq.)	Flap	TDP (hours)	DH (hours)	LHS (days)	Donor site closure
1	4*7	Peroneal artery perforator-based pedicled flap	3	2	10	STSG
2	6*12	Peroneal artery perforator-based propellar flap	3.5	2	12	Primary closure
3	5*20	RSAP	3.5	2.5	10	Primary closure
4	5*12	RSAP	4	3	11	Primary closure
5	4*7	Bipedicle	2.5	1	9	STSG
6	5*8	Bipedicle	2	1	10	STSG
7	4*8	V-Y advancement	1	1	6	Primary closure
8	3*7	V-Y advancement	1.5	1.5	7	Primary closure

TDP- Total Duration of Procedure, DH- Duration of Harvesting Flap, LHS– Length Of Hospital Stay

There were two cases (25%) of wound dehiscence which was not significant and healed on its own. There were no cases of bleeding/ hematoma formation. Minimal serous discharge was seen only in one case (12.5 %). There were no cases of surgical site infection and flap necrosis.There was no donor site morbidity in the form of STSG loss, hypertrophy, pain, paresthesia, itching, pigmentation and numbness (Table 3).

Table 3: Complications.

Serial No.	Wound dehiscence	Bleeding/ Hematoma	Serous discharge	Surgical site infection	Flap necrosis	Donor site morbidity
1	None	None	None	None	None	None
2	Not significant	None	Minimal	None	None	None
3	None	None	None	None	None	None
4	None	None	None	None	None	None
5	None	None	None	None	None	None
6	Not significant	None	None	None	None	None
7	None	None	None	None	None	None
8	None	None	None	None	None	None

A Fischer exact test was conducted between type of flap and ankle range of motion as expected cell frequencies were less than five in all 4 cells. There was no statistically significant association between type of flap and ankle range of motion, $\chi 2(2) = 1.33$, $p = 1.000$. None of the patients experienced pain, difficulty in walking post-procedure or any problem in alignment while walking. None of the patients required revisional surgery (Table 4).

Table 4: Functional outcome.

S.No.	Ankle range of motion after 3 months	Pain	Ability to walk	Alignment while walking	Revisional surgery
1	Mild Restriction	-	Yes	+	No
2	Moderate Restriction	-	Yes	+	No
3	Mild Restriction	-	Yes	+	No
4	No Restriction	-	Yes	+	No
5	Mild Restriction	-	Yes	+	No
6	No Restriction	-	Yes	+	No
7	Mild Restriction	-	Yes	+	No
8	No Restriction	-	Yes	+	No

Ankle range of motion: Mild restriction (>30), Moderate restriction (15-29), Severe restriction (<15)

CASE ILLUSTRATION

Case Report 1

A 60-year-old male presented with a 4*6 cm wound over tendoachilles region after falling from stairs after a month. After initial evaluation patient underwent a single staged adipofascial reverse sural artery perforator flap. A line was drawn from the mid-popliteal point to the midpoint between the Achilles tendon and lateral malleolus, which is the course of the superficial sural nerve and the lesser saphenous vein. A 5*20 cm flap was then outlined on the lower leg. The cutaneous perforators in the posterior region of the lateral malleolus were confirmed bythe elevation of the adipofascial pedicle at the subfascial level. Adipofascial flap raised in an island form from proximal to distal direction and rotated 180 degree and inset done over tendoachilles region defect. The pedicle of the flap was buried subcutaneously through a skin incision.[2] Donor site closed primarily and STSG placed over the flap. No Flap failure, complications, or donor site morbidity was seen. Mild restriction of ankle range of motion after 3 months (Figure 1).

Figure 1: A) 4*6 cm sized defect over tendoachilles region due to fall from stairs in a 60-year-old male. **B)** covered with single-stage adipofascial reverse sural artery perforator flap. **C)** three months postoperative.

Case Report 2

A male patient aged 45 years presented with a 5*6 cm defect one month after RTA. The patient underwent peroneal artery perforator-based propeller flap. Using a Doppler probe, peroneal artery perforator wasidentified proximal to the superior edge of the wound and a 6*14 cm flap was designed.An incision was kept along the anterior aspect of the flap. Under loupe magnification, the dissection wasdone and local perforators were identified. The ideal perforator was selected based on vessel calibre and as distal position as possible outside the trauma zone. The posterior incision was then made, and the flap was completely elevated. The flap was propelled 180 degree and the inset was done without tension. The proximal donor site was closed primarily. In the post-operative period patient had wound dehiscence over inferomedial aspect with minimal serous discharge which healed conservatively. No flap loss was seen.

Case Report 3

A 19-year-old male patient presented with a defect of 4*5 cm sq, 3 months after RTA. The patient underwent peroneal artery perforator-based pedicled flap. Using a Doppler probe peroneal artery perforator was identified along superolateral edge of the wound and designed a 4*7 cm sq flap. Incision made along the anterior edge of the flap. Dissection carried out posteriorly local perforators were identified and protected. Posterior and proximal incision was made. The pedicle was rotated to cover the defect and the donor site closed with an STSG. There was no complication with mild restriction of ankle movement at three months follow-up.

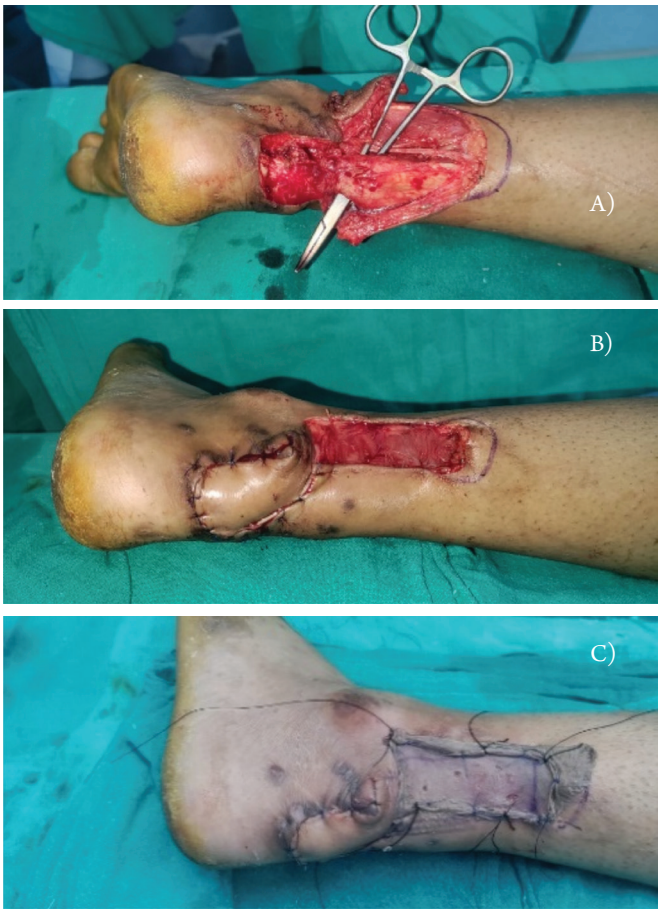

Figure 3: A) post-debridement tendoachilles region defect with flap raised. **B)** Pedicled peroneal artery perforator-based flap inset over defect, and **C)** Donor area closed with SSG.

Case Report 4

A 35-year-old female presented with wound dehiscence after tendon repair of 3*3 cm size after 5 months. The patient underwent local flap of v-y advancement. Two "v" shaped flap around the wound are marked and elevated. The flap advanced to cover the defect in the shape of a "Y". There were nil complications and the wound healed well. There was mild restriction of ankle range of motion after 3 months.

Figure 4: Local random pattern flap v-y advancement flap.

Figure 5: A) Defect over tendoachilles region **B)** bipedicled flap with donor closed with SSG

Case Report 5

A 30 years old female presented after 4 months of falling from stool in the kitchen resulting in 4x5 cm wound in tendoachilles region. The patient underwent bipedicle flap with STSG of raw area. The wound healed well and ankle range of movement showed no restriction.

DISCUSSION

Tendoachilles region defects represent a challenge to reconstructive surgeons as durable coverage to resist pressure and chronic irritation is required. Also,a pliable coverage needs to be provided asa suitable gliding surface for the underlying AT to move without the formation of adhesions [5]. If we look at the rungs of reconstructive ladder one by one starting with conservative treatmentwe would land up to flap coverage as the most suitable form of defect closure. Conservative management including VAC therapy is not suitable as it leads to intractable and chronic wounds Skin grafting is deemed to failure due to lack of well vascularized bed and repeated mechanical irritation [6]. Coming to armamentarium of flaps we have vast variety of flaps to choose from local to regional to free flap. Free flaps are able to resurface defects of any size even with multiple components in a single stage with a very good success rate. Hence though beingthe ideal option for reconstruction of soft tissue defects in the distal one-third of the legthey are bulky, needa trained team, special operating set and prolonged operating time, have potential donor-site morbidity and

may not be applicable for older patients. So, they should be reserved for major avulsions and surgically competent patients.[7]

Local random pattern flaps are good option for open tendoachilles defect wound coverage being easy to carry out in short operative time without much complication and no donor site morbidity and good functional outcome but there is a limitation to the size of the defect it can cover due to the limited mobility. Perforator flaps are good option for a larger defect range where due to limited mobility local flaps could not be used.

We observed a predominance of ATR in middle-aged males between ages 30 to 50 years comprising 37.5% of participants, which is consistent with other studies,[5,7,8] possibly reflecting their susceptibility to injury and/or increase the prevalence of men's sports participation. In our study, we noticed that soft tissue defects were commonly caused by trauma followed by suture line dehiscence post repair which was the opposite of what was seen in the study by Elhefnawy *et al*.[2] in which 66.7% was due to suture line dehiscence and 33.3% was due to trauma.

We considered small and medium-sized defect ranging from 4*5 cm to 5*7 cm for the perforator flap group and 2*4 to 3*5 cm for the local random pattern flap group. Lin *et al*.[3] managed to cover defects ranging from 6 to 28 cm^2 with bipedicle fasciocutaneous flaps[8].

In our study, we found out that there is no significant difference in the length of hospital stay or duration of procedure betweenrandom pattern or axial pattern local fasciocutaneous flap.

Our series demonstrated a low complication rate and good functional outcomesfor patients.These findings agreed with Kumta and Maffulli,[5] who used local fasciocutaneous flaps (i.e., 4 reverse flow peroneal flaps, 1 reverse flow posterior tibial flap and 6 medial plantar flaps) for coverage of soft tissue defects exposing the AT, and noted that all flaps and donor sites healed well and 63.6% of the patients had good functional outcome. Jammula et al. [9] preferred to use island propeller flaps to cover the exposed AT and reported excellent functional results with stable covering in all except one patient that had flap failure due to impaired venous return.

Thus, any local flap be it a random pattern or axial pattern flap (perforator) is a good option for tendoachilles defect closure of small to medium size.

CONCLUSION

Local fasciocutaneous flaps are reliable and simple solutions for covering small to moderate soft tissue defects overlying the Achilles Tendon, with acceptable functional and cosmetic outcomes. There is no difference in outcome whether a random pattern or perforator flap is used.

REFERENCES

1. Gopalakrishnan R, Rajalingam M, Rajagunasekaran B, Esakimuthu R. A clinical study on reconstruction of small and medium sized defects of tendo Achilles and heel regions with fascio cutaneous flaps. Int J Surg 2020 Jun 25; 7(7):2294-9
2. Elhefnawy AA., Hantash SA., Mahmoud WH, Homouda WI., Khedr MM. Versatility of Local Fasciocutaneous Island Flaps for Resurfacing Soft Tissue Defects Overlying the Achilles Tendon. World J Plast Surg. 2023;12(1):20-28
3. A. Marchesi, et al., Soft-tissue defects of the Achilles tendon region: Management and reconstructive ladder. Review of the literature, Injury (2016)
4. Chang SM, Zhang F, Yu GR, Hou CL, Gu YD. Modified distally based peroneal artery perforator flap for reconstruction of foot and ankle. Microsurgery 2004;24:530536
5. Kumta SM, Maffulli N. Local flap coverage for soft tissue defects following open repair of Achilles tendon rupture. Acta Orthop Belg 2003; 69(1):59-66.
6. Michlits W, Gruber S, Windhofer C, Macheiner P, Walsh M, Papp C. Reconstruction of soft tissue defects overlying the Achilles tendon using the super extended abductor hallucis muscle flap. J Trauma Acute Care Surg 2008 Dec 1; 65(6):1459-62
7. Zakaria Y, Khashaba HA, El-morshidy AF, Abdulazeem MA. The Versatility of the Reversed Sural Artery Flap in Coverage of Soft Tissue Defects of the Foot and Ankle. Egypt J Plast Reconstr Surg 2013 Jan; 37(1):111–7.
8. Lin CT, Chen SG, Chen TM, Dai NT, Chang SC. Bipedicled flap for the reconstruction of soft tissue defects of the Achilles tendon. Ann Plast Surg 2015 Apr 1; 74(4):484-7
9. Jammula SS, Rangachari S, Panagatla P. Propellar flap: safe, reliable option for coverage of exposed tendo achilles. Int J Res Orthop 2018 Jul; 4(4):572