Middle Black Sea Journal of Health Science / Mid Blac Sea J Health Sci **August 2021; 7(2):276-281**

RESEARCH ARTICLE **DOI:** 10.19127/mbsjohs.964872

Skin Traction Tecnique for Closure of Large and Complex Skin Defects in Special Cases

Seckin Aydin Savas[1(ID)]

[1]Department of Plastic and Reconstructive Surgery, Faculty of Medicine, Alanya Alaaddin Keykubat University, Alanya, Türkiye

Received: 08 July 2021, Accepted: 24 August 2021, Published online: 31 August 2021

Abstract

Objective: During the period of COVID-19 pandemic, the reconstructive surgeons don't want to take risks of complex and long operations, and to struggle with long recovery time after surgery as well as with associated donor-site morbidity. Therefore, they prefer much more simple techniques. The objective of this study is to evidence that skin traction technique is a simple, short term, useful, and good option for closing open wound complex defect which needs the reconstruction with large flap.

Methods: Skin traction techniques were applied to ten patients who had large complex defects in our clinic between March 2020 and March 2021. Patient's data including demographic characteristic, comorbidities, causes of defects, anatomic localization of defects, size of defect, time of closure defect, time interval of tightening suture, number of tightening sutures, time of staying in hospital, general complication was recorded.

Results: The study included 8 males and 2 females. The average age of patients was 42.8 years ranging from 22 to 60. The size of defects ranged between 8x5 cm and 18x10 cm with an average of 11.7x7.2 cm. The average duration of follow-up was 6 months. After 3 months, we evaluated subjectively quality of skin thickness, mobility, and colour. Skin was thinner and less mobile in the areas that were reconstructed with graft when compared with skin traction territories where the colour of skin was also normal in the cases with skin defect which was repaired by primarily closure after skin traction. All patients were satisfied with results. Complications such as skin necrosis at the traction site and hematoma were not observed. Superficial wound infection was seen in one patient, and it was resolved with antibiotherapy.

Conclusions: We suggest using the traction suture technique for complex defects as an easy, cheap, and short-time procedure to reconstruct large and complex skin defects especially in recipient vessel problems, cases suffered from flap failure, patients with comorbidities and special conditions (for example, during the COVID-19 pandemic).

Key words: Adenoma, Surgery, Trans-sphenoidal, Pituitary.

Suggested Citation: Ozdemir B, Batcik OE. Trans-Sphenoidal Surgery for "Growth Hormone-secreting adenoma; Revisiting Surgical Outcome. Mid Blac Sea Journal of Health Sci, 2021; 7(2):276-281

Address for correspondence/reprints: **E-mail:** dr.saydin@hotmail.com

Seckin Aydin Savas

Telephone number: +90 (505) 354 32 38

Introduction

Many surgical methods have been applied for the closure of large skin defects such as primer skin graft, vacuum assisted closure, tissue stretching and expansion, local flaps, and free flaps. These methods are preferred according to criteria as follows: 1. exposed of nerve, vessel, bone, and tendon, 2. presence of deperiosted bone, 3. localization and size of the defect, 4. the degree of nerve and vascular injury, and 5. detailed history of patient as age and associated vascular comorbidity (1).

Reconstructive ladder goes through simple to complex. However, this diagram may be reversed for complex large defect when no suitable recipient vessels and no options of reliable local flaps are found and already all free flaps options are exhausted (1, 2). During the period of COVID-19 pandemic, the reconstructive surgeons don't want to take risks of complex and long operations, and to struggle with long recovery time after surgery as well as with associated donor-site morbidity. Therefore, they can prefer much more simple techniques as medical dressing with different drug, VAC (vacuum assisted closure) therapy, and skin traction.

Optimal amplitude mechanic force, tension and waveform may provide skin elongation due to skin's viscoelastic properties. Primary closure may be provided by the viscoelastic properties of the skin. The skin's mechanic properties such as mechanical creep and stress relaxation were described more than 40 years ago (1, 2). As a result, if skin is stretched with a constant force as a result, skin will expand during it is kept under tension, the phenomenon is called as mechanical creep. If the skin is stretched to a constant distance, it will expand. The reduction of force or tension on the skin over time after it has expanded is called stress relaxation. Tissue traction can be used for closure complex defect by utilizing skin's mechanic properties (3, 4).

The aim of this study is to evidence that skin traction technique is simple, short term, useful, and good option for closing open wound complex defect which needs the reconstruction with large flap.

Methods

Skin traction techniques were applied to ten patients who had large complex defects in our clinic between March 2020 and March 2021. The essential approval was obtained from Alaaddin Keykubat University Training and Research Hospital to use the hospital database. The study protocol was approved by the ethics committee of Faculty of Medicine, Alanya Alaaddin Keykubat University. Patient's data including dermographic characteristic, comorbidite, causes of defects, anatomic localization of defects, size of defect, time of closure defect, time interval of tightening suture, number of tightening suture, time of staying in hospital, general complication were recorded.

Surgical Technique

Serial debridments were performed till the nonviable tissue was discarded in all patients. Skin traction sessions were initiated with using simple skin sutures across the wound edges with 2.0 prolen which had cutting needle while patients were under sedation or local anasthesia. First suture loop was placed at 1,5 cm away from wound edges on the healthy skin. Minimal three and maximum ten traction sutures were needed for each of defects. The skin traction was applied untill the skin was blanched and appeared too tight. All wounds were cleaned, and their dressings were changed daily. When skin relaxation was achieved, traction suture was renewed. However, renewing time was different in all patients due to their skin mechanical properties. In the follow-up period, the skin edges and distal extremity were evaluated by clinical observation—capillary refilling, skin color, peripheric artery pulsation, and sensation—

Results

The study included 8 males and 2 females. The average age of patients was 42.8 years ranging from 22 to 60. The etiological causes of defects were traffic accident in four patients, gunshot injury in two patients, job-related injury in one patient, diabatic foot in one patient, whereas one of them has congenital foot deformity. When the location of defects was evaluated, the defects were located in the lower extremity in nine cases and in the upper extremity in one case. The size of defects ranged between 8x5 cm and 18x10 cm with an average of 11.7x7.2 cm (Table 1).

Patient	Age (year)	Gender	Localization of defects	Size of defect (cm)
1	22	M	L-LE Anterolateral tibia	12x10
2	41	F	R-UE Forearm	12X8
3	58	M	L-LE Calcaneus	8X5
4	25	F	L-LE Plantar surface	9x5
5	60	M	R-LE Medial tibia	11x10
6	34	M	L-LE Anteriolateral tibia	12x10
7	50	M	L-LE Foot lateral surface	10x4
8	35	M	R-LE Anterior tibia	9x5
9	55	M	L-LE Knee medial surface	10x5
10	48	M	L-LE Anterolateral tibia	18x10

Debridement's and skin traction procedures of all the patients were generally performed by ambulatory surgery under local anesthesia. Also, vacuum assisted therapy and traction sutures were used simultaneously in one patient. Skin traction provided enough time for evolving granulation tissue and decreasing defect sizes in five patients and then these defects were grafted. Skin tractions were enabled us to close five of these defect primarily.

The average duration of follow-up was 6 months. After 3 months, we evaluated subjectively quality of skin thickness, mobility, and colour. Skin was thinner and less mobile in the areas that were reconstructed with graft when compared with skin traction territories where the colour of skin was also normal in the cases with skin defect which was repaired by primarily closure after skin traction. All patients were satisfied with results.

Complications such as skin necrosis at the traction site and hematoma were not observed. Superficial wound infection was seen in one patient, and it was resolved with antibiotherapy.

Case Reports

Case 1

A 22-years-old man underwent gunshot injury, and 12x10 cm soft tissue defect was on the anterolateral tibia with exposed tibia bone and tendons. The wound was prepared for closure of defect by debridement. Six traction sutures were placed with 2.0 prolen and then sutures were tightened within three days. Defect could be repaired with primary closure expect only a limited area in which splint thickness graft was used. The wound was healed after a month (Figure 1).

Figure 1. Photographs of case 1st (A: View of defect before debridement, B: View of exposed tendons and tibia bone after debridement, C: View of repaired defect by skin traction and skin graft after 2 months postoperatively)

Case 2

A 58-year-old man who was referred with the 8x5 cm diabetic ulcer on the left heel with exposed calcaneus bone. After debridement, four traction sutures were used, and sutures were tightened within six days when defect was closed. The defect was closed by using simple interrupted sutures. The wound was healed after twenty-one days (Figure 2).

Figure 2. Photographs of case 2nd (A: View of defect of heel preoperatively, B/C: Application of skin traction, D: View of repaired defect by skin traction after 6 months postoperatively)

Case 3

A 25-year-old female patient who had congenital foot deformity: There was a 6x5 cm pressure sore on the plantar surface of the foot, in which the plantar fascia was exposed due to the changes in areas which were the load-bearing and imposed to pressure. Plantar forefoot defect was closed by medial plantar Fascio cutaneous island flap. Unfortunately, after total flap necrosis skin defect with an area of 9x5 cm was observed. Therefore, other reconstruction options were not remaining. Five traction sutures were used and tightened sequentially every 7 days. The defect was closed by using simple interrupted sutures. The wound was healed after forty-five days (Figure 3).

Figure 3: Photographs of case 3rd (A: View of defect before debridement, B/C/D/E: Application of skin traction, F: View of repaired defect by skin traction in the early postoperative period)

Discussion

Soft tissue defects can be repaired by various reconstruction methods. Complex defects of upper or lower extremity which are with exposed tendon, vascular structure, and nerve are difficult for reconstruction (1). This kind of large defect needs free flaps because of restricted options of local flap, no suitable pedicle, and the needs for flaps with different textures. Yet, this method requires long operation times, experienced surgeon, suitable recipient vessel with donor area morbidity (1). Especially if there is not a good recipient vessel, sometimes it leads to amputation. Also, after flap failure, the surgeon has no other option when limb salvage is still feasible (1,5).

VAC device should not be used for covering over extensive bone or an extensive fracture line. Therefore, the indication of VAC device is restricted. VAC device is a valuable adjunctive therapy method. Medical dressing is a long-term treatment which has an important disadvantage because of infection (2).

During the COVID-19 pandemic, some easier surgery methods with a short operation time and an ease of postoperative care, and without donor site morbidity are more suitable instead of more aggressive procedures. In accordingly, skin traction is a preferred option (6).

The mechanical properties of human skin and visco-elastic parameter were described by Gibson in 1977. The viscoelastic property of mechanical creep and stress relaxion were adverted in various studies (7). Mechanic stimuli such as shear force, tension, compression, and hydrostatic pressure convert to electrical signal by mechanosensory and mechanic stretching modulates growth direction (3, 4, 8). Mechanical creep means that if skin is stretched with constant, optimal amplitude force, it will grow and extend. Extensible connective tissue contains fibrous collagen network and elastin within extracellular matrix. Also stress relaxation mean if the skin is stretched to constant distance, skin will extend and then the tension of skin will reduce (9, 10). Consequently, skin is elongated by this viscoelastic property, and thus skin allows to use primary closure of wound.

Multiple techniques subsist to close wound and fasciotomy or perform scar revision by dermatotraction such as Schoelace tecnique, Marburger skin approximation (11), skin traction wire (12), clips and needles method (9), skin tape application, skin streching device, and presuturing (13). The major disadvantage in these techniques is need additional surgical instruments; as an example, a silastic vessel loop is needed for schoelace technique. In our technique, any of specific surgical instruments is not used except sutures. Skin traction technique is cheaper and easier than the other techniques.

Another advantage of our technique is that the quality of skin was always found to be satisfactory. Stretching site was preserved of sensation and colour. Five of defects could be closed primary and three of defects were closed with STSG. However, this method allows a significant decrease in applied graft area. Stretching site is more successful in terms of skin sensation and colour than graft area.

The stretching force as a limiting factor for using this technique has not been exaggerated because of skin viability. Safe stretching indicator was defined as skin pallor and pain. Another limiting factor is the difficulty of using irregular traumatic wound.

Conclusion

The suggested method can be applied with cheap and available materials in everywhere and everybody, depending on viscoelastic properties and ability of expandability of skin. We suggest to use the traction suture technique for complex defects as an easy, cheap, and short-time procedure to reconstruct large and complex skin defects especially in recipient vessel problems, cases suffered from flap failure, patients with comorbidities and special conditions (for example, during the COVID-19 pandemic).

Ethics Committee Approval: This study was conducted with the approval of the ethics committee of Alaaddin Keykubat University Training and Research Hospital, Clinical Research Ethics Committee. (Ethics Committee date and Decision no: 23/06/2021 -11/07)
Peer-review: Externally peer-reviewed.
Author Contributions:
Concept, Design, Literature search, Data Collection and Processing, Analysis or Interpretation, Writing: SAS
Conflict of Interest: The authors do not declare any conflict of interest.
Financial Disclosure: No financial support was received for this study.

References

1. Kang MJ, Chung CH, Chang YJ, and Kim KH. Reconstruction of the lower extremity using free flaps. Archives of plastic surgery, 2013; 40(5):575.
2. Wen G, Wang CY, Chai Y M, Cheng L, Chen M, and Yi-Min LV. Distally based saphenous neurocutaneous perforator flap combined with vac therapy for soft tissue reconstruction and hardware salvage in the lower extremities. Microsurgery, 2013;33(8):625-630.
3. Topaz M, Carmel NN, Silberman A, Li MS, and Li YZ. The TopClosure® 3S System, for skin stretching and a secure wound closure. European journal of plastic surgery, 2012;35(7):533-543.
4. Ryan TJ. Biochemical consequences of mechanical forces generated by distention and distortion. Journal of the American Academy of Dermatology. 1989; 21.1:115-130
5. Lu L, Liu A, Zhu L, Zhang J, Zhu X, and Jiang H. Cross-leg flaps: our preferred alternative to free flaps in the treatment of complex traumatic lower extremity wounds. Journal of the American College of Surgeons, 2013; 217(3): 461-471.
6. Chi D, Chen AD, Dorante MI, Lee BT, and Sacks JM. Plastic surgery in the time of COVID-19. Journal of reconstructive microsurgery, 2021; 37(02): 124-131.
7. Gibson T, Kenedi RM, and Craik, J E. The mobile micro-architecture of dermal collagen: A bio-engineering study. British Journal of Surgery, 1965: 52(10): 764-770.

8. Hill Sean M, and Eric T. Elwood. Pediatric lower extremity mower injuries. Annals of plastic surgery 2011: 67.3:279-287.
9. Marek DJ, Copeland GE, Zlowodzki M, and Cole PA. The application of dermatotraction for primary skin closure. The American journal of surgery, 2005;190(1): 123-126.
10. Purslow PP, Wess TJ, and Hukins DW. Collagen orientation and molecular spacing during creep and stress-relaxation in soft connective tissues. The Journal of experimental biology, 1998; 201(1): 135-142.
11. Zorrilla P, Marín A, Gómez LA, and Salido JA. Shoelace technique for gradual closure of fasciotomy wounds. Journal of Trauma and Acute Care Surgery, 2005;59(6):1515-1517.12.
12. Kocialkowski A, Marsh DR, and Shackley DC. Closure of the skin defect overlying infected non-union by skin traction. British journal of plastic surgery 1998;51.4: 307-310.
13. Daya, Mahendra, and Vaneshree Nair. Traction-assisted dermatogenesis by serial intermittent skin tape application. Plastic and reconstructive surgery 2008;122.4:1047-1054.