



Contents lists available at ScienceDirect

International Journal of Surgery Case Reports

journal homepage: www.casereports.com

Immediate emergency free anterolateral thigh flap after car-tyre friction injury: A case report with eight years follow-up



Abdullah Merter^{a,*}, Mehmet Armangil^b, Burak Kaya^c, Sinan Bilgin^b

^a Kahramanmaraş Afsin State Hospital, Orthopedic Clinic, Turkey

^b Ankara University, School of Medicine, Ibn-i Sina Hospital, Department of Orthopedics, Division of Hand Surgery, Turkey

^c Ankara University, School of Medicine, Cebeçi Hospital, Department of Plastic and Reconstructive Surgery, Turkey

ARTICLE INFO

Article history:

Received 2 February 2017

Received in revised form 31 May 2017

Accepted 4 June 2017

Available online 19 July 2017

ABSTRACT

The car-tyre friction injury has differences from other injuries. The components of injury which are burn, crushing, shearing, and degloving occur. Many treatment options can be performed for coverage of wound which are Vacuum Assisted Closure system (V.A.C), skin grafting, free flaps, local flaps and cross leg flap.

© 2017 The Authors. Published by Elsevier Ltd on behalf of IJS Publishing Group Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Free flaps offer many advantages for limb coverage, including a one-step procedure, decreased incidence of infection, promotion of bone consolidation, shorter hospitalization, and cost reduction. Immediate treatment is considered a reasonable option in terms of low bacterial colonization, shortened hospitalization period and cost effectiveness. We report car-tyre friction injury affecting the foot of 2 years old child treated with immediate emergency free anterolateral thigh flap (ALT) with eight years follow-up.

1. Introduction

Car-tyre friction injuries of the foot are common in countries where children are left unattended to play in the street [1]. The injured extremity in car-tyre friction injury is presented with combination of friction burn, crushing, shearing, and degloving. Car-tyre friction injury differs from the other type of foot injuries, this type of injury is detailed and classified by Al-Qattan [2]. These injuries have been classified into five grades according to the severity of the injury and magnitude of tissue damage. Higher grade of injuries need flap reconstruction and initial reconstruction directly associated with good outcome [2,3]. Naturally, the reconstructed foot grows with the child and the literature is very limited about long term follow-up in car-tyre friction injuries. We report on grade IV car-tyre friction injury affecting the foot of 2 years old child treated with immediate emergency free anterolateral thigh flap (ALT) with eight years follow-up. Outcome of the patient evaluated on the basis of function, gait, shoe-wear and the problems regarding growing of foot and also flap in long term.

2. Case report

In June 2006, a 2-years-old male patient was presented grade IV car-tyre friction injury (dorsal skin avulsion defect with tendon + arterial injury and bone exposure) of his left ankle and dorsal foot. He had no additional injury and co-morbidity at the time of injury. After completion of emergency assessment and support, he was taken directly to surgical room. Initial evaluation of the injured foot was performed under general anesthesia. The injury had severe crush and burn component and the wound was very contaminated with 7 × 5 cm defect just anterior of ankle joint. The defect was started from distal anteromedial metaphysis of tibia and finalised at anteromedial of the mid-foot. The area of skin defect was about 30 cm². Distal tibial periost, talonavicular joint and anterior of talus was exposed. Anterior tibial artery was injured at the proximal edge of the wound. Tibialis anterior and extensor hallucis longus tendons had defective injury where extensor digitorum longus tendons were intact (Fig. 1). There was no fracture at any bone.

A single-stage reconstruction was planned: thorough surgical debridement, tendon repair and transfer, soft tissue coverage using immediate emergency free ALT flap. After wide debridement and saline washing, resulting defect was about 40 cm². Short segment from the distal stump of extensor hallucis longus tendon was taken to repair anterior tibial tendon as a tendon graft, distal stump was transferred using end-to-side fashion to extensor digitorum longus tendons. Defect on the tibialis anterior tendon was reconstructed anatomically with interpositional tendon graft which was obtained from extensor hallucis longus, using “0” no polypropylene (Atramat® Internacional Farmacéutica, Inc.) (Fig. 2). Anterior tibial artery and accompanying veins were prepared as recipient vessels. 9 × 6 cm ALT flap was elevated based on two perforators including fascia full breadth with the flap dimension as a tendon gliding surface from ipsilateral thigh (Fig. 3). The anastomoses were performed

* Corresponding author at: Yesilyurt Mah. Afsin Devlet Hastanesi, Ortopedi Polikliniği, Afsin/Kahramanmaraş, Turkey.

E-mail address: dr.merter@gmail.com (A. Merter).



Fig. 1. First image after injury. 7 × 5 cm defect just anterior of ankle joint .

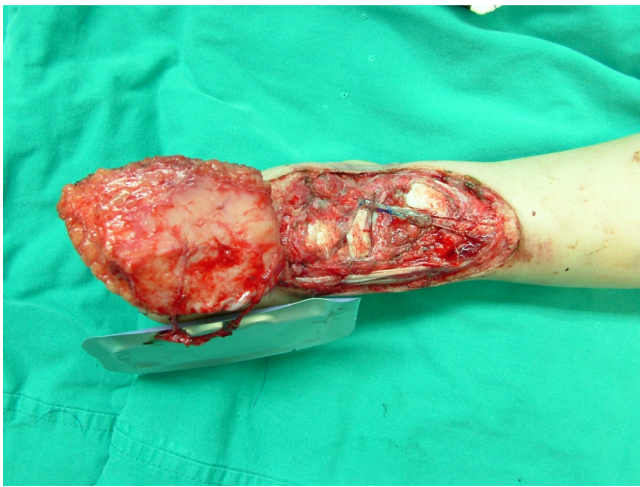


Fig. 2. The picture of the reconstructed tibialis anterior tendon with interpositional tendon graft which was obtained from extensor hallucis longus.



Fig. 4. The picture of flap after anastomoses.

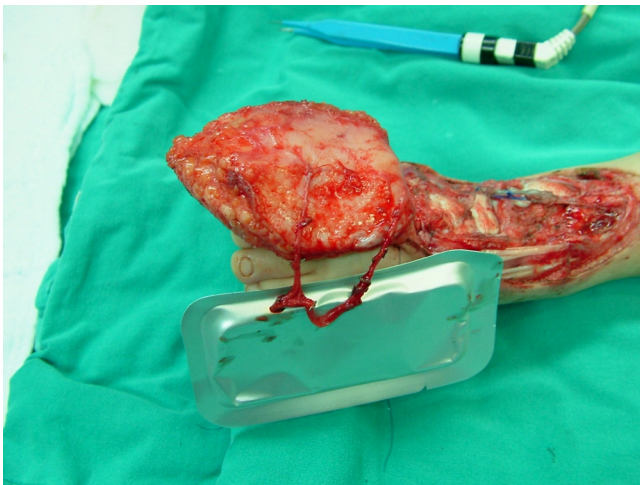


Fig. 3. The picture of elevated 9 × 6 cm ALT flap based on two perforators including fascia.

at proximal wound using end to end fashion with 10/0 polyamide monofilament nonabsorbable suture (Dafilon® Aesculap, Inc.) (Fig. 4). The donor side was closed primarily.

A short leg cast was used for immobilization. The total surgery time was 6 h, flap ischemia time was 45 min. Post-operative period was uneventful, hospitalization period was only 7 days, antiaggregant and/or anticoagulant treatment was not necessary in the early

post-op period. After four weeks of immobilization, patient was set free including weight bearing, no rehabilitation program was planned due to his age.

Only after 6 weeks after the reconstruction, his gait and running were almost normal, and he was using same and normal shoe like opposite side. No medical compression garment was used all along follow-up period but as he was growing, the ALT flap gained weight and became bulky preventing using same size shoe like opposite side. Liposuction was performed at two sessions for debulking procedure 8 years after the first reconstruction. (Fig. 5). After 8 years post-operatively, he has no functional deficit, his gait and running pattern were totally normal, he wears same size shoe compared to the other side. There is no ankle dorsiflexion deficit and extension lack of big toe was disappeared after three years post-operatively, now there is no extension lack of big toe (Fig. 6).

3. Discussion

The car-tyre friction injury has differences from other injuries. In this injury; while the car is passing over on child's foot, the driver tries to stop the car and as a result of this event, the components of injury which are burn, crushing, shearing, and degloving occur. This injury has been classified by Al-Qattan [2]. Grade I superficial 2nd degree friction burn without skin loss, Grade II deep 2nd degree friction burn with a small area of skin loss, Grade III 3rd degree friction burn with or without a small area of skin loss, Grade IV skin avulsion with tendon and/or bone exposure, Grade V severe soft tissue injury with significant bone loss.



Fig. 5. The picture before and after debulking procedure performed eight years later.

Many treatment options can be performed for coverage of wound which are Vacuum Assisted Closure system (V.A.C), skin grafting, free flaps, local flaps and cross leg flap. Most patients with car-tyre injuries present with friction burns to the dorsal aspect of the foot and these are either treated conservatively (grade I injuries) or with a skin grafting (grade II and III injuries). In grades IV and V injuries there is major soft tissue and bone loss in addition to the friction burn of the wound edges. These severe injuries require flap coverage [2]. However, the limiting factors which are age of patient, grade of injury, time of injury and experience of surgeon may influence choice of treatment. The pattern of injury is influenced by mass and acceleration, both of which are extreme in car-tyre injuries, and soft tissues and deeper structures are torn away sometimes with an added burn injury to the surrounding skin [3]. This condition further reduces the possibility of reconstruction with a local flap in this region. A recent series [6] that advocated the V.A.C. system as an alternative to free flap coverage cannot be considered as purely pediatric because patients as old as 19 years were included in that series. Two major drawbacks were identified: Sufficient granulation for secondary skin grafting was obtained in only 15 of 27 patients, and general anesthesia was required every 3 days to change the dressing. Therefore, V.A.C. system especially in children does not seem to be a viable alternative to flap coverage. The other treatment option is cross-leg flap. Although children tolerate the immobilization accompanying the use of cross-leg flaps much easier than adults do, these should be restricted to very special or complicated cases where free flaps have already failed or are virtually impossible because of the lack of microsurgical skills [7]. If the

patient has grade IV or V car tyre injury, reconstruction with free flap will be a best choice for treatment because of bone exposure and tendon injury. Free flaps offer many advantages for limb coverage, including a one-step procedure, decreased incidence of infection, promotion of bone consolidation, shorter hospitalization, and cost reduction. In terms of technical aspect; two particular problems are encountered in pediatric patients compared with adults: greater vasospasticity and smaller vessel diameter. To reduce the risk of spasm, vessel dissection (both at the donor and recipient site) was performed with considerable care to avoid trauma [5]. The skin and subcutaneous adipose tissue of the dorsum of the foot is thin and pliable. The reconstruction of soft tissue defects in this region requires a thin and pliable flap. For this reason free fasciocutaneous flaps seems to be ideal for coverage of this region. Free muscle flaps can provide large wound coverage for exposed bone, obliterate dead spaces, and improve local vascularity [8]. Muscle flaps were criticized for the bulkiness that disturbs the contouring of the foot and constraining the patient to wear custom-made shoes [19,20]. On the other hand, free fasciocutaneous flaps are better suited for shallow defects, especially on the distal third of the leg, ankle, and foot, where bone may be exposed but there are no massive bone or soft-tissue defects [9,10]. If anterolateral thigh flap (ALT) is selected as fasciocutaneous flap, there is no need to change patient position during the operation. Additionally debulking procedure for ALT flap is more safer than to do for free muscle flap. Another advantage of ALT, the long vascular pedicle of the this flap allows anastomosis to be performed more proximal out of injury zone and the vessels of the flap match closely to the tibialis anterior vessels in size. The ALT flap almost cover all prerequisites of the reconstruction in car tyre friction injuries in pediatric cases as presented in this case report.

The employment of more aggressive techniques supporting the “as early as possible” morphological and functional reconstruction path has become the rule in dealing with emergency reconstructive interventions [4]. Immediate emergency free flaps are free flap which is performed directly following debridement within the same surgical stage as proposed by Georgescu AV et al., based on the fact that only in the first 3 days do the tissues remain fresh and free of inflammatory or septic processes [4]. The primary debridement must be carefully and thoroughly performed to achieve preservation of lasting function. Control of infection is the first aim in this pathology [11,12]. Time of surgery will always be dependent on the surgeon's schedule and experience. Free flap surgery requires more experience, especially, in children due to small size of vessels. Many authors stated that infection is present in granulation tissue which is also poorly penetrated by systemic antibiotics [13,14]. The infection rate dropped drastically to 1.5% Godina, 9.7% Lister and Scheker and 2% Arnez when these authors analyzed their series of radical debridement and emergency free flap reconstructions, respectively



Fig. 6. The picture of extension of the ankle and big toe.

in 134, 31 and 100 patients [15,17,18]. Immediate emergency or early free flap coverage of car tyre friction injuries in pediatric population is safe and applicable surgical technique that prevents infection and additional complications, besides as early as possible reconstruction directly associated with good outcome as presented by this case report and previous reports. [2,3]

Cost effectiveness should also be considered. In Godina's series the average length of hospital stay was 27 days and the average number of operations was 1.3 per patient [15]. In Lister and Schecker's series of upper extremity injuries the average hospital stay was 11.8 days and 27 out of their 31 patients returned to work, 18 of them to their previous employment [18]. In Arnez's series of 100 emergency free flaps the hospitalization ranged between 14–25 days [17]. In this series the average hospital stay was 27.8 days (ranged between 20–44 days) and the average number of operations was 2 per patient. Our patient's hospitalization period was only 7 days and he was operated only once. Just 6 weeks after the injury, he was back to his normal life, including playground.

Age is not a contraindication for the use of acute free flaps, as clearly demonstrated by Lister, the youngest patient on whom this author has performed an early free flap was 2,5 years old, the oldest was 76 and both did well [21]. Of course, surgical techniques are getting harder to apply free flap in younger ages. Our patient was only 2 years old and the total surgery time was 6 h, flap ischemia time was only 45 min. Post-operative period was uneventful despite his age.

On the dorsum of the foot, a thin and pliable reconstruction is necessary for normal footwear to allow dorsal tendon gliding and ankle motion. Debulking procedures almost always requires [22]. While the child is growing up, the flap is growing at the same time. However the ALT flap has more fat tissue than ankle dorsal tissue. For this reason one may encounter with aesthetic and shoe size problems after many years. Tarek et al. [22] investigated retrospectively 42 pediatric patients who are reconstructed with ALT flap for dorsal foot resurfacing. He stated nearly one third of the successful flaps required debulking, which lead to improvement in contour with improving ability to wear normal shoes in long term. In literature liposuction is the most popular debulking procedure [22]. Askouni et al. [23] stated that flap thinning using lipo suction can lead to significant improvements in cosmetic outcomes. Primary thinning of ALT flap can be performed to avoid additional operations, but on the other hand, systematic review of the literature indicates that primary thinning of ALT flaps measuring >150 cm² leads to a statistically significant increase in the rate of flap compromise compared with smaller flaps [24]. Primary thinning of the ALT flap did not performed in this 2 years old boy not to jeopardize the flap. There is no information in literature about medical compression garment to prevent bulking of flap. However, based our clinical applications and experience from other cases, it may be useful to avoid from additional interventions. But unfortunately, any medical compression garment was applied to this case due to perfect mid-term results. 8 years after the reconstruction, liposuction procedure for debulking the ALT was inevitable to wear same shoe size.

4. Conclusion

In conclusion, car tyre friction injury of ankle must be evaluated different from other injuries. If the surgeon faces with grade IV or V injury, emergency free flaps have already proved to be a reliable and advantageous technique than delayed wound closures in these injuries. But one should remember that microsurgery experience and set-up is, undoubtedly, the most important feature in making this decision. Too many advantages of one step reconstruction

has been shown in this case report such as; shorter hospitalization period and early-return to normal life without any functional deficit, no psychiatric problem, no infection and delighted parents. Bulkiness of ALT flap can be an important aesthetic and uncomfortable problem after many years from surgery. For this reason, patients must be followed up in long term. Liposuction is applicable and safe for debulking. Although not in the literature, early application of compression garment may be useful to prevent bulking and additional interventions.

Conflicts of interest

We have no conflict of interest.

Funding

Our study sponsors had no such involvement.

Ethical approval

Written and signed consent was obtained to publish a case report from the patient.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

Study concept or design, data collection, data analysis or interpretation and writing the paper were made by Dr. Abdullah Merter.

Guarantor

Dr. Abdullah Merter is the guarantor of the study.

References

- [1] E. Nuzumlali, C. Gurbuz, U. Kantarci, S. Cepel, O. Bayri, O. Polatkan, Moving car-tyre injuries of the foot: reconstruction with microvascular free flaps, *J. Reconstr. Microsurg.* 12 (1996) 297–302.
- [2] M.M. Al-Qattan, Car-tyre friction injuries of the foot in children, *Burns* 26 (2000) 399–408.
- [3] Y. Demirtas, T. Neimetzade, Free anterolateral thigh flap for reconstruction of car tire injuries of children's feet, *Foot Ankle Int.* 26 (January (1)) (2010).
- [4] A.V. Georgescu, O. Ivan, Emergency free flaps, *Microsurgery* 23 (2003) 206–216.
- [5] F. Duteille, A. Lim, Dautel G. Free, Flap coverage of upper and lower limb tissue defects in children: a series of 22 patients, *Ann. Plast. Surg.* 50 (2003) 344–349.
- [6] J.F. Mooney, L.C. Argenta, M.W. Marks, et al., Treatment of soft tissue defects in pediatric patients using the V.A.C. TM system, *Clin. Orthop. Rel. Res.* 376 (2000) 26–31.
- [7] Koenraad Van Landuyt, Moustapha Hamdi, Free perforator flaps in children, *Plast. Reconstr. Surg.* 116 (2005) 159.
- [8] L. Heller, L.S. Levin, Lower extremity microsurgical reconstruction, *Plast. Reconstr. Surg.* 108 (2001) 1029–1038.
- [9] J.A. Goldberk, P. Adkins, T.M. Tsai, Microvascular reconstruction of the foot: weight-bearing patterns, gait analysis, and long-term follow-up, *Plast. Reconstr. Surg.* 92 (1993) 904.
- [10] N. Weinzweig, B.W. Davies, Foot and ankle reconstruction using the radial forearm flap: a review of 25 cases, *Plast. Reconstr. Surg.* 102 (1998) 1999–2005.
- [11] B. Haury, G. Rodeheaver, J. Vensko, et al., Debridement: an essential component of traumatic wound care, *Am. J. Surg.* 135 (1978) 238–242.
- [12] A. Janzekovic, The burn wound from a surgical point of view, *J. Trauma* 15 (1975) 42–46.
- [13] J.F. Burke, Effects of inflammation on wound repair, *J. Dent. Res.* 50 (1971) 296–302.

- [14] M.C. Robson, L.E. Edstron, T.J. Krizek, M.G. Groskin, The efficacy of systemic antibiotics in the treatment of granulating wounds, *J. Surg. Res.* 16 (1974) 299–306.
- [15] M. Godina, Early microsurgical reconstruction of complex trauma of the extremities, *Plast. Reconstr. Surg.* 78 (1986) 285–292.
- [17] Z.M. Arnez, Acute free flaps, in: D. Soutar (Ed.), *Microvascular Surgery and Free Tissue Transfer*, vol 14, Edward Arnold, London, Melbourne Auckland, 1993, pp. 140–151.
- [18] G. Lister, L. Shecker, Emergency free flaps to the upper extremity, *J. Hand Surg. A* 13 (1993) 22–29.
- [19] Y.C. Chiang, S.F. Jeng, M.C. Yeh, et al., Free tissue transfer for leg reconstruction in children, *Br. J. Plast. Surg.* 50 (1997) 335–342.
- [20] J.S. Gould, S.M. Shi, Free vascularised soft tissue flaps for coverage of the foot and ankle, *Clin. Orthop.* 314 (1995) 26–33.
- [21] G. Lister, Emergency free flaps, in: D.P. Green (Ed.), *Operative Hand Surgery*, vol 26, 2nd edn., Churchill Livingstone, Edinburgh, 1988, pp. 1127–1149.
- [22] Tarek A. El-gammal, Amr El-Sayed, Dorsal foot resurfacing using free anterolateral thigh (ALT) flap in children, *Microsurgery* 33 (May (4)) (2013) 4259–4264.
- [23] Evita Paraskevi Askouni, Adam Topping, Outcomes of anterolateral thigh free flap thinning, using liposuction following lower limb trauma, *J. Plas. Reconst. Aesthetic Surg.* 65 (2012) 474–481.
- [24] Safa E. Sharabi, Daniel A. Hatef, Is primary thinning of the anterolateral thigh flap recommended? *Ann. Plast. Surg.* 65 (December) (2010) (Number 6).

Open Access

This article is published Open Access at [sciencedirect.com](https://www.sciencedirect.com). It is distributed under the [IJSCR Supplemental terms and conditions](#), which permits unrestricted non commercial use, distribution, and reproduction in any medium, provided the original authors and source are credited.