



ELSEVIER

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Trauma Case Reports

journal homepage: www.elsevier.com/locate/tcr

Case Report

The use of the anterolateral thigh vascular free flap in complex open elbow fractures after major trauma - An illustrated report of an interesting case[☆]

Efstratios Gerakopoulos^{*}, Toby Colegate-Stone, Edmund Fitzgerald O'Connor, Victoria Rose

Kings College Hospital, Denmark Hill, London, UK

ARTICLE INFO

Keywords:

Elbow
Open fractures
Free flaps
Ligament reconstruction

ABSTRACT

Major trauma may result in severe open elbow fractures with significant soft tissue injury and skin loss. Reconstruction of those defects can be complicated and inadequate cover can result in severely limited functional outcome.

The free anterolateral thigh flap (ALT) is one of the ways to reconstruct those defects. Its utilisation in severe complex open elbow fractures is recently being increased due to its advantages. The purpose of this article is to present an interesting case where the ALT flap was used with success in a challenging situation of a severe elbow bony, ligamentous and soft tissue injury.

Our case has demonstrated that the ALT flap presents an effective method in treating successfully severe open elbow fractures, and its advantages include 1) large amount of available skin and subcutaneous tissue for coverage of the elbow joint without creating strictures, 2) potential of using the vascularised vastus lateralis muscle to minimise the residual dead space in order to prevent infection and as a vascular bed for nerve grafting and 3) the ability to harvest fascia lata grafts and use them to reconstruct ligamentous and tendinous injuries. We recommend the use of the vascularised ALT flap when treating severe open elbow fractures.

Introduction

The elbow is a joint that commonly develops post traumatic stiffness and prevention of that is crucial for a successful treatment outcome following an open fracture. The extent of the injury usually dictates the final functional outcome [1]. Previous studies have highlighted the fact that soft tissue defects greater than 40 cm², especially when there are nerve, muscle, joint or bony injuries, are associated with higher degree of stiffness post operatively [2]. The treating surgeon should perform appropriate and thorough debridement in a timely fashion. Fine balance must be kept between removing all nonviable tissues and preserving critical structures. Prompt reconstruction is very important in avoiding infection and preserving function [3].

Major trauma may result in severe open elbow fractures with significant soft tissue injury and skin loss. Reconstruction of those defects can be complicated and inadequate cover can result in severely limited functional outcome by restricting motion and impairing upper limb function. The properties of a successful reconstruction tissue include being soft, thin, pliable and durable with repetitive

[☆] No conflicts of interest to declare.

^{*} Corresponding author.

E-mail address: stratosgerako@hotmail.com (E. Gerakopoulos).

<https://doi.org/10.1016/j.tcr.2021.100463>

Accepted 13 March 2021

Available online 17 March 2021

2352-6440/© 2021 Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

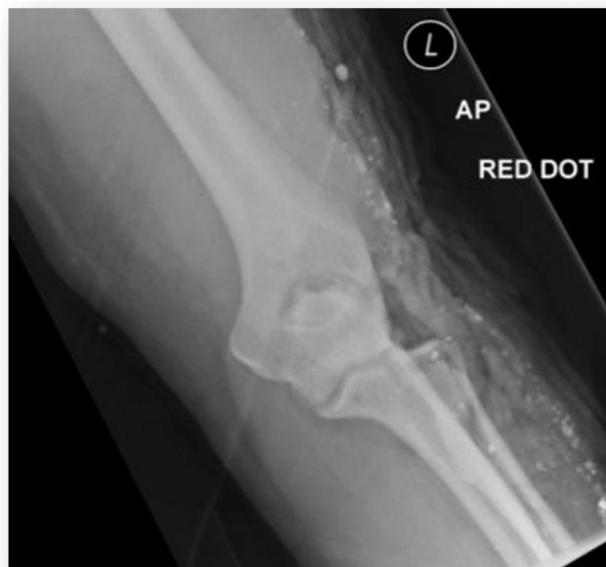


Fig. 1. AP radiograph of the left elbow at presentation.



Fig. 2. Clinical picture of the left elbow on the day of admission.

motion. Local and regional pedicle flaps have been used historically around the elbow to provide adequate soft tissue transfer but the advances of microsurgery made free tissue transfer the gold standard [4]. Those type of flaps have been shown in the literature to provide adequate cover as to allow early mobilisation and return to function [5]. The free anterolateral thigh flap (ALT) is one those free flaps. Its utilisation in severe complex open elbow fractures is recently being increased due to its advantages of allowing some gliding between the skin and the underlying elbow joint thus preventing secondary procedures such as osteotomies or capsular releases. The purpose of this article is to present an interesting case where the ALT flap was used with success in a challenging situation of a severe elbow bony, ligamentous and soft tissue injury.

Methods

A 54 year old lorry driver with free past medical history was involved in a road traffic collision and suffered a Grade IIIB left elbow



Fig. 3. Clinical picture of the left elbow after initial surgical management.



Fig. 4. Bony tunnels' preparation during definitive ligamentous reconstruction.

open fracture. This involved a dislocation of the elbow with bone loss of the whole lateral humeral condyle and the radial head with concomitant disruption of the lateral collateral ligament (Fig. 1). There was a significant amount of skin loss on the postero-lateral aspect of the forearm and the upper arm which made the surgical management challenging (Fig. 2). Other injuries included haemothorax and an intra-abdominal injury that required urgent laparotomy.

The orthopaedic surgical management followed the BOAST guidelines for open fractures [6]. Thorough debridement of the devitalised tissue and initial stabilisation with a spanning external fixator were performed (Fig. 3). The fixator remained in situ until the patient was ready for the definitive fixation of the ligamentous injury and the coverage of the severe skin loss. In the meantime negative pressure wound therapy was used to protect the wound from infection. The definitive joint ortho-plastics operation was scheduled two weeks after the initial injury due to the concomitant abdominal injury and subsequent infection of the laparotomy wound.

The ALT flap was harvested in a standard fashion as previously described in the literature [7]. A vascularised musculocutaneous flap was harvested to meet the reconstructive needs of our case. We utilised a band of the fascia lata as a graft to reconstruct the damaged lateral collateral ligament using a bony tunnel technique (Figs. 4 and 5). The skin paddle was then prepared as to cover adequately the anastomosis and close the skin defect without tension (Fig. 6). The proximal brachial artery was preferred as the site of the anastomosis using a well-recognised surgical technique [8]. After skin closure and dressing application the elbow was splinted in



Fig. 5. The fascia lata graft was passed through the tunnels and tensioned in order to reconstruct the lateral collateral ligament.



Fig. 6. The skin paddle was prepared and the skin defect was closed without tension.

30 degrees of flexion and elevated. Mobilisation and passive range of motion exercises were initiated one week postoperatively.

Regular follow ups were arranged at three, six, twelve and eighteen months postoperatively in our outpatient clinic. Radiographic evaluation was performed (Figs. 7 and 8) and clinical pictures were taken after clinical and functional examination (Fig. 9). The range of motion achieved at 1 year was 10–110 functional arc with 30 degrees of pronation and supination. The flap healed without any complications and the Mayo elbow score improved from 10 at three months to 80 at the last follow up in eighteen months (45 at 6 months and 75 at 12 months) with the patient being able to return to his workplace on light duties.

Discussion-conclusion

Patients with large elbow defects require stable reconstruction and durable skin coverage as to be allowed early joint mobilisation to prevent postoperative stiffness [9]. The presence of dead space around the injury site can create issues of postoperative pain if the flap does not conform to the bony surfaces. A vascularised well prepared muscle flap can aid in filling that dead space and also reduce the risk of infection.

Several types of flaps have been described for elbow reconstruction. Free flaps have been indicated to cover large defects around the elbow with success. However taking into account their promising results they have not received enough attention from the literature and there are relatively few reports on their use. Choudry et al. [2] indicated in their study that the ALT flap may not be commonly used due to its poor vascular supply but recent authors have managed to define its vascular anatomy in more detail and prove its reliability from that aspect [10]. It is believed that ALT flap has a lot of advantages when used for elbow coverage by providing large amounts of skin as well part of the vastus lateralis muscle in order to minimise any residual dead space and prevent infection [11]. Additionally the

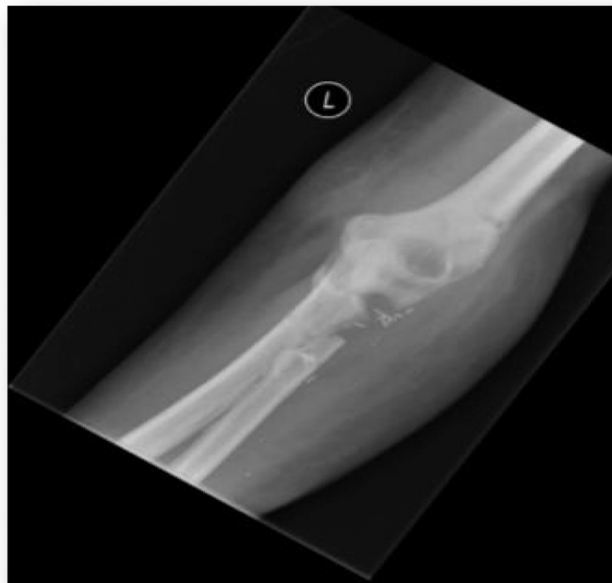


Fig. 7. AP radiograph at 1 year post-operative follow up.



Fig. 8. Lateral radiograph at 1 year post-operative follow up.

nerve to the vastus can be harvested and used in cases where a vascularised nerve graft is required, without creating unacceptable donor site morbidity with patients being able to return to their preoperative functional level [12].

In our case the lateral collateral ligament was reconstructed using bony tunnels and a specially prepared and shaped fascia lata graft which was harvested easily at the time of the flap elevation. This graft can be also used in cases where other ligamentous or tendinous structures around the elbow joint need to be reconstructed. The ligament reconstruction provided excellent stability of the joint and early painless range of motion exercises were prescribed for our patient, preventing the development of devastating post traumatic heterotopic ossification and subsequent stiffness [13].

To conclude, the use of the ALT flap presents a very effective method in treating successfully severe open elbow fractures, and this has been demonstrated in our case. The advantages of the ALT flap include 1) the large amount of available skin and subcutaneous



Fig. 9. Clinical picture of the left elbow at 1 year post-operative follow up.

tissue for coverage of the elbow joint without creating strictures, 2) the potential of using the vascularised vastus lateralis muscle to minimise the residual dead space in order to prevent infection and as a vascular bed for nerve grafting and 3) the ability to harvest fascia lata grafts and use them to reconstruct ligamentous and tendinous injuries. We recommend the use of the vascularised ALT flap when treating open elbow fractures with extensive soft tissue loss and concomitant ligamentous injury.

References

- [1] J.O. Sojbjerg, The stiff elbow, *Acta Orthop. Scand.* 67 (1996) 626–631.
- [2] U.H. Choudry, S.L. Moran, S. Li, et al., Soft-tissue coverage of the elbow: an outcome analysis and reconstructive algorithm, *Plast. Reconstr. Surg.* 119 (2007) 1852–1857.
- [3] B.P. Kelley, K.C. Chung, Soft-tissue coverage for elbow trauma, *Hand Clin.* 31 (4) (2015) 693–703.
- [4] M. Jensen, S.L. Moran, Soft tissue coverage of the elbow: a reconstructive algorithm, *Orthop Clin North Am* 39 (2008) 251–264.
- [5] M. Stevanovic, F. Sharpe, J.M. Itamura, Treatment of soft tissue problems about the elbow, *Clin Orthop and Rel Research* 370 (2000) 127–137.
- [6] British Orthopaedic Association, British Association of Plastic, Reconstructive & Aesthetic Surgeons Audit Standards For Trauma, Open Fractures, December 2017.
- [7] C.H. Wong, F.C. Wei, Anterolateral thigh flap, *Head Neck* 32 (2010) 529–540.
- [8] B.K. Tan, C.H. Wong, W. Chew, et al., Use of the slit arteriotomy for end-to-side arterial anastomosis in free-tissue transfers to the extremities, *J. Plast. Reconstr. Aesthet. Surg.* 62 (2009) 1519–1523.
- [9] D.H. Lee, Treatment options for complex elbow fracture dislocations, *Injury* 32 (Suppl. 4) (2001) SD41–69.
- [10] C.H. Wong, F.C. Wei, B. Fu, et al., Alternative vascular pedicle of the anterolateral thigh flap: the oblique branch of the lateral circumflex femoral artery, *Plast. Reconstr. Surg.* 123 (2009) 571–577.
- [11] Mardini S, Lin LC, Moran SL, et al. Anterolateral thigh flap In: Wei FC, Mardini S, editors. *Flaps and reconstructive surgery*. Philadelphia: Elsevier; 2009. p. 538–58.
- [12] M.M. Hanasono, R.J. Skoracki, P. Yu, A prospective study of donor-site morbidity after anterolateral thigh fasciocutaneous and myocutaneous free flap harvest in 220 patients, *Plast. Reconstr. Surg.* 125 (2010) 209–214.
- [13] M.T. Keschner, N. Paksima, The stiff elbow, *Bull NYU Hosp Jt Dis* 65 (2007) 24–28.