



Use of A Brachial Vein Conduit and A Rotational Skin Flap Graft Repairing A Vascular Trauma

Yuniel Hernandez Castillo*

Consultant Angiologist and Vascular Surgeon, General Surgery, Milton Cato Memorial Hospital, Saint Vincent and the Grenadines, Caribbean

***Corresponding Author:** Yuniel Hernandez Castillo, Consultant Angiologist and Vascular Surgeon, General Surgery, Milton Cato Memorial Hospital, Saint Vincent and the Grenadines, Caribbean.

Received: November 22, 2019; **Published:** December 04, 2019

DOI: 10.31080/ASMS.2020.04.0492

Abstract

Introduction: Elbow dislocations are sometimes associated with neurovascular injuries where brachial artery is the most frequently injured artery requiring emergency and adequate often complex surgical treatment in order to manage their severe complications. The literature consists of only a few limited case reports on associated vascular or neurovascular injuries resulting from this type of trauma with no reference to the particular techniques we combined to treat our patient.

Presentation of Case: We present a Brachial Artery reconstruction in a 31-year-old patient with an Open Complex Right Elbow Dislocation. In the Clinical and Surgical Examination an open wound in the Anterior-Medial Right Antecubital Fossa presented with accompanying Brachial Pedicle all structures Transection was confirm. To repair the Brachial Artery a Substitution By-Pass and End-to-End Anastomosis was conducted using an Autologous Reverse Brachial Vein Conduit graft from the ipsilateral arm under General Anesthesia. For the Wound Closure a Rotational Skin and subcutaneous Fat Flap Graft. Postoperative patient progress, it was successful developing no Systemic Complications nor Ischemic Signs in the Right Upper Limb being discharge for Out-Patient follow-up once the Surgical Wound conditions allowed and a Duplex-Ultrasound on late postoperative confirm normal blood flow conditions through the By-pass and distal limb.

Discussion: In our patient Restoration of Brachial Veins continuity and blood flow it was impossible because of external resources related factors and then Brachial Veins Ligation decided, based on what our next decision was to preserve the Basilic and Cephalic Veins for Upper Limb Collateral Venous Return harvesting a segment of one Brachial Vein long enough as conduit for the Arterial By-Pass instead the Great Saphenous Vein which would imply unnecessary delay in the procedure. By the other hand we use a Rotational Skin and subcutaneous Fat Flap Graft for wound closure ensuring proper coverage of the conduit and no compartment increased pressure.

Conclusion: This approach of Brachial Artery and Neurovascular Pedicle Traumatic Transection can be technically conducted with success and a non-reparable Brachial Vein used as autologous by-pass conduit preserving Superficial Upper Limb Venous network to avoid perfusion compromise because of Deep Veins Ligation in a setting of no possible Deep Vein repair.

Keywords: Brachial Artery Trauma; Brachial Vein Trauma; Brachial Vein Ligation; Autologous By-Pass; Opened Elbow Dislocation; Rotational Flap Graft

Introduction

Elbow dislocations are common injuries in trauma practice with an incidence of 6 to 8 dislocations per 100,000 people [1,2] accounting the 11 - 28% of all the elbow injuries [3] and around 20% of all joint dislocations [4].

Even when the elbow is said to be the second [5] or the third [4,6,7] most commonly dislocated joint in our system, the literature consists of only a few limited case reports on associated vascular or neurovascular injuries resulting from this type of trauma [7,8] typically caused by falling from a height on the extended hand or small flexion, sports activities, work-associated activities

or traffic accidents [9-11] and explained because of the anatomical characteristics of this joint with a close anatomical proximity to the neuro-vascular structures.

These injuries require emergency and adequate surgical treatment in order to manage their severe complications, reducing them to a minimum.

The treatment includes orthopedic reposition, immobilization and adequate rehabilitation having good prognosis with possible mild restrictions of movement [12,13].

Functional results after adequate and emergency surgical treatment of this severe injury in the literature are generally good and are accompanied by a smaller decrease in range of motion in the elbow joint and often mild neurological disorders [14].

During the last decades, the rate of amputation in upper limb vascular injuries has minimized due to increased surgical experience [15].

Materials and Methods

Case Report

A 31-years-old male patient was admitted in the Accident and Emergency Unit because of an opened bleeding wound in the medial-anterior aspect of his right elbow after a vehicle accident around five hours before.

On admission the patient was found fully conscience, well oriented, and without any evidence of Central Nervous System impairment as well as hemodynamically stable, just complaining of “tolerable” pain The medial-anterior aspect of the right elbow it was seen actively bleeding and with an evident tissues defect being compressed with sterile gauzes and bandaged stopping the bleeding.

On Physical Examination just positive findings were absent radial and ulnar pulses in the Right Upper Limb, Superficial Anaesthesia in the right hand (first, second and third fingers) and impossibility for active movements but passive ones possible in the entire Right Upper Limb.

Multiple Trauma Complementary Assessment according to accepted Current Standards and our setting recourses were done with just Radiological findings of Right Elbow Dislocation (Figure 1), and Simple Doppler evaluation for Arterial Signal Tracking in the radial and ulnar pulses projection in the right wrist with complete absent Doppler Signal.



Figure 1: Elbow Dislocation (Right upper Limb).

Consequently, with all this assessment the patient was taken to the Operating Theatre with a Highly Suspected Brachial Neurovascular Trauma of the Upper Right Limb [7].

On Operating Theatre under General Anaesthesia, during wound exploration it was confirm a Total Section of the Right Brachial Artery, Veins and Median Nerve with around five centimetres tissue defect of the Brachial Pedicle structures as well as the surrounding tissues, with indemnity of the Basilic Vein (Figure 2) Meticulous cleaning of the wound and removal of any no-evident alive tissues was done.

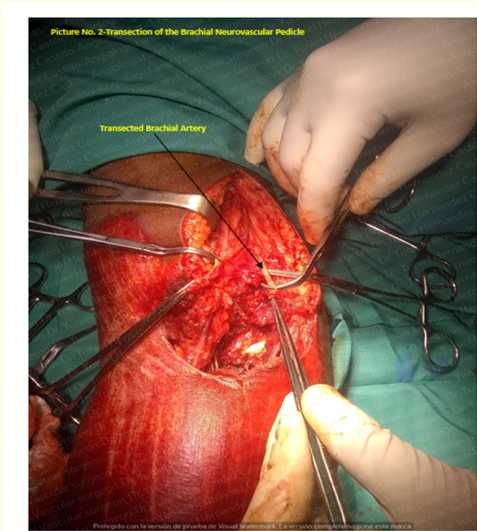


Figure 2: Transection of the Brachial Neurovascular Pedicle.

After this, exposure and control of the Brachial arterial and venous proximal and distal ends was done as well as Medium Nerve proximal and distal ends.

Orthopaedic Surgeons assess the elbow condition and stabilized it by hand manoeuvres concluding no need for any Surgical Intervention at the moment but in a second time.

Vascular Surgery decision for the revascularization procedure was then Brachial Arterial Re-construction with an Autologous Reversed Brachial Vein Interposition By-Pass and End-to-End Anastomosis using Prolene® 6.0 suture (after Sodic Heparin 5000 iu administered intravenously and Heparinized Saline flushed by both proximal and distal Brachial artery ends until clinic evident blood flow achieved). Brachial Veins were ligated and preserved the Ulnar and Cephalic Veins (Figure 3 and 4)

For Wound Closure because of the tissues lost at the wound site after medial flexor muscles proximal and distally joined back, a Pedicle Skin and Subcutaneous-fat flap by rotation graft was done to warrant the appropriate cover and isolation of the By-Pass Conduit. (Figure 5) No approximation of aponeurosis was done.

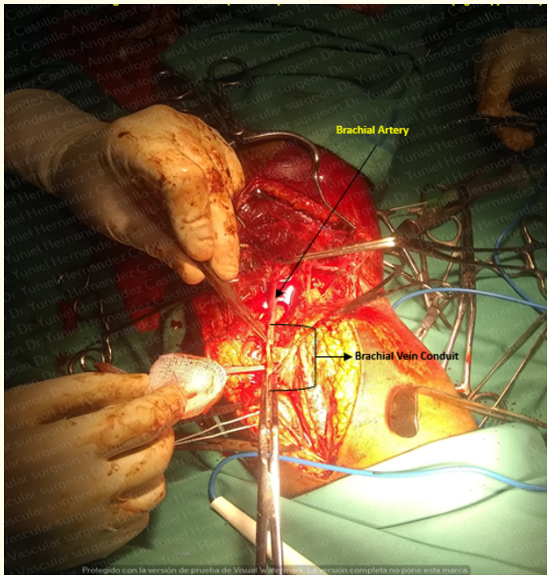


Figure 3: Autologous Brachial Vein Interposition By-Pass and End-to-End Anastomosis (Right Upper Limb).

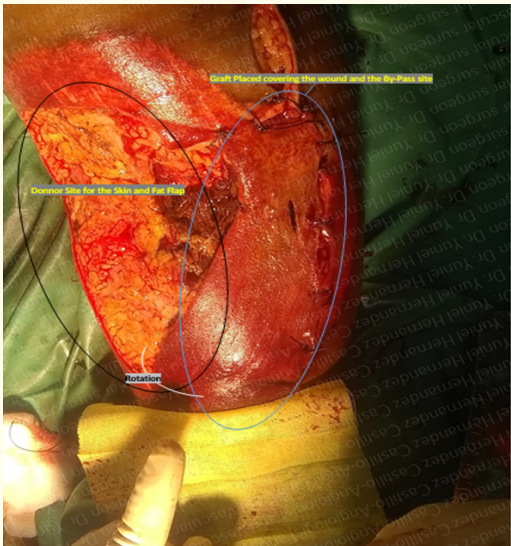


Figure 5: Rotational Skin and Subcutaneous-fat flap graft (Right upper Limb).



Figure 4: Autologous Brachial Vein Interposition By-Pass and End-to-End Anastomosis (Right upper Limb).



Figure 6: Post-Operatory Elbow X-Ray (Right upper Limb).

Medium Nerve repair was postponed for a second time intervention according to orthopaedic team criteria.

Right Upper Limb Elbow was restricted at 90 degrees' flexion (Figure 6).

Triple intravenous antibiotic therapy was started immediately with Amoxicillin 500 mg, Metronidazole 500 mg and Gentamicin 80 mg every 8 hours all of them.

Also Enoxaparin (Clexane®) 1,5 mg/kg/ daily was started as well as analgesic medication started efficiently.

Tetanus antitoxin it was given.

Trans-operative and earlier 24 hours were successful according to good hemodynamic status and not occurrence of any symptom or sign of ischemia in the Right Upper Limb, and pain control. At that time oedema was observed in the right upper limb predominantly in the forearm and the hand (no more than 3 cm perimeter between both upper limb), and not palpable radial neither ulnar pulses but an intense Arterial both radial and ulnar signal was assessed on Simple Doppler evaluation and was repeated daily in the earlier post-operative in-hospital follow-up The Skin Graft treatment consisted in local dressings with Betadine® and Triple Antibiotic® ointment every other day keeping the wound covered.

On day 17th. Post-operative once wound conditions allowed it a Duplex Ultrasound was done in the entire Right Upper Limb tracking the By-Pass conduit and both arterial and venous distal and proximal blood flow characteristics, showing permeability and good blood flow characteristics along the upper limb (Figure 7).

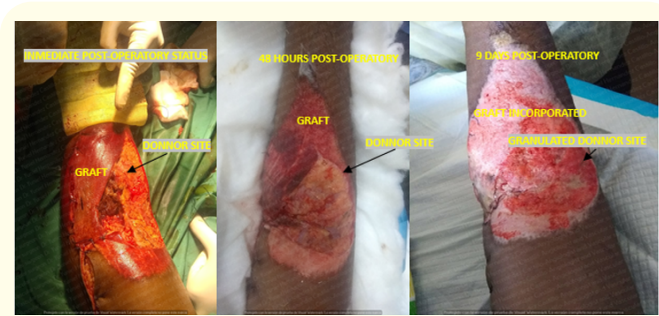


Figure 7: Progress of the Rotational Skin and Subcutaneous-fat flap graft (Right upper Limb).

Because no complication occurs patient was discharged that same day for Outpatient Follow-Up with same previously mentioned dressing and Rivaroxaban (Xarelto®).

Results and Discussion

The brachial artery is the most frequently injured artery because of trauma in the upper limb [16,17] constituting a relatively large proportion of peripheral arterial injuries [18] only being exceeding in frequency by vascular trauma associated with dislocations of the knee [19].

As seen in this patient injuries to arteries occur in 5 -13% [19] of all elbow dislocations, especially in cases of open exposed dislocation more often when homers damages the skin [8,20] being a necessary condition in acute dislocation of the elbow to occur a fracture of the bone structures or breakage of one or both collateral ligaments but also can be seen if penetrating trauma occurs [7] mechanism which is most common (about 73%) like stab injuries, glass cut injuries, and gunshots [21] usually characterized by limited damage within a limited area and few accompanying lesions but with approximately 78% of patients having concomitant soft tissue and nerve injuries [22].

The 6% of these injuries are attributable to blunt trauma more frequently associated with neurological and orthopaedic injuries leading to a significantly higher rate of disability [23,24] while less than 1% of vascular injuries are associated with a traumatic dislocation alone [25] even when it has been described isolated cases of open elbow dislocation without fractures but neurovascular injuries [26-29].

By the other hand, closed dislocations are only rarely associated with vascular injuries [4].

Brachial Artery injures responses good to Vascular Repair, so assessing the dislocation should not delay surgery to avoid limb ischemia [27,29].

From an orthopaedic point of view, there is no doubt that the elbow should be reduced and repositioned as soon as the diagnosis of dislocation has been confirmed. However, discussion continues with regard to how the joint immobilization should be implemented and whether ligament repair is necessary.

Immobilization of the elbow is necessary both during the surgery, to enable meticulous suturing of the venous graft, and during the postoperative period enabling healing of the By-Pass graft [8].

Some groups recommended that trans articular external fixation should be used in all cases ensuring maximum security of stability and also facilitating local care, especially after fasciotomy and suggest that arterial revascularization should be done first and ideally followed by skeletal stabilization and nerve and tendon repair [4,30].

However, other authors [8,31] who evaluated elbow stability after reduction only performed external fixation if the joint was unstable.

In our patient Orthopaedic Stabilization of the join and no First Time Surgical Intervention was decided.

Whether primary and secondary nerve repair procedures are helpful is a point of controversy [32] even when an injury to the upper extremity includes nerve injuries as in our patient the rate of functional disability may ranges from 27% to 44% [33].

In cases of neurological injury, many authors have recommended that an expectant attitude should be taken. Some authors reported that complete spontaneous improvement of these lesions is common [7,34]. On the other hand, there are authors [4] who have shown in their series that none or almost none of their patients achieved neurological recovery.

In our patient Second Time Nerve Repair it was decided since the Orthopaedic Point of view.

Ligation of the common brachial artery carries a 55% amputation rate compared to 25% below the Deep Brachial Artery [35].

There is now sufficient and irrefutable evidence in the literature, for recommending vascular repair in all case [8,34,36-42].

Vascular reconstruction depends on the type of lesion.

Direct anastomosis of both proximal and distal arterial ends is preferable if there is not excessive tension at the anastomotic sites which may lead to increased failure rate. Therefore, if there is a vas-

cular defect more than 5 mm, interposition graft should be performed instead of primary repair [17,36,42].

Interposition graft is usually performed with reverse shunting using the great saphenous vein.

Magna saphenous vein is the ideal solution because of no limitations in length, the appropriate lumen diameter than can be chosen, and it cannot be easily damaged during subsequent orthopaedic operations [43].

It has been observed that saphenous vein grafts have better patency rates and better resistance to graft infection compared with synthetic grafts. Thus, a saphenous vein interposition graft should be selected instead of a synthetic graft for vascular repair [18].

In our patient as the literature shows, the site of brachial artery injury was its distal portion above its bifurcation in to the radial and ulnar arteries [8,13], but with about five centimetres tissue defect in the Brachial artery and Veins, and Median Nerve.

so End-to-End distal and proximal Arterial anastomosis was technically impossible and an Interposition By-Pass needed.

The selected conduit for our patient Revascularization Technique it was one of the Brachial Veins Arteries instead the Great Saphenous Vein from a lower limb.

This choice was done based on the rationale that we were unable to prepare and repair the Brachial Veins because reasons related with material resources in our practice scenario, not having other choice than veins ligation knowing the rate of thrombosis associated with venous repair ranges from 39% to 59% but repair of the injured major veins jet advisable so that arterial flow can be restored properly [44,45].

We did not decide for a Basilic Vein, as it has been described in the literature as by-pass conduit [46-48] or a Cephalic Vein for not to compromise more the venous and so the arterial blood flow preserving them as the natural collateral venous pathway in the upper limb when Deep Venous System is obstructed and knowing the role this rich collateral arterial and venous network plays in the upper limb and around the elbow joint.

We did not decide for Great Saphenous Vein conduit because even when a relatively stable patient in trans-operative status we were in an Emergency Setting facing not only his general Hemodynamic Status but the Ischemic Conditions of the Limb timing from the moment of the trauma until the final restoration of the arterial blood flow with the end of the surgical procedure so it would be an unnecessary delay in the procedure having at hands a biologically

natural conduit just available with same or even more anatomical and physiological characteristics to fit as by-pass conduit.

For avoiding Compartmental Syndrome in the forearm fasciotomy is described in the literature following indications like increased compartmental pressure in the forearm, very severe oedema of the elbow and a very long interval greater than four hours between the trauma and the surgery [18,49-51].

In our patient because of an opened trauma with an important amount of tissue defect needing to be closed our option was to perform anterior-medial flexors muscles repair without restoration of fascia continuity and a Skin and Subcutaneous Fat Rotational Flap Graft (Figure 8 and 9)

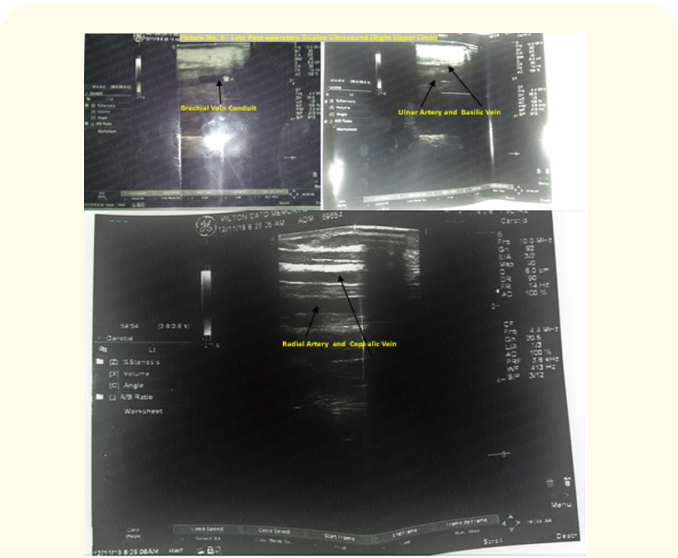


Figure 8: Late Post-Operative Duplex Ultrasound (Right Upper Limb).



Figure 9: Wound Closure without Fascial Tension and with Rotational Skin and Subcutaneous Flap Graft (Right Upper Limb).

We decided for a Rotational Skin and Subcutaneous Fat Flap Graf instead a Free Flap because technically feasible and because its well-known outcomes because of the rich vascularization network they provide, even when in literature non conclusive data's are available comparing both methods [52,53].

Conclusions

The surgical approach of this patient intended save first his life and then his limb in the challenging setting of Multiple Trauma where Scientific and Empirical Evidence Base Practice needs to be fit into the specific patient and also the economic and social scenarios that influence the Medical Status and Practice [54-57] so some of the more often step in the procedure were necessary obviated driving us into a congruent "Surgical Creative Art" field.

In our literature review no other reference to a similar approach for Brachial Artery Repair was found.

Based on the successful result from this procedure, even on an early evaluation, the use of a Brachial Vein Conduit as Substitution Arterial By-Pass ligating Brachial Veins, preserving Superficial Upper Limb Veins and using a Rotational Skin and subcutaneous Flap Graft for without tension wound closure it could be a good option when no matter the reason but impossible to follow traditional procedures.

Conflict of Interest

The author declares no interest conflict.

Bibliography

1. Josefsson Per Olof and Bo E Nilsson. "Incidence of Elbow Dislocation". *Acta Orthopaedica Scandinavica* 57.6 (1986): 537-538.

2. Hildebrand Kevin A., et al. "Acute Elbow Dislocations". *Orthopedic Clinics of North America* 30.1 (1999): 63-79.

3. Lasanianos Nikolaos and Christos Gernavos. "An Unusual Case of Elbow Dislocation". *Orthopedics* 31.8 (2008): 1-3.

4. Platz Andreas., et al. "Posterior Elbow Dislocation with Associated Vascular Injury After Blunt Trauma". *The Journal of Trauma: Injury, Infection, and Critical Care* 46.5 (1999): 948-950.

5. MT Mercadante. "Protocolo De Manuseio Da Luxação traumática Aguda De Cotovelo". *Revista Brasileira De Ortopedia* 38 (2003): 402-406.

6. Endean Eric D., et al. "Recognition of Arterial Injury in Elbow Dislocation". *Journal of Vascular Surgery* 16.3 (1992): 402-406.

7. Ayel J-E., et al. "Acute Elbow Dislocation with Arterial Rupture. Analysis of Nine Cases". *Orthopaedics and Traumatology: Surgery and Research* 95. 5 (2009): 343-351.

8. Martin Benjamin D., et al. "Complications Related to Simple Dislocations of The Elbow". *Hand Clinics* 24.1 (2008): 9-25.

9. Miyazaki Alberto Naoki., et al. "Brachial Artery Injury Due to Closed Posterior Elbow Dislocation: Case Report". *Revista Brasileira De Ortopedia* 51.2 (2016): 239-243.

10. Seidman Glen D and Paul A. Koerner. "Brachial Artery Rupture Associated with Closed Posterior Elbow Dislocation". *The Journal of Trauma: Injury, Infection, and Critical Care* 38.2 (1995): 318-321.

11. Englert Carsten., et al. "Elbow Dislocations: A Review Ranging from Soft Tissue Injuries to Complex Elbow Fracture Dislocations". *Advances in Orthopedics* 2013 (2013): 1-11.

12. Josefsson PO., et al. "Surgical Versus Non-Surgical Treatment of Ligamentous Injuries Following Dislocation of The Elbow Joint. A Prospective Randomized Study". *The Journal of Bone and Joint Surgery* 69.4 (1987): 605-608.

13. Mehlhoff TL., et al. "Simple Dislocation of The Elbow In The Adult. Results After Closed Treatment". *The Journal of Bone and Joint Surgery* 70.2 (1988): 244-249.

14. Padayachy V., et al. "A Retrospective Review of Brachial Artery Injuries and Repairs-Is It Still A "Training Artery". *Injury* 41.9 (2010): 960-963.

15. Schmidt Robert D. "Traumatic Injuries of The Brachial Artery". *The Journal of Emergency Medicine* 8.1 (1990): 105.

16. Ekim Hasan and Mustafa Tuncer. "Management of Traumatic Brachial Artery Injuries: A Report On 49 Patients". *Annals of Saudi Medicine* 29.2 (2009): 105-109.

17. Kim John YS., et al. "Risk Factors for Compartment Syndrome In Traumatic Brachial Artery Injuries: An Institutional Experience In 139 Patients". *The Journal of Trauma: Injury, Infection, and Critical Care* 67.6 (2009): 1339-1344.

18. Hunt charles A and John R kingsley. "Vascular Injuries of The Upper Extremity". *Southern Medical Journal* 93.5 (2000): 466-468.

19. Bonneville P., et al. "Luxations Traumatiques Du Genou Associées À Une Interruption De L'Artère Poplitée". *Revue De Chirurgie Orthopédique Et Réparatrice De L'appareil Moteur* 92.8 (2006): 768-777.

20. Shukla Dave R and Michael Hausman. "Surgical Management of Congenital Elbow Instability: A Case Report". *Journal of Shoulder and Elbow Surgery* 25.4 (2016): e104-e109.

21. Zellweger R., *et al.* "An Analysis Of 124 Surgically Managed Brachial Artery Injuries". *Journal of Vascular Surgery* 41.2 (2005): 372.

22. Franz Randall W., *et al.* "A Five-Year Review Of Management Of Upper-Extremity Arterial Injuries At An Urban Level I Trauma Center". *Annals of Vascular Surgery* 26.5 (2012): 655-664.

23. Myers Stuart I., *et al.* "Complex Upper Extremity Vascular Trauma in An Urban Population". *Journal of Vascular Surgery* 12.3 (1990): 305-309.

24. Vlsser Philip A., *et al.* "Prognosis Of Nerve Injuries Incurred During Acute Trauma To Peripheral Arteries". *The American Journal of Surgery* 140.5 (1980): 596-599.

25. Sparks Steven R., *et al.* "Arterial Injury In Uncomplicated Upper Extremity Dislocations". *Annals of Vascular Surgery* 14.2 (2000): 110-113.

26. Polat Gökhan., *et al.* "Pediatric Open Elbow Dislocation Without Fracture: A Case Report". *International Journal of Surgery Case Reports* 5.12 (2014): 1064-1067.

27. Nazli Yunus., *et al.* "Brachial Artery Transection Associated with Open Elbow Dislocation In A 12-Year-Old: A Case Report". *Vascular* 21.1 (2011): 27-30.

28. Ahmad R., *et al.* "Open Dislocation of The Elbow with Ipsilateral Fracture Of The Radial Head And Distal Radius: A Rare Combination Without Vascular Injury". *Emergency Medicine Journal* 24. 12 (2007): 860-860.

29. Redjil Nouredine., *et al.* "Open Elbow Dislocation Associated with Distal Ischemia in Children About One Case and Review of The Literature". *Pan African Medical Journal* (2015).

30. Nagre SurajWasudeo. "Brachial Artery Injury Management: Case Series". *Indian Journal of Vascular and Endovascular Surgery* 3.1 (2016): 7.

31. Marcheix Bertrand., *et al.* "Transection of The Brachial Artery After Closed Posterior Elbow Dislocation". *Journal of Vascular Surgery* 42.6 (2005): 1230-1232.

32. Rich Norman M., *et al.* "Vascular Trauma". Elsevier Saunders (2004).

33. Hardin WD., *et al.* "Traumatic Arterial Injuries of The Upper Extremity: Determinants of Disability". *The Journal of Trauma: Injury, Infection, and Critical Care* 26.5 (1986): 490.

34. Grimer RJ and S Brooks. "Brachial Artery Damage Accompanying Closed Posterior Dislocation of The Elbow". *The Journal of Bone and Joint Surgery* 67.3 (1985): 378-381.

35. Fields Charles E., *et al.* "Brachial and Forearm Vessel Injuries". *Surgical Clinics of North America* 82.1 (2002): 105-114.

36. Boretto Jorge G., *et al.* "Comparative Study of Simple and Complex Open Elbow Dislocations". *Clinical Orthopaedics and Related Research* 472.7 (2014): 2037-2043.

37. Iordens Gijs IT., *et al.* "Early Mobilisation Versus Plaster Immobilisation of Simple Elbow Dislocations: Results of The Funcsie Multicentre Randomised Clinical Trial". *British Journal of Sports Medicine* 51.6 (2015): 531-538.

38. Dickens Jonathan F., *et al.* "Risk Factors for Decreased Range of Motion and Poor Outcomes in Open Periarticular Elbow Fractures". *Injury* 46.4 (2015): 676-681.

39. Doody O., *et al.* "Extremities-Indications and Techniques for Treatment of Extremity Vascular Injuries". *Injury* 39.11 (2008): 1295-1303.

40. Louis Dean S., *et al.* "Arterial Injury". *The Journal of Bone and Joint Surgery* 56.8 (1974): 1631-1636.

41. Orcutt Michael B., *et al.* "Civilian Vascular Trauma of The Upper Extremity". *The Journal of Trauma: Injury, Infection, and Critical Care* 26.1 (1986): 63-67.

42. Bongard Fred S., *et al.* "Management Strategy of Complex Extremity Injuries". *The American Journal of Surgery* 158.2 (1989): 151-155.

43. Howard AC., *et al.* "Transection of The Brachial Artery Complicating Closed Posterior Dislocation of The Elbow". *Injury* 22.3 (1991): 240-242.

44. Timberlake Gregory A., *et al.* "Venous Injury: To Repair or Ligate, The Dilemma". *Journal of Vascular Surgery* 4.6 (1986): 553-558.

45. Williams Timothy K and W Darrin Clouse. "Current Concepts in Repair of Extremity Vascular Injury". *Journal of Vascular Surgery: Venous and Lymphatic Disorders* 4.2 (2016): 238-247.

46. Spahos T and F Torella. "The Basilic Vein: An Alternative Conduit for Complex Iliofemoral Reconstruction". *European Journal of Vascular and Endovascular Surgery* 43.4 (2012): 457-459.

47. Kim Hyunyoung G., *et al.* "Brachial Artery Repair Using the Basilic Vein as A Reliable Conduit In A 3-Year-Old Child". *Journal of Pediatric Surgery Case Reports* 19 (2017): 16-18.

48. Park Dae-Joon., *et al.* "Lower Extremity Arterial Bypass with Arm Vein Conduits and Literature Review". *Vascular Specialist International* 32.4 (2016): 160-165.

49. Prichayudh Supparerk., *et al.* "Management of Upper Extremity Vascular Injury: Outcome Related to The Mangled Extremity Severity Score". *World Journal of Surgery* 33.4 (2009): 857-863.

50. Feliciano David V and Steven R Shackford. "Vascular Injury: 50Th Anniversary Year Review Article of The Journal of Trauma". *The Journal of Trauma: Injury, Infection, and Critical Care* 68. 4 (2010): 1009-1013.

51. Rozycki Grace S., *et al.* "Blunt Vascular Trauma in The Extremity: Diagnosis, Management, And Outcome". *The Journal of Trauma: Injury, Infection, and Critical Care* 55.5 (2003): 814-824.

52. Gabrysz-Forget Fanny., *et al.* "Free Versus Pedicled Flaps for Reconstruction of Head and Neck Cancer Defects: A Systematic Review". *Journal of Otolaryngology - Head and Neck Surgery* 48. 1 (2019).

53. Rodriguez-Collazo Edgardo., *et al.* "A Systematic Review of Outcomes and Flap Selection Following Lower Extremity Free Tissue Transfer Versus Vascularized Perforator Pedicle Flap Transfer in Lower Limb Reconstruction". *International Journal of Orthoplastic Surgery* 1.2 (2018): 1-12.

54. Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference NY (1946): 19-22.

55. Camara Phyllis Jones., *et al.* "Addressing the Social Determinants of Children'S Health: A Cliff Analogy". *Journal of Health Care for The Poor and Underserved* 20. 4A (2009): 1-12.

56. Adler Nancy E., *et al.* "Socioeconomic Status and Health: The Challenge of The Gradient". *American Psychologist* 49.1 (1994): 15-24.

57. Daniel Hilary., *et al.* "Addressing Social Determinants to Improve Patient Care and Promote Health Equity: An American College of Physicians Position Paper". *Annals of Internal Medicine* 168.8 (2018): 577.

Volume 4 Issue 1 January 2020

© All rights are reserved by Yuniel Hernandez Castillo.