СРПСКИ АРХИВ
ЗА ЦЕЛОКУПНО ЛЕКАРСТВО
SERBIAN ARCHIVES
OF MEDICINE

Address: 1 Kraljice Natalije Street, Belgrade 11000, Serbia
☏ +381 11 4092 776, Fax: +381 11 3348 653
E-mail: office@srpskiarhiv.rs, Web address: www.srpskiarhiv.rs

Paper Accepted*

ISSN Online 2406-0895

Case Report / Приказ болесника

Suzana Milutinović[1,2,♣], Slađana Matić[1,2], Miloš Vučetić[3]

Successful replantation after avulsion amputation of the thumb

Успешна реплантација након авулзионе ампутације палца

[1]University Clinical Center of Serbia, Clinic for Orthopedic Surgery and Traumatology, Belgrade, Serbia;
[2]University of Belgrade, Faculty of Medicine, Belgrade, Serbia;
[3]Banjica Institute for Orthopedic Surgery, Belgrade, Serbia

Received: September 8, 2024
Revised: August 11, 2025
Accepted: August 12, 2025
Online First: August 20, 2025
DOI: https://doi.org/10.2298/SARH240908066M

♣**Correspondence to:**
Suzana MILUTINOVIĆ
Bohinjska 1, 11000 Belgrade, Serbia
E-mail: smilutinovic@yahoo.com

Successful replantation after avulsion amputation of the thumb

Успешна реплантација након авулзионе ампутације палца

SUMMARY

Introduction Degloving injuries to the fingers, especially the thumb, present a significant challenge for reconstructive surgeons. Several classifications have been proposed to assess the extent of injury. Latest approach is now that microsurgical repair is the method of choice in all types of ischemic injuries, including type III ring avulsion.

Case outline We present a case of a successful microvascular replantation of the thumb amputated by an avulsion mechanism caused by a drill in the 19-year-old male. The thumb was almost completely degloved about 2cm distal to the metacarpophalangeal joint. According to the Urbaniak classification, it was a type III degree of injury (Kay type IV). Surgery was performed three hours after the injury. The ulnar digital artery was anastomosed end-to-end. Two dorsal veins were drained and anastomosed. After six months, the appearance of the replanted finger was aesthetically pleasing. The patient was followed up again 30 months after surgery. Grip strength measured with Jamar's dynamometer is 5% less compared to the uninjured hand. According to the TAM (total arc of motion) scale almost full range of motion was obtained in the metacarpophalangeal joint with full opposition and good grip. According to the MRC (Medical Research Council) scale, the sensitive recovery has reached S3. DASH score is 0 point. This represents a complete and unlimited function even though the thumb is contracted in the interphalangeal joint.

Conclusion The patient returned to his previous workplace and he remains satisfied with the function of the replanted thumb for daily and work activities.

Keywords: avulsion amputation; replantation; hand

САЖЕТАК

Увод Дегловинг повреде прстију, посебно палца, представљају значајан изазов за реконструктивног хирурга. Предложено је неколико класификација како би се проценио обим повреде. Нови ставови су сада да је микрохируршка репарација метода избора у свим типовима исхемичних повреда, укључујући тип *III* ring авулзија.

Приказ случаја Приказујемо случај успешне микроваскуларне реплантације ампутираног палца по типу авулзије задобијене бушилицом. Мушкарац од 19 год., механичар по занимању, задобио је повреду палца на радном месту када је бушилица закачила његову рукавицу. Палац је био скоро потпуно откинут - дегловиран на око 2 цм дистално од метакарпофалангеалног зглоба. Према Урбаниак класификацији радило се о типу *III* степену повреде (*Kay* тип *IV*). Пацијент је оперисан три сата након повреде. Улнарна дигитална артерија је анастомозирана *end-to-end* анастомозом. Након уклањања микроваскуларние клеме, реплантирани палац је добио циркулацију. Дренирале су две аностомозиране дорсалне вене. Након шест месеци, изглед реплантираног прста био је естетски задовољавајући. Пацијент је поново виђен након 30 месеци од операције. Снага стиска мерена Јамаровим димометром износила је 5% мање у односу на неповређену руку. Обим покрета је мерен према *total arc of motion* скали и добијен је скоро пун обим покрета у метакарпофалангеалном зглобу са потпуном опозицијом и добрим хватом. Према скали *Medical Research Council*, сензитивни опоравак је достигао *S3*. *DASH* скор износи 0 поена. Добијена је одлична функција иако је палац остао у контрактури у интерфалнгеалном зглобу.

Закључак Пацијент се вратио на радно место, задовољан је функцијом реплантираног палца за свакодневне и радне активности.

Кључне речи: авулзиона ампутација; реплантација; шака

INTRODUCTION

Degloving injuries to the fingers, especially the thumb, present a significant challenge for reconstructive surgeons, as it is extremely difficult to revascularize the amputated finger and restore its function and appearance. Such injuries can range from soft tissue injury to complete amputation [1]. Several classifications have been proposed to assess the extent of injury.

Urbaniak's [2] classification is widely accepted. According to this classification, type I represents a circumferential laceration of the skin, without damage to the circulation. Type II represents incomplete annular avulsion, with impairment of arterial or venous blood flow and requires repair of the artery or vein, while type III represents complete avulsion. Urbaniak's classification later had two modifications. Kay et al. [3] expanded the classification into four categories and Sturzenegger et al. [4] proposed a modification based on the level of injury to the neurovascular elements [5, 6] (Figure 1).

According to the referred classification, in type III avulsions, replantation is not indicated and some authors prefer primary amputation or ray resection [2, 3, 4]. On the other hand, type II is considered an absolute indication for microvascular repair, because almost complete function of the finger can be expected [5]. Latest approach is now that microsurgical repair is the method of choice in all types of ischemic injuries, including type III ring avulsion [7, 8, 9].

We present a case of a successful microvascular replantation of the thumb amputated by an avulsion mechanism caused by a drill.

CASE REPORT

A 19-year-old male, a mechanic by trade, injured his thumb while on the job when a drill caught his glove. The thumb was almost completely torn off – degloved about 2 cm distal to the metacarpophalangeal joint. According to the Urbaniak classification, it was a type III degree of injury (Kay type IV). The amputated part was in contact via a 3 mm wide skin flap and contained part of the proximal and the entire distal phalanx, skin, subcutaneous tissue and nail. The long flexor of the thumb was completely torn from the forearm along with the muscular part. He had signs of a major soft tissue contusion. The proximal phalanx, tendons of the thumb

and part of the thenar muscle were exposed. Both severed neurovascular pedicles were distended with significant elements of contusion (Figure 2). The proximal phalanx of the thumb had a comminuted fracture with a bony defect (Figure 3).

The surgery was performed three hours after the injury. The operation was done under regional anesthesia. After copious irrigation, a careful excision of the contused edges of the wound was performed. Then the preparation of neurovascular structures was done under a microscope. It was decided to attempt microvascular reconstruction when the ulnar digital artery was observed to function well enough for successful microvascular anastomosis. The proximal phalanx was repositioned and fixed with two 1.5 mm Kirschner pins (Figure 4). The ulnar digital artery was anastomosed end-to-end with a 9-0 nylon suture. After removing the microvascular clip, the replanted thumb received circulation. Two dorsal veins were drained and anastomosed with 10-0 nylon thread. The digital artery on the radial side had severe elements of tearing, so its reconstruction was not possible. Both digital nerves were sutured, but both were severely damaged and distended (Figure 5). The surgery took three hours, and the duration of ischemia was around five hours. After the operation, the patient was given anticoagulant, antiplatelet and triple antibiotic therapy as well as antitetanus protection. Diuresis was monitored, blood counts were checked, and the circulation of the replanted finger was observed frequently. The wound healed without infection. The sutures were removed after two weeks, and the patient was discharged from the hospital three weeks after surgery. The Kirschner pins were removed ten weeks after surgery (Figure 6). After six months, the appearance of the replanted finger was aesthetically pleasing.

The patient was followed up again 30 months after surgery.

The nail was growing, but the sensation in the thumb was poor. Grip strength measured with Jamar's dynamometer is 5% less compared to the uninjured hand.

The range of motion was measured according to the TAM scale (TAM = total arc of motion) and almost full range of motion was obtained in the metacarpophalangeal joint with full opposition and good grip. The interphalangeal joint remained contracted in the physiological position. The patient returned to his previous workplace and he remains satisfied with the function of the replanted thumb for daily and work activities. (Figure 7). According to the MRC (Medical Research Council) scale, the sensitive recovery has reached S3. DASH score is 0 point. This represents a complete and unlimited function even though the thumb is contracted in the interphalangeal joint.

Ethics: All procedures performed in the studies were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Written consent to publish all shown material was obtained from the patient

DISCUSSION

Avulsion amputations are most often caused by rotating machinery, transmission belts for transport or traction or a ring when a classic ring avulsion occurs. Digital nerves and blood vessels are often severed beyond the level of the skin wound [10, 11, 12]. The amputated part usually has additional contusions [13], which can also damage the capillary network. The microsurgeon must carefully assess the degree of soft tissue contusion and the degree of blood vessel damage [14]. The presented case is classified as a complete Urbaniak III or Kay IV amputation and as such is an indication for amputation according to earlier recommendations. According to the new standards, it is recommended that an arterial anastomosis is to be performed first, so that the surgeon can assess the ability of the repaired artery to supply blood to the finger. If the blood flow through the soft tissue is not satisfactory, it indicates that the

blood vessel and capillary network have suffered severe injury. This order avoids long-term replantation attempts in futile cases [15, 16]. A method for identifying the dorsal veins is to look for a spot of bleeding or coagulum at the dorsal edge of the amputated part, after the arterial anastomoses have been completed. Venous bleeding suggests that satisfactory venous flow can be maintained after replantation. If no veins are found or the veins are too damaged to have adequate venous flow, a vein graft can be taken [17, 18]. Medical leeches can be used for venous congestion in the postoperative period [19]. In their work, Kurata et al. [20] showed that the artery is more important than the vein in final survival. Microvascular replantation of degloved fingers has functional and aesthetic advantages over alternative reconstructive techniques and the authors recommend that replantation efforts should be pursued. However, the probability of achieving successful replantation is much lower than with straight amputation and according to the authors, in 83% of cases patients with type III avulsion require additional surgery [21]. When vessel damage is such that an anastomosis is impossible, alternative reconstructive options are considered. One option is a vascularized skin flap of the first dorsal metacarpal artery arising from the radial artery just distal to the extensor pollicis longus tendon [22, 23]. Preservation of the thumb can also be achieved with a reverse radial skin flap from the forearm, which is "wrapped" around the completely degloved finger and thus a high-quality skin cover is obtained [24]. Another alternative method is the pedicled abdominal flap, but due to the patient's discomfort, the need for subsequent flap separation, the impossibility of elevating the injured hand and the length of time this method is more often used in complex injuries involving the entire hand [25, 26, 27]. Patients should be informed preoperatively about all options and that replantation may not be technically possible and all alternative methods of reconstruction should be considered during surgery.

Treatment results are good in type I and II injuries, but in type III injuries, where there is severe damage to neurovascular structures, successful replantation can be done in very rare cases. Other adequate solutions are resorted to in order to preserve the length of the finger.

Conflict of interest: None declared.

REFERENCES

1. Jewett CA, Uppuganti S, Desai MJ. Avoiding ring avulsion injuries with silicone rings: a biomechanical study. J Hand Surg. 2021;46(11):1030–5. [DOI: 10.1016/j.jhsa.2021.02.025] [PMID: 34001410]
2. Urbaniak JR, Evans JP, Bright DS. Microvascular management of ring avulsion injuries. J Hand Surg.Am. 1981;6:25–30. [DOI: 10.1016/s0363-5023(81)80006-8] [PMID: 7204914]
3. Kay S, Wentz J, Wolf TW. Ring avulsion injuries: classification and prognosis. J Hand Surg. Am.1989;14(2 Pt 1):204–13. [DOI: 10.1016/0363-5023(89)90008-7] [PMID: 2649544]
4. Sturzenegger M, Buchler U, Frey HP. Ring avulsion injuries: improved indications for replantation. Handchir Mikrochir Plast Chir. 1988;20(5):255–8. [PMID: 3181823]
5. Horn A, Freniere B, Sheng AY. A Case Report of Ring Avulsion Injury: Under-recognized for Its Unique Implications in Transfer. Clin Pract Cases Emerg Med. 2021;5(1):75–8. [DOI: 10.5811/cpcem.2020.11.49917] [PMID: 33560957]
6. Van Handel AC, Pet MA. Fingertip replantation: technique details and evidence review. Hand Clin. 2021;37(1):53–65. [DOI: 10.1016/j.hcl.2020.09.006] [PMID: 33198918]
7. Zhu Y, Currie L. Reimplantation of ring avulsion amputation of finger: intraoperative challenges and rehabilitation outcomes. BMJ Case Reports. 2021;14(10):e245994. [DOI: 10.1136/bcr-2021-245994] [PMID: 34667048]
8. Gardiner S, Friebel TR, Bray J, Anadkat M, Nikkhah D. Practical techniques to ensure success in digital ring avulsion injuries. Plast Reconstr Surg Glob Open. 2021;9(8):e3771. [DOI: 10.1097/GOX.0000000000003771] [PMID: 34667701]
9. Lupon E, Goutard M, Chaput B, Grolleau JL, Cetrulo CL, Laumonerie P, et al. The impact of microsurgery on the treatment of ring avulsion injuries. Plast Reconstr Surg. 2021;147(1):163e-65e. [DOI: 10.1097/PRS.0000000000007487] [PMID: 33027202]
10. Paleu G, Perraudin T, Majchrzak A, Grigore M, Lupon E, Camuzard O. Vascularized posterior interosseous nerve graft for digital neurovascular bundle reconstruction. Hand Surg Rehabil. 2024;43(4):101761. [DOI: 10.1016/j.hansur.2024.101761] [PMID: 39128593]
11. L Chouquet, Y Berkane, G Paleu, Gandolfi S, O Camuzard, E Lupon. Hand and wrist complete degloving: A case report and litterature review. Ann Chir Plast Esthet. 2024;S0294-1260(24)00169-9. [DOI: 10.1016/j.anplas.2024.09.005] [PMID: 39448342]
12. Horoz L, Çakmak MF. Leech therapy for the treatment of venous congestion in digital re-plants and revascularizations. J Orthop Res Rehabil. 2023;1(1):16–8. [DOI: 10.51271/JORR-0004]
13. Abualadas H. Replantation of middle fingertip following complete Tamai Zone 2 amputation and eschar development: A clinical case report. Int J Surg Case Rep. 2025;126:110664. [DOI: 10.1016/j.ijscr.2024.110664] [PMID: 39612904]
14. Zhou Z, Yu L, Meng F, Wen J, Xiao Y, Zhou B et al. Replantation of multiple fingertip amputations using super microsurgery: A case report and literature review. JPRAS Open. 2024;40:245–52. [DOI: 10.1016/j.jpra.2024.03.008] [PMID: 38694441]
15. Altam A, Obadiel Y, Alazaiza RS, Alshujaa MA, Alhajami F, Ahmed F, et al. Microsurgical Digits Replantation in Resource-Limited Setting: A Retrospective Study. Open Access Emerg Med. 2024;16:1–13. [DOI: 10.2147/OAEM.S443219] [PMID: 38192570]
16. Hayashi K, Hattori Y, Chia DSY, Sakamoto S, Sonezaki S, Doi K. Fingertip replantation: surgical technique, tips, and tricks. Plast Reconstr Surg 2024;153(1):168–71. [DOI: 10.1097/PRS.0000000000010521] [PMID: 37036316]
17. Kobayashi K, Shinoura S, Nishimura K, Sugawara R. Selection bias in avoiding vein graft in replantation/revascularization may exist in distal and proximal amputations, respectively. Plast Reconstr Surg Glob Open. 2023;11(5):e4992 [DOI:10.1097/GOX.0000000000004992]
18. Bouz A, Liu Y, Yamaguchi KT, Friedrich JB. Closed ring avulsion injury with isolated arterial insufficiency. J Hand Surg Glob Online. 2021;3(6):356–9. [DOI: 10.1016/j.jhsg.2021.07.004] [PMID: 35415580]
19. Toshinskiy S, Frees M, Hillard C. Predictors of leech therapy failure in revascularized and replanted digits. J Hand Microsurg. 2024;16(4):100080. [DOI: 10.1016/j.jham.2024.100080] [PMID: 39234374]
20. Kurata T, O'Brien BM, Black MJ: Microvascular surgeries in degloving injuries: An experimental study. Br J Plast Surg.1978;31(2):117–20. [DOI: 10.1016/s0007-1226(78)90058-9] [PMID: 346121]
21. Yoon AP, Kane RL, Wang L, Wang L, Chung KC. Variation in surgeon proficiency scores and association with digit replantation outcomes. JAMA Network Open. 2021;4(10):e2128765. [DOI: 10.1001/jamanetworkopen.2021.28765] [PMID: 34698849]
22. De TG, Sosa-Serrano AFJ, Zepeda-Mora A. First dorsal metacarpal artery flap for thumb reconstruction. Cir Plast. 2022;32(3):129–33. [DOI:10.35366/108830]
23. Zyluk A, Flicinski F.Outcomes of coverage of soft tissue defects in the thumb with a "kite flap".Handchir Mikrochir Plast Chir. 2023;55(1):47–52. [DOI: 10.1055/a-1862-8129] [PMID: 35853471]

24. Hao R, Wang B, Wang H, Yang H, Huo Y. Repair of distal thumb degloving injury using combination of reverse dorsoradial flap of the thumb and middle finger proper digital arterial island flap. J Orthop Surg Res. 2020;15(1):417. [DOI: 10.1186/s13018-020-01940-y] [PMID: 32938492]
25. Hidajat NN, Damayanthi ED, Akbar HF, Magetsari RMSN, Hidajat NN. Replantation using groin flap in thirty-four years old male with traumatic total degloving of little finger: A case report. Int J Surg Case Rep. 2023;108:108377. [DOI: 10.1016/j.ijscr.2023.108377] [PMID: 37352768]
26. Manoukov Y, Beauthier-Landauer V, Sautet A, Teboul F, Thumser J, Cambon-Binder A. An ultra-thinned groin flap for reconstruction of complete digital ring avulsion injuries. Journal of Hand Surgery (European Volume). 2022;47(6):626–32. [DOI:10.1177/17531934221078233] [PMID: 35107037]
27. Wagner RD, Carr L, Netscher DT. Current indications for abdominal-based flaps in hand and forearm reconstruction. Injury. 2020;51(12):2916–21. [DOI: 10.1016/j.injury.2020.02.105]

Urbaniak Classification		
Class	Description	Treatment
Class I	Circulation adequate	Standard bone and soft tissue care
Class II	Circulation inadequate	Vessel repair
Class III	Complete degloving or complete amputation	Amputation

Kay, Wemtz and Wolff Classification		
Class	Description	Treatment
Class I	Circulation adequate	Standard bone and soft tissue repair
Class II	Arterial compromise only	Vessel repair
Class III	Inadequate circulation with bone, tendon, or nerve injury.	Amputation
Class IV	Complete degloving or complete amputation.	Amputation

Figure 1. Urban classification

Figure 2. Finger injury

Figure 3. Preoperative X-ray scans of the affected hand and finger

Figure 4. Finger and X-ray with K-needles

Figure 5. Finger immediately after surgery

Figure 6. Thumb without K-needles

Figure 7. Final results

