Microvascular Replantation Following Facial Dog Bites in Children
Systematic Review and Management Algorithm

Amanda J. Williams, BS, Jeremy M. Powers, MD,† Jennifer L. Rhodes, MD,† and Andrea L. Pozez, MD†*

Background: Pediatric dog bite injuries account for 1% of emergency department visits per year and represent an underrecognized and underreported public health problem. Reconstructive surgery is frequently utilized, and in the most extreme injuries, microvascular replantation may be considered. We sought to systematically review the available literature on microvascular replantation after facial dog bite injuries in children, with particular attention to perioperative morbidity and long-term follow-up.

Methods: We reviewed a case of microvascular replantation after a facial dog bite injury in a child from our own institution and conducted a systematic literature search to identify other similar reports. Clinical variables were collected from the reported cases, and descriptive statistics were calculated. A management algorithm was developed from the reviewed published experience.

Results: We report the youngest child to date in the literature to undergo replantation after a facial dog bite injury. Nineteen other cases were found involving children aged 18 months to 17 years, with follow-up ranging from 2 weeks to 28 years. Anastomosis techniques varied considerably and included both an artery and vein in only 9 (47%) of 19 cases. Venous congestion was nearly universal, and multimodal techniques were used until native venous outflow was reestablished. Blood transfusion was common, but intensive care unit utilization was not frequently reported. Long-term outcomes were excellent, with growth of the replanted part and recovery of function; however, minor revision procedures were common.

Conclusions: Microvascular replantation following facial dog bite amputation injuries in the pediatric population is the ultimate step in the reconstructive ladder. Strong consideration should be given to microvascular exploration with involvement of large or whole segments of the lip, nose, or ear; however, parents should be counseled extensively regarding the known morbidity of replantation surgery. With meticulous surgical technique and careful postoperative care, replantation after facial dog bite amputation injuries may successfully achieve dramatic and lasting results for pediatric patients.

Key Words: dog bites, facial trauma, microvascular replantation, pediatric plastic surgery

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Dog bites are a common source of injury in the pediatric population of the United States. Of the approximately 4.7 million dog bite injuries that occur annually in the United States, nearly 1 in 6 patients require some form of medical attention for dog bite injuries, accounting for approximately 1% of emergency department visits overall.[1,2] Male children aged 5 to 9 years had the highest incidence rate (60.7 per 10,000 persons) in 1 study,[1] whereas grade-school children aged 6 to 12 years accounted for the majority of injuries in another report.[2] The proportion of dog bite injuries affecting the face ranged from 29.8% to 73%, with the majority of facial injuries affecting the lips and nose.[1–3] Stratified by age, injuries to the face were more common in infants and preschool-aged children, whereas injuries to the extremities were more common in grade-school children and teenagers.[2] Dog bite injuries in children are an underrecognized and underreported public health problem, which may lead to posttraumatic symptoms, life-altering and disfiguring scars, significant disability, or even death.[2,4,5] Both primary and secondary reconstructive surgery is frequently required to preserve and restore form and function for these children.

Many methods of reconstruction are utilized following dog bites in pediatric patients, ranging from primary closure to regional flap options. In the most severe injuries involving an avulsion/amputation of partial or entire subunits, immediate exploration and microvascular replantation have been proposed as first-line management whenever possible. Numerous case reports have advocated that replantation most ideally reestablishes lip and nose aesthetics and function after facial dog bites in children.[6–9] We hypothesize that while replantation allows for full restoration without borrowing from neighboring tissues it comes at a cost with heightened intensity of care and increased risk of complications. In addition to analyzing our clinical experience, we performed a systematic review of pediatric dog bite injuries to the face managed with microvascular replantation, with particular attention to the morbidity of replantation and outcomes with long-term follow-up. Based on the available published experience, we offer an algorithm for surgical management when replantation is being considered.

METHODS

Institutional review board approval was obtained for this study (VCU IRB protocol HM20007881). The written records of a case of pediatric microvascular replantation after a facial dog bite injury at our institution were reviewed and summarized. The English literature was searched using PubMed and Google Scholar using the search strings "(dog bite OR dog bites) AND (child OR children OR pediatric) AND (facial) AND (replantation)." Articles reporting cases of microvascular replantation after dog bite injury in children were included for review, and the following variables relating to each case were obtained when available: age, location of injury, ischemia time, details of vascular anastomoses, units of blood transfusion (standardized to 250 mL/U), anticoagulant therapy and use of leeches, duration of follow-up, and outcomes including complications. Small sample size limited analysis beyond descriptive statistics. After a comprehensive review of our clinical experience and the evidence presented in each article, a management algorithm for microvascular replantation after pediatric facial dog bite injury was developed.

RESULTS

Clinical Experience

A 14-month-old girl sustained a dog bite injury that resulted in amputation of 60% of the right upper lip, sparing the right oral commissure but including the philtrum. The amputated segment measured 2 × 3 cm and was brought in on ice with the patient. The patient was taken to the operating room for exploration of the wound in consideration for microvascular replantation.

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From the *Virginia Commonwealth University School of Medicine; and †Division of Plastic and Reconstructive Surgery, Virginia Commonwealth University Medical Center, Richmond, VA.
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Reprints: Jeremy M. Powers, MD, VCU Division of Plastic and Reconstructive Surgery, Box 980154, 1250 E Marshall St, Richmond, VA 23298. E-mail: jeremy.powers@vcuhealth.org.

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Dissection of the amputated lip tissue found that the superior labial artery was of adequate length and caliber for anastomosis; this was anastomosed to the right facial artery using 11-0 nylon. A vein that was less than 0.5 mm in diameter was found in the avulsed segment and was anastomosed to a vein found in the superior aspect of the wound with 11-0 nylon sutures. Reperfusion was evident after completion of the anastomoses, with appropriate color change of the tissues, visible capillary refill, and bleeding of raw surfaces. Total ischemia time was 3 hours.

The patient was transferred to the pediatric intensive care unit (ICU), and a heparin drip was initiated. The patient was placed on intravenous antibiotics and remained intubated to protect the repair. Nasoenteric tube feeding was initiated to optimize nutrition for wound healing.

In the hours following the procedure, the replanted lip showed signs of venous congestion. Several sutures were removed to externalize the lateral and superior portion of the flap. Leech therapy was initiated on postoperative day 1 (POD1) and continued for 9 days. Heparin gauze dressings were also applied on POD1 and discontinued on POD6. Pin pricking was performed once on POD4 to promote bleeding when the lip became dark purple. Throughout the patient's course, she received a total of 3730 mL of packed red blood cells, 400 mL of plasma, and 456 mL of platelets.

The patient was extubated on POD14 and began tolerating a diet the following day. The patient was discharged 19 days after admission, and on close follow-up, the lip was viable and pink in color with no evidence of congestion (Fig. 1, upper left). At an early postoperative follow-up, the patient demonstrated oral competence by drinking from a bottle without drooling (Fig. 1, upper right). At a 10-year follow-up, appropriate growth of the replanted part had occurred with full orbicularis function and sensation (Fig. 1, lower images). There were no deficits in speech or oral competence; in fact, she was able to whistle. The patient was satisfied with her appearance at that time and did not desire scar revision.

Literature Review

Twenty published reports describing 19 cases of microvascular replantation after pediatric facial dog bite injury were found (Table 1).[7–18] The average child's age was 7.8 years, with 9 children (47%) ranging from 0 to 6 years, 7 children (37%) ranging from 7 to 12 years, and 3 children (16%) 13 years or older. The case we report above represents the youngest patient in the literature to undergo replantation after dog bite injury to the face. The duration of ischemia time ranged from 3 to 9 hours. The majority of wounds involved the lip and/or nose/cheek, with less frequent cases of partial or total nose or ear amputations (Table 2).

Arterial and venous anastomoses were completed in 9 (47%) of 19 cases, with artery only or arterialization of the venous system being completed in 10 (53%) of 19 cases (Table 2). Leeching was common, with 13 patients (72%) requiring leeching overall, with 6 of these being immediate postoperative application. Patients were placed on postoperative anticoagulation utilizing different combinations of heparin, dextran, acetylsalicylic acid (ASA), and other agents, with 1 patient not receiving any postoperative anticoagulation regimen. Other adjunctive techniques to address venous congestion were reported in 12 cases (63%) and included delayed inset, topical application of heparin, nitroglycerin, papaverine, pin pricking/bleeding, heparin gauze application, and hyperbaric oxygen (Table 2).

Intensive care unit length of stay was not reported in any case; however, 4 cases (21%) reported that patients remained intubated after surgery and listed the POD of extubation. When reported, this ranged from POD5 to POD8. Blood transfusion requirements were published in 17 cases (89%). Of these, 15 patients (88%) required blood transfusion. The average transfusion requirement was 6 U (250 mL/U), ranging from 0.6 to 17 U. Requirements for other blood products were not reported.

Postoperative complications were reported in all 19 patients (Table 3). Venous congestion was the most commonly reported complication, occurring in 18 cases (95%). Partial necrosis was reported in 4 children (21%); there were no cases of total flap failure reported. Hypertrophic scarring and prolonged edema were reported in 6 (32%) and 4 (21%) patients, respectively. One case (5%) was complicated by a postoperative hematoma, which required reoperation. Early/anastomotic revision occurred in 2 children (11%), whereas delayed revision procedures

FIGURE 1. Replantation of right upper lip after dog bite amputation injury in a 14-month-old girl. Upper left, Seven weeks after replantation, the scars are maturing, and the vermillion border is well approximated. She had no difficulty with eating and had regained the weight lost during her hospital stay. Upper right, Oral competence as demonstrated by using a bottle at an early postoperative follow-up visit. Lower images, Ten-year follow-up demonstrates excellent healing with minimal scar burden.

TABLE 1. Summary of Cases of Pediatric Facial Dog Bite Replantation

Reference	Age, y	Injury Location	Ischemia Time, h	Anastomoses	Post-Operative Anticoagulation	Leech Therapy	Other Adjuncts	Blood Transfusion (250 mL/U)	Complications	Follow-up	Results	Comments
James,[10] 1976	3	Upper lip and part of the nose	3.5	Artery-artery, vein-vein	Heparin, dextran, ASA	NR	NR	NR	Venous congestion requiring revision of venous anastomosis; partial necrosis	7 mo	Survival of most of the replanted segment	Partial necrosis managed with wound care
Walton et al,[6] 1998	9	Right upper lip	NR	Artery-artery, vein-vein × 2	Heparin	Started on POD1, continued for 24 h	Topical lidocaine, hyperbaric oxygen	17	Hypertrophic scarring, venous congestion	2 y	Good functional and aesthetic result	No revisions needed
Walton et al,[6] 1998	17.1	Right upper lip	NR	Artery-artery	Heparin, ASA	5 d	NR	8	Prolonged edema, hypertrophic scarring, venous congestion	7.5 y	Excellent result	3 Scar revisions
Walton et al,[6] 1998	5.4	Right upper lip	NR	Artery-artery × 2, vein-vein	Heparin, dextran	Started on POD3, continued for 7 d	Topical lidocaine, topical papaverine	1.2	Prolonged edema, hypertrophic scarring, venous congestion	1 y	Excellent color, preserved motor/sensory function	—
Walton et al,[6] 1998	12	Right lower lip	NR	Artery-artery	Heparin, ASA	Started on POD1, continued for 4 d	NR	12	Prolonged edema, venous congestion	8.3 y	Excellent color, preserved motor/sensory function	—
Walton et al,[6] 1998	2.7	Left upper lip	NR	Artery-artery	Dextran	Started on POD1, continued for 6 d	Heparin gauze, topical nitroglycerin	4.8	Postoperative hematoma, delayed closure cheek wound, hypertrophic scarring, venous congestion	2.9 y	Excellent color, preserved motor/sensory function	Scars noted to be from leech therapy
Walton et al,[6] 1998	6.7	Left upper lip	NR	Artery-artery	Heparin, Wydase heparin	Started immediately postoperatively and continued for 1 d	Topical papaverine	1	Partial necrosis secondary to surgical trauma, venous congestion	1.4 y	Excellent color, preserved motor/sensory function	Operative revision × 1
Walton et al,[6] 1998	5.1	Left upper lip	NR	Artery-artery, vein-vein	Heparin, dextran, Coumadin	No	NR	8.4	Hypertrophic scarring	1.7 y	Excellent color, preserved motor/sensory function	Operative revision × 1
Walton et al,[6] 1998	10.1	Mid upper lip	NR	Artery-artery	Heparin, dextran	Started immediately postoperatively and continued for 8 d	Intra-arterial papaverine	5	Hypertrophic scarring, venous congestion	1 y	Good color, preserved motor/sensory function	—

Tajima et al,[11] 1989 Ueda et al,[12] 2014	9	Two-thirds of lower half of nose	4	Artery-artery with vein graft, artery-vein with vein graft*	Heparin, dextran, PGE1	Not available in Japan at the time	Heparin gauze, pin pricking	0.6	Venous congestion, partial necrosis	28 y	Natural contour with sufficient growth of amputated part	FTSG to upper lip, vermillion plasty, and FTSG to nasal dorsum 1, 7, and 19 mo after initial surgery, scar revision 22 y later
Taylor and Andrews,[7] 2009	17	Central upper lip	>7	Artery-artery	Heparin	Started immediately postoperatively and continued for 7 d	Delayed inset, heparin gauze	10	Significant edema, venous congestion	11 mo	Fully functional, sensate lip with subtle scarring	Delayed inset × 2, use of allograft over open portion, small lenticular excision with Kenalog injection at 10 mo
Schonauer et al,[13] 2004	15	Upper two-thirds of right pinna	NR	Artery-artery, vein-vein	Dextran, ASA	Started on POD5, stopped after 24 h	NR	None	Venous congestion at POD5, resolved with 24 h of leeching	1 mo	Complete survival	Good cosmetic result
Hendrick and Tiwari,[14] 2012	7	Right upper lip	9	Artery-vein	Heparin, ASA	Started immediately postoperatively and continued for 8 d	Delayed inset	10	Venous congestion	2 weeks	Aesthetically acceptable outcome with nearly normal function	Delayed inset of lateral portion of the flap to prevent venous compression
Marík and Kurial,[15] 2012	7	Entire ear	6	Artery-artery, vein-vein with vein graft	Heparin, dextran, Fraxiparine	None	Topical bleeding, hyperbaric oxygen	Required transfusion but total not reported	Venous congestion	8 mo	Complete survival	No revisions reported
Baptista et al,[8] 2015	2	Total upper lip, partial nose	3	Artery-artery, vein-vein	None	Not available in Brazil at the time	None	1	Congestion and vasospasm requiring exploration and additional vein anastomosis	18 mo	Satisfactory aesthetic result with excellent contour, shape, and color match	Sensation recovery, satisfactory lip positioning and oral competence
DeLeon et al,[9] 2014	6	Right upper and lower lip	4	Artery-artery, vein-vein	NR	Yes	NR	2.2	Venous congestion	1 year	Full motor function; complete survival of replanted segment; symmetric facial animation	Full restoration of sensation; no revisions needed
Deleyiannis and Powers,[16] 2014	1.75	Lip and cheek	9	Artery-artery	NR	Immediate leeching × 5 d	NR	Required transfusion but total not reported	Venous congestion, partial necrosis	3 mo	Competent oral sphincter	FTSG on POD18 to heal partial-thickness necrosis

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TABLE 1. *(Continued)*

Reference	Age, y	Injury Location	Ischemia Time, h	Anastomoses	Post-Operative Anticoagulation	Leech Therapy	Other Adjuncts	Blood Transfusion (250 mL/U)	Complications	Follow-up	Results	Comments
Marsden et al,[17] 2015	1.5	Entire nose	6	Artery-vein	NR	Immediate leeching × 7 d	NR	4	Venous congestion	10 y	Normal sensation, normal growth of part with child	Excellent cosmetic result, no revision, no airflow obstruction
Stupka et al,[18] 2015	11	Entire nose	NR	Artery-artery, vein-vein with arterial graft	Heparin, ASA, enoxaparin	None	Nasal tip abrasion, topical enoxaparin	NR	Venous congestion	10 y	Full healing, growth of replanted part, recovery of sensation	Patient was satisfied and refused minor revision

*Artery on amputated part was anastomosed to a recipient vein, in addition to a standard artery-artery anastomosis.
NR indicates not reported; FTSG, full thickness skin graft; PGE1, prostaglandin E1.

occurred in 6 cases (32%). Comments from the clinical reports noted growth of replanted parts as well as restored orbicularis function and lip sensation. Follow-up ranged from 2 weeks to 28 years.

DISCUSSION

Microvascular replantation of an amputated facial segment is a highly challenging task that increases in complexity with the avulsion/crush mechanism of dog bite injuries and the delicate anatomy of pediatric patients. The ability to achieve a truly ideal reconstruction must be weighed against the morbidity of replantation. The purpose of this article is to discuss the published cases involving replantation after pediatric facial dog bite injuries with particular attention to perioperative morbidity and long-term follow-up.

Nonstandard vascular anastomoses (artery only or arterialization of the venous system) were the majority rather than the exception, and venous congestion was nearly universally experienced regardless of the type of anastomosis. Several factors may account for the difficulty of venous anastomosis and postoperative venous congestion including size of vessels in pediatric population and the nature of the injury.[8] Dog bites usually result in violent tearing and avulsion forces, which may result in stretch/rupture of fragile venous vessels and subsequent

TABLE 2. Surgical and Treatment Details

	n (%)
Injury location	
Lip only	11 (85)
Lip and cheek	1 (5)
Lip and nose	2 (11)
Partial nose	1 (5)
Total nose	2 (11)
Partial ear	1 (5)
Total ear	1 (5)
Type of anastomosis	
Artery and vein	7 (37)
Artery × 2 and vein	1 (5)
Artery and vein × 2	1 (5)
Artery only	7 (37)
Artery to vein	3 (16)
Postoperative anticoagulation	
No. reporting	16 (84)
No anticoagulation	1 (6)
Heparin +/− ASA	6 (38)
Dextran +/− ASA	2 (13)
Heparin + dextran	3 (19)
Heparin + multiple other agents	5 (25)
Leech therapy	
No. reporting	18 (95)
Overall utilizing	13 (72)
Immediate postoperative application	6 (46)
Delayed postoperative application	7 (54)
Average leech duration	5 d
Adjunct therapies	
No. reporting	12 (63)
Delayed inset	2 (17)
Topical medications	5 (42)
Pin pricking/bleeding	3 (25)
Heparin gauze	3 (25)
Hyperbaric oxygen	2 (17)

TABLE 3. Complications and Reoperation

	n (%)
Complications	
Any complication	19 (100)
Venous congestion	18 (95)
Partial necrosis	4 (21)
Hypertrophic scarring	6 (32)
Prolonged edema	4 (21)
Postoperative bleeding/hematoma	1 (5)
Reoperation	
Early (anastomotic) revision	2 (11)
Single delayed revision	3 (16)
Multiple delayed revisions	3 (16)
No revision noted	11 (58)

retraction into the tissues.[6,19,20] Despite the difficulty of anastomosis and prolonged ischemia times (up to 9 hours in the cases reviewed), excellent outcomes were achieved. It is suggested that young age is an absolute indication to attempt replantation even with prolonged ischemia times, noting that ischemia-reperfusion injury in younger patients may be less severe than in adults because of less aggressive neutrophil response, decreased neutrophil oxidative burst, and less mast cell degranulation-related damage.[16,21]

Multimodal strategies were used postoperatively to address venous congestion, with aggressive utilization of leeches and both topical and systemic anticoagulation in most cases. This seemed to partially mitigate the detrimental effects of venous congestion; however, there were significant blood transfusion requirements when reported. The rate of adverse events after blood transfusion in infants is nearly 3 times the rate in adults and includes clerical error, allergic reactions, and infection transmission, as well as potentially fatal noninfectious reactions such as transfusion-related acute lung injury, transfusion-associated circulatory overload, alloimmunization, and immunomodulation.[22,23] The near certainty of blood transfusion with replantation surgery and the attendant risks should be discussed with parents preoperatively. Prolonged postoperative endotracheal intubation/mechanical ventilation was also a strategy used in several cases including ours; however, the majority of reports did not mention ICU length of stay or need for mechanical ventilation. Future clinical reports should include amounts of blood products transfused and ICU course and length of stay in order to appropriately understand the implications of replantation for pediatric patients.

Overall outcomes were excellent; however, urgent re-explorations, minor wound complications, and subsequent revision rates were not insignificant. True success rates are difficult to estimate, given the relative

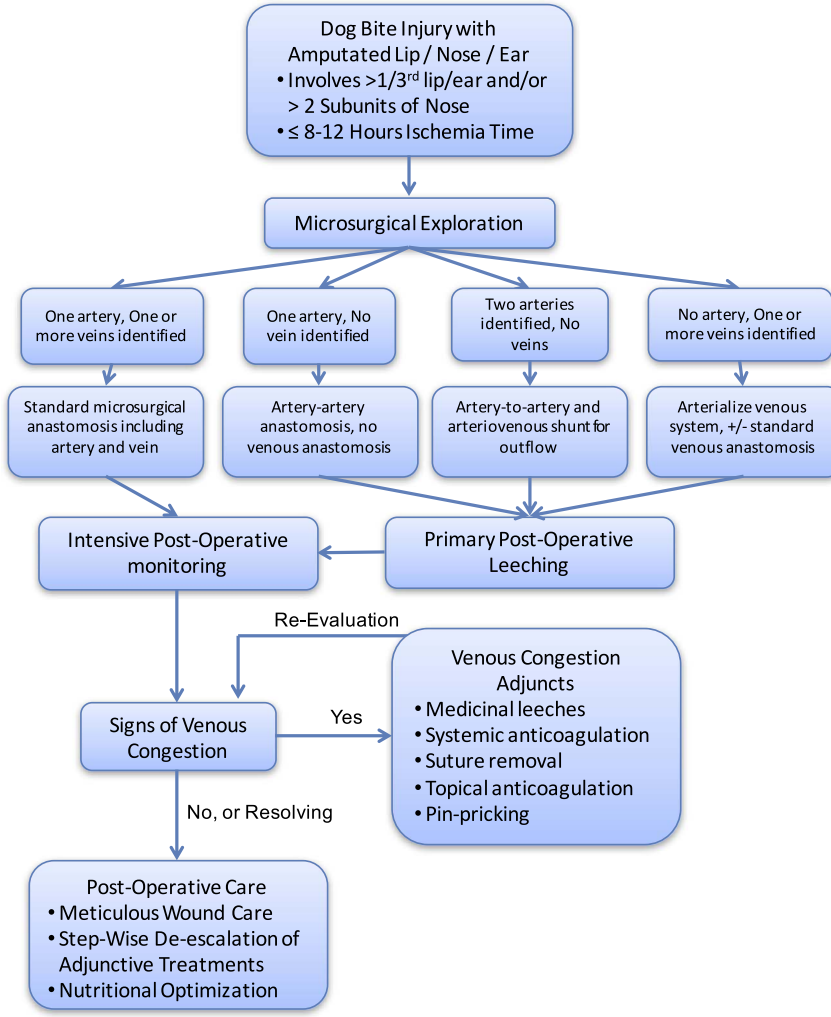

FIGURE 2. Management algorithm for microvascular replantation after pediatric facial dog bite injuries.

rarity of replantation in general and that the published experience is limited to case reports and small case series. In a recent review of nasal replantation, the success rate was 85%, with 15% requiring revision procedures for partial necrosis.[17] A comprehensive review of head and neck microsurgical replantation in all ages reported an overall success rate of 72.1%, with partial failure in 20.2% and complete failure in 7.7%.[24] We suspect that the success rate in our review is artificially high because of publication bias; indeed, the authors are aware of unpublished cases in which microsurgical replantation after pediatric dog bite injury was attempted and proved unsuccessful (J.L.R., personal communication). Each clinical case is unique, and during the informed consent process, parents must be made aware of the difficulties involved in providing estimates of possible success.

In the absence of severe associated injuries necessitating delay of reconstruction, we propose that microvascular replantation be considered when a dog bite amputation injury involves more than one-third to one-half of the lip or ear or more than 2 subunits of the nose, and ischemia time can be anticipated to be less than 8 to 12 hours. Based on our clinical experience and review of the literature, a segment of this size will often contain adequate vessels for revascularization when replanted. Given the superior aesthetic and functional outcomes of microvascular replantation, we encourage all providers to consider it as an immediate option in the appropriate clinical situation. We propose a management algorithm, with particular attention to decision making related to anastomotic technique and postoperative strategies to address venous congestion (Fig. 2).

CONCLUSIONS

Microvascular replantation following facial dog bite amputation injuries in the pediatric population is the ultimate reconstructive option and has the capacity to yield excellent long-term aesthetic and functional outcomes, even in growing children. The risks of embarking on a replantation surgery should be thoroughly discussed with patients and parents, with assent obtained from children when possible and informed consent obtained from parents. The treatment algorithm provided summarizes the known experience in microvascular replantation following pediatric facial dog bite injury and will provide guidance in the appropriate clinical scenario. With meticulous surgical technique and careful postoperative care, replantation after dog bite amputation injuries may effectively achieve dramatic and lasting results for pediatric patients.

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REFERENCES

1. Weiss HB, Friedman DI, Coben JH. Incidence of dog bite injuries treated in emergency departments. *JAMA*. 1998;279:51–53.
2. Kaye AE, Belz JM, Kirschner RE. Pediatric dog bite injuries: a 5-year review of the experience at the Children's Hospital of Philadelphia. *Plast Reconstr Surg*. 2009;124:551–558.
3. Gurunluoglu R, Glasgow M, Arton J, et al. Retrospective analysis of facial dog bite injuries at a level I trauma center in the Denver metro area. *J Trauma Acute Care Surg*. 2014;76:1294–1300.
4. Bini JK, Cohn SM, Acosta SM, et al. Mortality, mauling, and maiming by vicious dogs. *Ann Surg*. 2011;253:791–797.
5. Rusch MD, Grunert BK, Sanger JR, et al. Psychological adjustment in children after traumatic disfiguring injuries: a 12-month follow-up. *Plast Reconstr Surg*. 2000;106:1451–1458; discussion 1459–1960.
6. Walton RL, Beahm EK, Brown RE, et al. Microsurgical replantation of the lip: a multi-institutional experience. *Plast Reconstr Surg*. 1998;102:358–368.
7. Taylor HO, Andrews B. Lip replantation and delayed inset after a dog bite: a case report and literature review. *Microsurgery*. 2009;29:657–661.
8. Baptista R, Barreiro G, Alonso N. Pediatric lip replantation: a case of supermicrosurgical venous anastomosis. *J Reconstr Microsurg*. 2015;31:154–156.
9. DeLeon AN, Rinard JR, Mahabir RC. Successful replantation of a portion of the upper and lower lip with the oral commissure. *Ann Plast Surg*. 2014;72:3–4.
10. James NJ. Survival of large replanted segment of upper lip and nose. Case report. *Plast Reconstr Surg*. 1976;58:623–625.
11. Tajima S, Ueda K, Tanaka Y. Successful replantation of a bitten-off nose by microvascular anastomosis. *Microsurgery*. 1989;10:5–7.
12. Ueda K, Nuri T, Okada M, et al. 28 Years' follow-up of bitten-off nose replantation performed in a 9-year-old girl. *Plast Reconstr Surg*. 2014;133:904e–905e.
13. Schonauer F, Blair JW, Moloney DM, et al. Three cases of successful microvascular ear replantation after bite avulsion injury. *Scand J Plast Reconstr Surg Hand Surg*. 2004;38:177–182.
14. Hendrick RG Jr, Tiwari P. Successful replantation of upper lip avulsion injury using an arterialized venous anastomosis. *Plast Reconstr Surg*. 2012;130:628e–630e.
15. Maríık V, Kurial P. Successful replantation of a completely amputated ear on a child. *Acta Chir Plast*. 2012;54:19–22.
16. Deleyiannis FW, Powers MA. Lip replantation in an infant after prolonged ischemia: age as a factor affecting success. *Plast Reconstr Surg*. 2014;133:240e–241e.
17. Marsden NJ, Kyle A, Jessop ZM, et al. Long-term outcomes of microsurgical nasal replantation: review of the literature and illustrated 10-year follow-up of a pediatric case with full sensory recovery. *Front Surg*. 2015;2:1–8.
18. Stupka I, Dvorak Z, Vesely J, et al. Reconstruction of a nose bitten and eaten by a dog: a ten-year follow-up of a bitten-off nose replantation performed on an eleven-year-old boy. *Ann Plast Surg*. 2015;75:585–587.
19. Baj A, Beltramini G, Laganà F, et al. Amputation trauma of the face: surgical techniques and microsurgical replantations. *Acta Otorhinolaryngol Ital*. 2009;29:92–96.
20. Stillaert FB, Roche N, Zeltzer A, et al. Artery only microanastomosis in nose replantation: a report of two cases. *J Plast Reconstr Aesthet Surg*. 2012;65:513–516.
21. Mowlavi A, Reynolds C, Neumeister MW, et al. Age-related differences of neutrophil activation in a skeletal muscle ischemia-reperfusion model. *Ann Plast Surg*. 2003;50:403–411.
22. Lavoie J. Blood transfusion risks and alternative strategies in pediatric patients. *Paediatr Anaesth*. 2011;21:14–24.
23. Oakley FD, Woods M, Arnold S, et al. Transfusion reactions in pediatric compared with adult patients: a look at rate, reaction type, and associated products. *Transfusion*. 2014;55:563–570.
24. Efanov JI, Montoya IJ, Huang KN, et al. Microvascular replantation of head and neck amputated parts: a systematic review. *Microsurgery*. 2017;14:313–318.