

Vascular Lower Lip Enlargement: Reconstruction Using the Step Technique

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ABSTRACT

The formidable therapeutic challenge of vascular lesions of the face continues to tax the imagination of the plastic surgeon. The lack of understanding of the proper diagnosis and natural history of vascular malformations contributed to delays in treatment. In this report, the results of treatment of vascular lower lip enlargement (28 patients) were reviewed over a two-year period. Seventeen patients presented with venous vascular malformations, five with hemangiomas and six with port-wine (capillary) vascular malformations. The age range was 3 years-32 years with an average of 7 years. Large vascular lesions of the lower lip were excised and reconstructed using the step technique. Bilateral step flaps from the remaining parts of the lower lip were used for reconstruction of lip defects of up to $\frac{2}{3}$ of the lower lip. Additional intraoperative adjuncts to control bleeding and facilitate removal of those highly vascular lesions were employed. Intralesional ligatures were used to control protruding parts of the venous lesions outside the lip. There was no recurrence after resection in a one-year to two-year follow-up. Partial dehiscence at the vermilion border occurred in one patient and hypertrophic scar in another. The function of orbicularis oris and lip movements were restored to normal. All patients had a symmetrical, mobile, oral sphincter with intact commissures, adequate buccal sulcus, no symptomatic microstomia and normal sensation. The aesthetic results were excellent. The results were superior to other flap methods as regards to function and aesthetics due to use of the adjacent lip tissue for reconstruction, which preserves the normal anatomical components of the lower lip. Early excision of large vascular lesions of the lower lip and reconstruction with the step flaps offers much to many of these patients and relieves the psychological burden of the child and family.

INTRODUCTION

Vascular lesions of the face pose a social problem for the patient and a reconstructive challenge for the plastic surgeon [1]. There is a continuous debate as to the timing and nature of treatment of these patients [2]. A conservative uninformed medical community and cultural factors contribute to delay in both diagnosis and treatment, which may lead to psychological problems for the patient. Mulliken and Glowaki were the first to reclassify

these lesions into hemangiomas and vascular malformations based on their biologic behavior (endothelial features and clinical evolution) [3]. This classification has provided a common language for discussion of the diagnosis and treatment modalities in patients with vascular lesions [2].

Many treatment modalities exist. These include laser photocoagulation [4], sclerotherapy, embolisation and direct surgical excision and often a combination of techniques yields the best results [5]. When non-operative modalities fail, surgery is usually needed. For the lip, in particular, the distortion of normal anatomy in three dimensions is not possible to correct without surgical reduction. Debulking of small lesions can usually be achieved by a variety of excisional techniques such as horizontal and vertical wedge resections and elliptical excisions [1]. For large vascular lesions of the lower lip, many techniques are available including advancement flaps, switching flaps, rotation flaps and regional flaps [6]. Some of these employed flaps without regard for the facial grooves or landmarks [7]. Some methods required incisions through nerves supplying the orbicularis oris and the flaps used for lower lip reconstruction [6]. Local rotation flaps (e.g. fan flaps) frequently give rise to deformity of the cheeks and the labial commissure in function. In order to overcome these problems reconstruction with adjacent parts of the lower lip using the step technique [8] was employed. In this report, we review critically the results of treatment of 28 patients with vascular lower lip enlargement using the step technique including patient presentation, timing of interference, surgical planning and technique and postoperative results and follow up.

PATIENTS AND METHODS

This study involved 28 patients treated for vascular lower lip enlargement during the period

between February 2003 and February 2005. 18 patients were females and 10 were males. The age range was 3 years-32 years with an average of 7 years. Nowadays, patients with vascular lesions are presenting at an earlier age. Clinically, of the 28 patients with vascular lower lip enlargement, 17 patients had slow venous vascular malformation, 6 patients had port wine (capillary) vascular malformation and 5 patients had involuting hemangioma of the lower lip. There were no cases of arteriovenous malformation in this series. Of our 28 patients, 13 had some form of unsatisfactory treatment before presentation to the plastic surgery service. These included laser (5 port-wine stains) and local corticosteroid injection (5 hemangiomas and 3 venous malformations). The size of the lesions ranged from $1/2$ to $2/3$, or more, of the lower lip. Many lesions extended to adjacent anatomic tissues. One oral commissure was involved, without enlargement of the commissure, in 6 cases with venous malformation. In these 6 patients, the lesions variably involved the tongue, inside of the cheek(s), floor of the mouth, chin and neck. The two oral commissures were involved in two cases with port wine (capillary) vascular malformation without enlargement of the commissures. Functional impairment, including difficulty with eating and drinking, were present in patients (5 venous malformations) where weight of the lesion interfered with oral competence. All patients were operated on using the step technique. Oral function, sensibility and appearance were evaluated. Patients were photographed at rest and while opening the mouth, pouting the lips, blowing up the cheeks and smiling.

Operative Technique: Some authors [8] have elaborated upon the details of the operation, which is similar to what will be described with minor modifications. The operation is performed under general anesthesia. Marking was followed by injection of dilute adrenaline 1: 200,000 and isolation of the area with blocking sutures to minimize bleeding. The lesion is removed in a rectangular fashion. The angles of the mouth are preserved. Reconstruction of the lip is performed with lateral advancement flaps from the remaining parts of the lower lip prepared by step-wise formed skin incisions downwards and laterally. The upper border of the flap is the free vermilion margin. The lower border takes the form of a step-wise formed incisions. The first horizontal incision line is a continuation of the lower border of the excised lesion and is made parallel to the vermilion border and is approximately half the length of the resected part. The first incision is made through the full thickness of the lip, but the other incisions are

made through the skin only. The following steps, usually two to four, are made vertically about 10mm and horizontally about 10mm and follow, but do not cross, the labiomental fold. For each step a very small rectangle of excess skin of the lip is removed to allow advancement of the flaps (Fig. 1). The flaps are then moved horizontally into the defect and the mucosal, muscular and skin layers are sutured in the first step. Only skin is closed in the remaining parts. In paramedian and large defects, asymmetrical bilateral flaps are used with fewer flap steps in the lateral flap. In a defect near the angle of the mouth, a single medially based flap is used. Excised lesions were sent for histopathological examination.

Intralesional Ligatures: Large buried polyglactin ligatures were applied to control the prominent parts of intraoral venous malformation outside the lip in 6 cases. These mainly included the lower surface and left side of the tongue and the inside of the left cheek. In one of these patients, a small (0.5cm) saccular venous malformation adjacent to the left commissure was controlled with intralesional ligation, not resection, to preserve the commissure.

RESULTS

Follow-up ranged from 12-24 months. Healing was uneventful without necrosis or infection except for a superficial dehiscence of the vermilion border that healed with conservative treatment in one patient and a hypertrophic scar that softened during the follow up in another patient (Figs. 2-5). Muscle function returned immediately after disappearance of edema. The ability to pout against resistance as in playing wind instruments, indicating retained orbicularis function, was not disturbed. The lower lip was in normal balance with intact commissures and adequate buccal sulcus in all cases. No drooling was observed or reported, and the nasolabial and labiomental folds were preserved. Lip movements including opening the mouth, pouting the lips, blowing up the cheeks and other movements were restored to normal. After larger defects the lip was tight immediately after surgery but stretched with time. The slight concavity below the vermilion of the lower lip was reproduced in all cases except in one with port-wine stain (Fig. 5). The slight reduction of sensation observed in the flaps improved with time and at one-year follow-up was comparable to the unoperated upper lip. Scars were noticeable but discrete with the majority becoming inconspicuous, 6-12 months after surgery. Lip aesthetics were excellent and the psychological burden was relieved.

The protruding parts of intraoral venous malformations outside the lip were controlled with intralesional ligation and there was no need for further interference thereafter during the follow-up period. The bluish discoloration, however, persisted (Figs. 2,3). One patient had a small 0.5cm saccular venous malformation appearing, at three-month follow up, in the vicinity of the angle of the mouth. The lesion at that site was not excised at the time of the original operation. It was controlled with intralesional ligation to preserve the angle of the mouth. Once again the saccular lesion was controlled with subcutaneous polygalactin ligatures under local anesthesia (Fig. 2). Other asymptomatic parts of venous malformation, which were present under the chin and in the neck region, showed as bluish discoloration of the skin and filled out on dependency and as such, were of no concern to the patients.

Histological results were available for 24 patients: 14 venous malformations, 6 port-wine (capillary) malformations and 4 hemangiomas. These coincided with the clinical diagnoses. Histological examination of venous malformations revealed a non-circumscribed lesion consisting of several thick-walled vascular channels lined by a single layer of quiescent flat endothelial cells with no evidence of proliferation (Fig. 3). Hemangiomas revealed atrophic epidermis with infiltration of the underlying dermis with lobulated tumor tissue formed of capillary-sized blood spaces lined by plump endothelial cells. Some of the capillaries were immature and solid (Fig. 4). Only one hemangioma was of the mixed capillary-cavernous type with a cavernous component. Port-wine stains revealed large ectatic vessels, lined by flat endothelial cells, located in the reticular dermis.

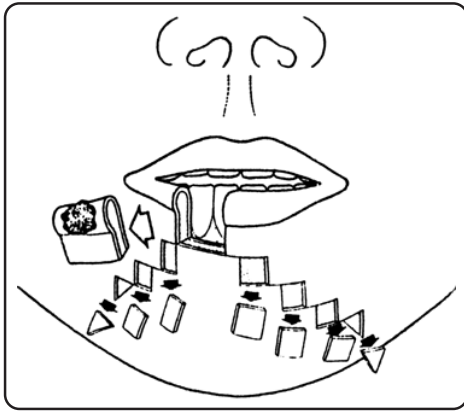


Fig. (1-A): Illustration of the step technique with bilateral flaps. Full thickness incisions are only made in the rectangle including the vascular lesion and the first horizontal incision line.



Fig. (1-B): The flaps are moved horizontally into the defect. For each step a very small rectangle of excess skin of the lip is removed to allow advancement of the flaps.

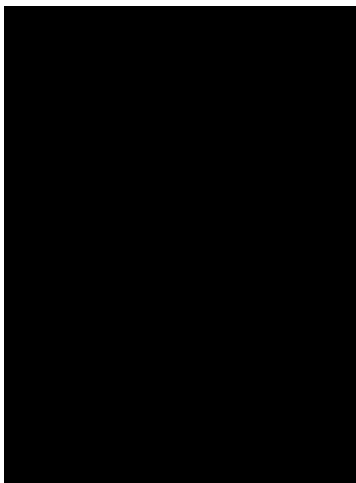


Fig. (2-A): 32-year-old female with venous malformation of the lower lip. Lesions involving the left side of the tongue and the inside of the left cheek were controlled with intralesional ligatures.

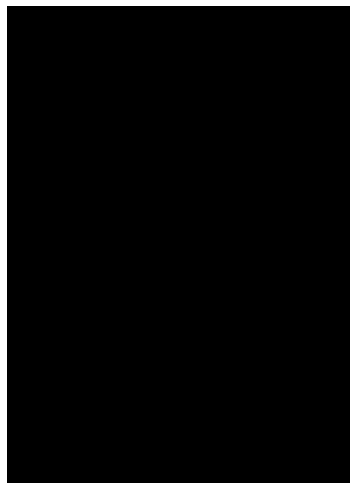


Fig. (2-B): Design of asymmetrical bilateral step flaps. A small lesion adjacent to the left oral commissure was controlled with intralesional ligatures to preserve the commissure.



Fig. (2-C): Follow up, 3 months after healing. A recurrent small lesion adjacent to the left oral commissure was controlled with intralesional ligatures.

Fig. (2-E): With the mouth wide open.

Fig. (3-A): 5-year-old female child with venous vascular malformation of middle $\frac{2}{3}$ of the lower lip.

Fig. (3-B): Design of symmetrical bilateral step flaps.

Fig. (3-C): 10-month-follow-up. Hypertrophic scar softened with appropriate treatment.

Fig. (3-D): 18-month-follow-up. Inconspicuous scar, satisfactory cosmetic result.

Fig. (3-E): Thick-walled vascular channels lined by a single layer of quiescent flat endothelial cells with no evidence of proliferation. The picture is consistent with venous malformation (Hematoxylin and eosin x 100 above and x 400 below).

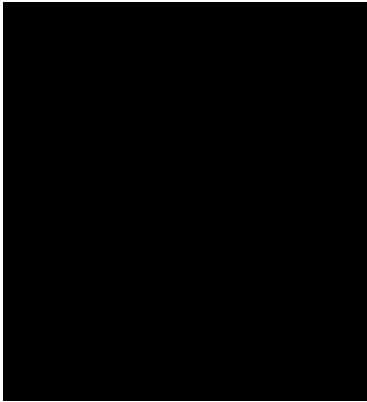


Fig. (4-A): 4-year-old child with incompletely involuted hemangioma of the lower lip.

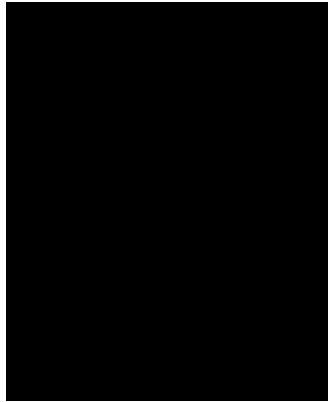


Fig. (4-B): Design of the step flaps.



Fig. (4-C): Hemangioma involving more than half of the oral side of the lower lip. The area is isolated with blocking sutures to control bleeding during excision of the lesion.

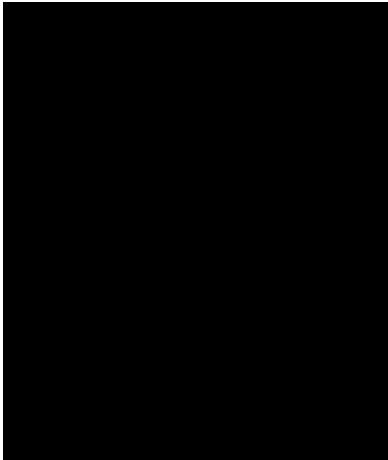


Fig. (4-D): One-year follow up. Inconspicuous scar, good lip aesthetics and satisfactory oral opening with good muscular balance.

Fig. (4-E): Lobulated tumor tissue formed of capillary-sized blood spaces lined by plump endothelial cells with large nuclei indicating endothelial proliferation. The picture is consistent with hemangioma (Hematoxylin and eosin, x 100 above and x 400 below).

Fig. (5-A): 16-year-old male with port wine (capillary) vascular malformation of right $\frac{2}{3}$ of the lower lip. The oral commissures were involved without enlargement.

Fig. (5-B): Lateral view.

Fig. (5-C): Design of the step flaps.

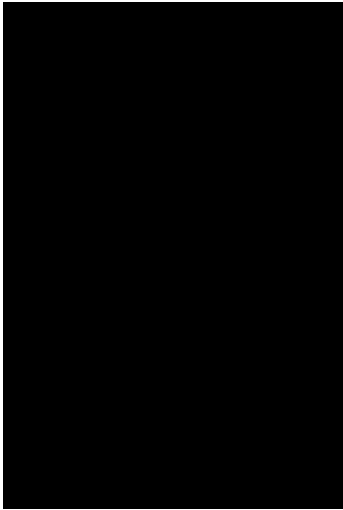


Fig. (5-D): 2-year follow-up, at rest. Scars are hardly noticeable and the nasolabial and mentolabial folds are preserved.

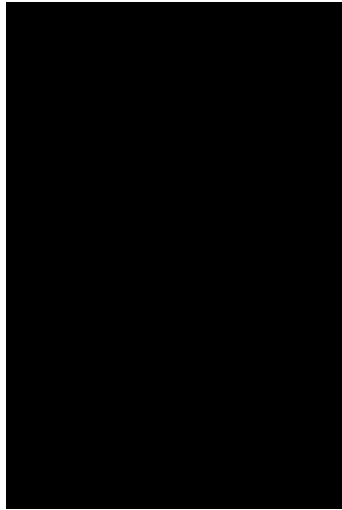


Fig. (5-E): With the mouth wide open.

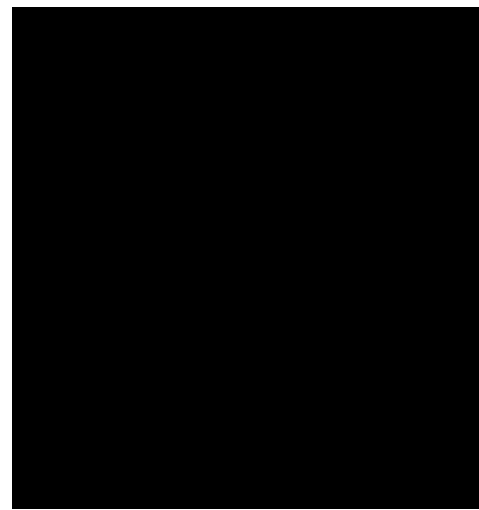


Fig. (5-F): Pouting the lips. The slight concavity below the vermilion of the lower lip was not completely restored due to the nature of involvement of the surrounding skin.

DISCUSSION

Vascular enlargement of the lower lip may be due to hemangiomas or vascular malformation. Because of their complexity and variability, it is important to accurately diagnose, classify and predict the natural history of the lesion to prepare the family for the specific treatments available and the reasonable expectations [9].

Hemangiomas are immature rests of vasoformative tissue that demonstrate angioplastic proliferation and regression [10]. They develop in up to 10% of newborns by age 1. The typical course of a hemangioma involves a period of rapid expansion followed by a prolonged period of regression [11]. Because of this natural course of regression, if and when to treat remains controversial. Excessive bleeding is infrequent. The highest risk appears to be with involvement of the nasal tip, lips, and ears. Lesions of the mucous membranes of the lip were found to regress less completely than elsewhere in the body. Plastic surgeons are often asked to intervene not only when hemangiomas cause life-threatening conditions but also for cosmetic concerns [12,13]. More recently there has been a thrust for early operative intervention for lesions that will leave negative stigmata. Thus by the age of 4 years, the lesion should be under control to allow the child to go to school without teasing [2].

Vascular malformations arise from sporadic inborn errors of vascular morphogenesis with normal endothelial cycle. Unlike hemangiomas,

they are often present at birth, grow commensurately with the child, and rarely regress. Hence, delay of treatment is not recommended. They may be divided, according to channel morphology and rheology, into two groups; low-flow and high-flow vascular malformations [3,14]. Port-wine stains and venous vascular malformations are low-flow vascular malformations [15].

Port wine (capillary) vascular malformation (found in 0.3 to 0.5% of neonates) manifests initially as a flat lesion with a red to pink hue that may lighten during the first year but then tends to darken throughout life, turning a deeper shade of red or blue and may even become thicker or more nodular as the individual matures [16]. Use of laser to diminish the discoloration has produced good results in some cases [4]. However, laser treatment does little to correct three-dimensional tissue deformities such as macrochelia, which must be addressed surgically [17].

Venous malformations are soft, bluish with no arterio-venous fistulas. They do not involute and may, rather, get worse with age. Long-term deformity can cause depression and feeling of isolation [18]. In spite of this fact, many patients in this series reached adulthood without an attempt to excise the lesion. A note also made in other reports [19]. The large number of venous lesions in this series does not reflect its true incidence. It may, rather, reveal a reluctance to interfere at an early age. Enlargement of the lesion tends to be more evident at the vermilion border and intraorally on

the mucosal side. The mucosa offers little resistance to, and becomes ballooned with, the lesion. The treatment options [5] include pulsed dye laser, sclerotherapy, percutaneous embolisation with fibrin glue and surgery [14,20].

In this series, vascular lesions of the lip were large and many patients had some form of unsatisfactory nonoperative treatment before presentation. Surgical excision and reconstruction was considered. Excision was always feared with horrific bleeding. This may have some merit especially in arteriovenous vascular malformations. In this series measures were taken to control bleeding during the procedure. Intraoperative tumescent injection and blocking sutures through the full thickness of the soft tissues surrounding the operative area help control bleeding during resection of the vascular lesion and reconstruction of the lip (Fig. 4). Non-crushing clamps positioned at the angle of the mouth may also make bleeding controllable. There were no instances of intra operative excessive bleeding in this series.

Intralesional absorbable ligatures, for intraoral extensions of venous lesions in this series, work by obliterating the vascular spaces and by virtue of initiating coagulation and then fibrinous adhesion. No sclerosing agent was used. This minimally invasive procedure is enough to tide the patient over a lifetime. Protruding parts of the lesion, which encroach to some extent, on the oral cavity and are as equally disfiguring can thus be controlled. Macroglossia in a female child was likewise managed with ligatures pending an excisional procedure. This proved unnecessary during the follow-up. Absence of arteriovenous fistulas makes it possible to control venous malformations with intralesional ligatures. This is not the case with arteriovenous malformations where recurrence can be rapid when invisible microfistulae become recruited [18]. In one series, transfixion technique was used in treatment of vascular anomalies of the oral cavity. It consists of interlacing polyglycolic acid suture a number of times until the vascular anomaly becomes bloodless [21]. In another one, compartmentalization was used to treat massive vascular malformations. Large non-absorbable sutures divided the lesion into multiple compartments to provide a more effective environment for the sclerosant [22].

The lips have an important functional and aesthetic role. In surgery of the lips, noticeable scars, evident mouth deformity, a distorted commissure, and too small a mouth opening (microstomia) are short of satisfactory. The best tissue for the lip

reconstruction is the lip, preferably the same lip [23]. The procedure reported here uses the remaining lip for this purpose. The step technique is recommended for reconstruction of up to two-thirds, or more, of the lower lip. Narrowing of the aperture of the mouth has only been a temporary problem, since the elasticity of the oral tissues has led to rapid readjustment. The steps at the lower border of the flaps follow the labiomenthal fold and rest on the firm mental protuberance. The scars are quite inconspicuous, as they follow the natural lines. The nasolabial and labiomenthal folds are disturbed when other local flaps are used [7,24].

The satisfactory functional results are attributable to the fact that the lower lip is repaired with the same type of tissue, the oral commissure is preserved and the motor nerves are undamaged. The flaps are advanced in the direction of the muscle fibers and the anatomical topography of the lip components remains unaltered. The blood supply and motor innervation are preserved in the wide pedicle of the step flap. Another advantage is that the corner of the mouth is left intact which preserves the insertion of the buccinator muscle and several small superficial mimic muscles (zygomaticus, risorius, depressor anguli oris). These muscles are important for the function of the cheek and the oral commissure, and if their alignment is altered, for example when fan flaps are used, the facial expressions and the personality of the face are changed [25,26]. In cases with asymptomatic extension of venous malformations outside the lip, raising flaps from these areas (e.g. cheeks) may make bleeding a nuisance. In the present technique, dissection is limited to the lip and no need for local flaps from adjacent involved cheeks. The muscles, which are transected, are mainly the orbicularis oris and the depressor labii inferior. This way of lower lip reconstruction using the remaining parts of the lower lip helps regain the continuity of the orbicularis oris and hence, its function. Step flaps were used in other series with good results [27,28]. The slight concavity below the vermilion of the lower lip was reproduced in all cases except in one with port-wine stain, which may be due to the nature of skin involvement in these cases. In this paper minor modifications were added. The steps were made equal (10mm) both vertically and horizontally to facilitate the procedure. In the original technique the steps were made 8mm vertically and 10mm horizontally [8]. For each step a very small rectangle (< 10mm horizontally) of excess skin was removed to allow advancement of the flaps. This even decreased with the following steps down the labiomenthal fold. Enough tissue is removed

with the vascular lesion; therefore, we should try to avoid removing more tissue for technical reasons.

Hemangiomas of the lower lip do not involute completely and vascular malformations may even get worse with age, so early treatment before school age is recommended. The ability of the of the lower lip tissues to expand enables reconstruction of large defects of the lower lip, from the remaining parts, using the step technique, without affecting its function. The lower lip is repaired with the same type of tissue and the motor nerves are not damaged. Advantages also include symmetrical, mobile, oral sphincter with intact commissures, adequate buccal sulcus, no symptomatic microstomia and normal sensation. The technique is simple, safe and flexible. The nasolabial and mentolabial folds are preserved with excellent aesthetic results. Some patients with vascular lower lip enlargement avoid or delay surgical treatment due to apprehension or fear of a permanent deformity. With this technique of lower lip reconstruction we can offer superior functional and aesthetic results to other flap methods. Early surgical treatment and reconstruction with the step flaps offers much to many of these patients and relieves the psychological burden of the child and family.

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