IMPORTANT INFANTILE HEMANGIOMAS (IHs) ARE THE MOST COMMON TUMORS OF INFANCY.

OBJECTIVES TO DESCRIBE THE PATTERNS OF OCCURRENCE OF LIP IHs AND CORRELATE THESE FINDINGS WITH PATTERNS OF ANATOMICAL DISTORTION AND PREDICTABLE CLINICAL OUTCOMES AND TO DESCRIBE THE SURGICAL MANAGEMENT OF THESE LESIONS.


SETTING TERTIARY CARE HOSPITAL AND PRACTICE SPECIALIZING IN THE CARE OF CONGENITAL PEDIATRIC VASCULAR ANOMALIES OF THE HEAD AND NECK.

PARTICIPANTS THREE HUNDRED FORTY-TWO PATIENTS WITH 360 IHs.

RESULTS A TOTAL OF 1916 IHs WERE DIAGNOSED. OF THESE, LIP IHs WERE FOUND IN 342 PATIENTS. WE REVIEWED THOSE PATIENTS’ MEDICAL RECORDS. OF THE LESIONS, 59.2% WERE FOCAL AND 40.8% WERE SEGMENTAL. A NONRANDOM DISTRIBUTION OF LIP IHs WAS FOUND. THE MOST COMMON FOCAL LESION OCCURRED AT THE LOWER LIP (98 OF 213 LESIONS [46.0%]). THE MOST COMMON SEGMENTAL LESION INVOLVED THE MANDIBULAR SEGMENT (75 OF 147 [51.0%]). OF THE 75 PATIENTS, 30 (40.0%) HAD AIRWAY INVOLVEMENT. THE MOST COMMON ANATOMICAL DISTORTIONS OF THE LIP INVOLVED THE VERRUCOCUTANEOUS JUNCTION IN 216 (61.5%). HORIZONTAL AND VERTICAL LENGTHENING OF THE LIP WAS EVIDENT IN 28.7% AND 31.0% OF PATIENTS, RESPECTIVELY. ULERATION AND SCARRING WERE COMMON FINDINGS IN 137 PATIENTS OVERALL (38.1%), WITH SEGMENTAL MANDIBULAR IHs ASSOCIATED WITH THE HIGHEST PERCENTAGE (46 OF 137 [33.6%]), FOLLOWED BY FOCAL IHs OF THE LOWER LIP (35 OF 137 [25.5%]). USING PREVIOUSLY DESCRIBED SURGICAL PROCEDURES, WE DEVELOPED A PROBLEM-ORIENTED SOLUTION FOR EACH OF THESE ZONES.

CONCLUSIONS AND RELEVANCE THE NONRANDOM DISTRIBUTION OF FACIAL HEMANGIOMAS HAS BEEN DOCUMENTED WITH FOCAL AND SEGMENTAL PATTERNS OF GROWTH. DISTINCT ANATOMICAL PATTERNS OF OCCURRENCE FOR LIP IHs ARE DESCRIBED. THE DISTRIBUTION SEEMS TO BE RELATED TO THE EMBRYOLOGIC DEVELOPMENT OF THE UPPER AND LOWER LIPS. THESE ANATOMICAL PATTERNS ALLOW FOR THE PREDICTION OF ANATOMICAL LOCATION, STRUCTURAL DISTORTION, AND POSSIBLE CLINICAL OUTCOMES. THIS INFORMATION IS RELEVANT WHEN PLANNING MEDICAL AND SURGICAL TREATMENT FOR THESE CHILDREN.

LEVEL OF EVIDENCE NA.
Infantile hemangiomas (IHs) or hemangiomas of infancy are the most common tumors of infancy, with 65% involving the head and neck.\(^1\)\(^2\) The nonrandom distribution of facial IHs has been previously documented.\(^3\) Facial IHs are noted to occur at certain sites more commonly than other sites, showing a predilection for regions of embryologic fusion. In this study, we focus on lip IHs and examine patterns of occurrence, lesion characteristics, complicating functional and aesthetic factors, and associated airway lesions in an effort to better understand the origin and natural history of these lesions. We then describe the surgical management of these lesions.

**Methods**

A retrospective medical record review of 342 patients with documented lip IH during an 8-year period was performed. A total of 1916 records of patients with IH were available. Of these records, 342 met the criteria for inclusion in this study: (1) the patient was evaluated by the senior clinician (M.W.), (2) the patient was diagnosed as having a lip IH, and (3) representative photographs were available for review. The diagnosis of IH was made on a clinical basis and confirmed by pathology reports.

The location of each IH was determined from clinical photographs and detailed clinic notes and drawings. The locations were then mapped on a schematic diagram of the lip by 1 author (C.S.-P. or M.T.), then verified for accuracy by independent analysis by the other 2 authors (T.M.O. and M.W.). The lesions were classified as focal or segmental lesions by independent analysis performed by each author. In all but one case, there was no question of the distribution of the lesion. The focal IHs were mapped on the facial schematic (Figure 1) and assigned a number based on the position of the lesion. For those lesions encompassing more than one adjacent site (which was the case for one patient), each of the adjacent focal sites was mapped and computed independently. The computations involved the incidence of lesions found to be at the same number. Segmental lesions were mapped and computed similarly, also noting whether they were unilateral or bilateral. The incidence of scarring and ulceration, airway obstruction, and associated cardiac anomalies were computed. The patient’s skin tone was noted.

Each patient’s treatment course was noted. Medical therapy included corticosteroids, vincristine sulfate, or propranolol hydrochloride. Patients who received interferon had been treated before presentation to our practice. In 2008, a new medical treatment for IHs became known.\(^4\) Since then, propranolol, a nonselective \(\beta\)-blocker, has replaced corticosteroids for the first-line medical therapy of hemangiomas by our group and worldwide. Regarding surgery, the surgical procedures for each location and IH type were noted. The most representative cases for each location were chosen for the surgical examples. Treatment also included laser therapy. The pulsed dye laser (PDL; 585-595 nm) was used as primary therapy in some superficial focal lesions and adjuvant treatment for compound focal lesions that required a staged approach. The PDL was also used in combination with corticosteroids, propranolol, or surgery in segmental IH. The following standard PDL settings for a Candela (Candela VBeam) laser were used: wavelength, 585 nm; pulse width, 1.5 ms; spot size, 7 mm; fluence, 12 J/cm\(^2\); and dynamic cooling, 40/30. When serial treatment was required, the treatments were spaced 4 to 6 weeks apart. Laser skin resurfacing was also used for atrophic scarring left by the IH. The carbon dioxide laser with a computer pattern generator was used (Lumenis, Inc) at a standard setting as follows: fluence, 100 mJ; frequency, 75 Hz; and computer pattern generator, 2-5-2 or 3-5-2.

**Results**

Between January 1, 2004, and December 31, 2011, there were a total of 1916 IHs diagnosed. The medical records of 342 patients with lip IH were reviewed.

A total of 360 lesions were mapped for the 342 patients included in this study. Two distinct patterns of tissue involvement, focal and segmental, were evident, consistent with the findings of a previously documented mapping of facial IHs.\(^3\)

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**Figure 1. Facial Schematic Showing the Location of Focal Lip Infantile Hemangiomas**

A, Lip schematic. B, Focal map showing positions of the lesions (1-4). C, Segmental map. FN indicates frontonasal; \(V_2\), maxillary; and \(V_3\), mandibular.
A total of 213 patients (62.3%) had focal lesions, whereas 129 patients (37.7%) were found to have a total of 147 segmental lesions.

The female-male ratio for the overall study group was 4:1. This ratio was 3:1 in patients with focal IH and 6:6:1 in patients with segmental lesions. Age at presentation ranged from birth to 8 years.

Patients’ skin types were noted. Of 285 patients, 247 patients (86.1%) were fair skinned, 29 (9.5%) were olive skinned, and 9 patients (2.95%) were dark skinned.

Of the focal lesions, 4 anatomical locations, designated as positions 1 through 4, were noted. Position 1 lesions are centered around the pillar of the philtrum. Expansion of these focal IHs distorted the philtrum and increased the vertical height of the ipsilateral hemilip. As a consequence, the vermilionocutaneous junction (VCJ) was displaced. Position 2 lesions are located in the subcutaneous tissue of the hemilip between the pillar of the philtrum and the lateral commissure. Expansion of these lesions increased the horizontal dimension of the ipsilateral hemilip. The vertical height was also increased, and the VCJ was inverted. These lesions extended to and frequently through the orbicularis oris muscle. Position 3 lesions are located in the subcutaneous tissues above and lateral to the commissure. Expansion of these lesions lengthens the lower hemilip and consequently extends to the midline and may appear to extend beyond. Growth of these lesions lengthens the lower hemilip and everts the VCJ. As indicated in Table 1 and Figure 2, the most common focal lesion sites were the lower lip (position 4) followed by the philtrum (position 1).

Segmental lesions involved the various facial segments or placodes. Involvement of the segment was either confluent or nonconfluent. The most common segmental lesions involved the mandibular (V₃) segment. In this group, there were 63 patients with unilateral and/or bilateral V₃ lesions (48.8% of all patients with segmental lesions). Twelve patients (9.3%) showed combined lesions of more than 1 segment with V₃ segmental involvement. Overall, there were 75 V₃ segmental lesions of 147 total lesions (51.0%). The maxillary (V₂) division was the second most common segment, with 28 patients with unilateral and/or bilateral V₂ lesions (21.7% of all patients with segmental lesions). Eleven patients (8.5%) showed combined lesions of more than 1 segment with the V₂ segment involved.

Thus, a total of 39 V₂ lesions (26.5%) of 147 lesions were noted. The frontonasal was the third most common segment, with 24 (18.6%) of 129 patients. Nine patients (7.0%) were noted to have combined lesions of more than 1 segment and the frontonasal segment involved. Thus, a total of 33 frontonasal lesions of all lesions were noted (22.5%) (Table 2 and Figure 2). These results are again consistent with the findings of previous studies.³ Lesions involving the V₃ segment have been noted to be associated with upper airway obstruction.² Our study confirmed this observation. Overall, 30 patients had airway involvement, all with cutaneous segmental lesions. Ten patients had subglottic involvement; of these, 4 patients also had tracheal involvement. Twenty-four of 30 patients were diagnosed as having V₃ lesions. Five patients had V₂ lesions and additional frontonal or V₂ segment involvement. One patient had a V₃ lesion.

One patient had V₃ and unilateral V₁ (ophthalmic segment) lesions with tracheal and laryngeal involvement. Another patient had V₃ and V₂ lesions with subglottic involvement. Of 2 patients with segmental IH of the hemiface (all 3 segments involved), 1 patient had tracheal IH. Two patients with V₂ lesions and bilateral parotid involvement had subglottic IHs. Ten patients required tracheotomies. Four of these patients have been decannulated. As previously published, airway lesions were not seen with focal lesions.³ The pattern of airway involvement was also segmental.⁵

Six patients with V₃ lesions and 1 patient with a V₂ lesion also had PHACES syndrome (posterior fossa, hemangioma, arterial lesions, cardiac abnormalities/aortic coarctation, eye abnormalities, and sternal defects). Other cardiovascular anomalies were also associated with segmental lesions: 1 patient with the frontonasal pattern had an asymptomatic small patent ductus arteriosus, and 2 patients with the frontonasal pattern also had aorta malformation. Two patients with a segmental V₃ lesion had a ventriculo septal defect, and 3 patients had a focal lesion. One patient with a V₃ segmental lesion showed signs of an enlarged heart, 2 patients with V₂ lesions were diagnosed as having cardiomegaly, and 2 patients with segmental

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**Table 1. Focal Lip Lesions of the Patients**

<table>
<thead>
<tr>
<th>Site No.</th>
<th>Lesions, No. (%)</th>
<th>Ulcerated Lesions, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50 (23.5)</td>
<td>13 (21.0)</td>
</tr>
<tr>
<td>2</td>
<td>28 (13.1)</td>
<td>5 (8.1)</td>
</tr>
<tr>
<td>3</td>
<td>37 (17.4)</td>
<td>9 (14.5)</td>
</tr>
<tr>
<td>4</td>
<td>98 (46.0)</td>
<td>35 (56.5)</td>
</tr>
</tbody>
</table>

* The sites are as follows: 1 indicates the pillar of the philtrum; 2, the subcutaneous tissue of the hemilip between the pillar of the philtrum and the lateral commissure; 3, the subcutaneous tissues above and lateral to the commissure; and 4, the lower lip, lateral to the midline. For a more detailed description, see the Results section.
lesions had congestive heart failure. Two patients (1 with V₂ IH and 1 with V₃ segmental IH) were also diagnosed as having Dandy-Walker malformation.

The normal boundaries of facial subunits and lip geography were analyzed for anatomical distortion from the lip IH. These analyses were based on clinical photographs and medical records and further confirmed by the primary surgeon (M.W.).

Each lesion was analyzed for its effect on the VCJ, extension to the commissure, nasolabial fold, philtrum, mentalab crease, and intraoral extent. Inversion or eversion of the lip and consequent vertical or horizontal lengthening, thickness, or scarring and ulceration were noted. The lesion extended to the VCJ in 183 patients (53.5%), to the commissure in 10 patients (2.9%), to both the VCJ and the commissure in 33 patients (9.6%), to the nasolabial fold in 49 patients (14.3%), to the philtrum in 83 patients (24.2%), to the mentalab crease in 58 patients (17.0%), and to the nose in 31 patients (9.1%). Sixty-six patients (19.3%) had intraoral extension, 19 had lip inversion (5.6%), and 31 (9.1%) had lip eversion. Ninety-eight (28.7%) had a horizontal lengthening, with 106 (31.0%) having vertical lengthening. Fifty-four (15.8%) of these had both horizontal and vertical lengthening.

A total of 137 (38.1%) focal and segmental lesions developed ulceration and subsequent scarring. Sixty-two (29.1%) of the 213 focal lesions, affecting 62 patients, were ulcerated. Of the focal ulcerated lesions, position 4 or the lower lip was the most common, occurring in 35 (56.5%) of 62 patients, and position 1 or the upper lip was the second most common, occurring in 13 (21.0%) of 62 patients. Ulceration was much more common in patients with segmental lesions (75 of 147 total segmental lesions [51.0%]). The V₃ distribution was again the most common segment to be involved, with 46 (61.3%) of the 75 ulcerated segmental lesions or 46 (33.6%) of the 137 total ulcerated lesions (Table 2).

Discussion

Lip IHs can be classified into focal and segmental patterns of tissue involvement. Focal lesions grow as tumorlike IHs, whereas segmental IHs tend to involve entire embryologic segments and grow as diffuse plaquelike lesions. For focal lesions, we have documented 4 distinct sites of occurrence. Segmental lesions occur in 3 distinct zones. The significance of our findings is that they further support a hypothesis that there are sites of predilection for IHs and that these sites seem to correlate with the embryologic development of the lip.

The basic structure of the face is formed between the 4th and 10th weeks of embryologic development; 5 mesenchymal prominences appear, including the midline frontonasal process and the paired V₂ and V₃ prominences. The V₃ swellings enlarge and grow ventrally and medially. The frontonasal process grows caudally and forms the intermaxillary process. The tips of the V₂ processes then fuse with the intermaxillary process, giving rise to the philtrum. The remainder of the upper lip is formed by the paired V₂ prominences.

The V₃ swellings, although in continuum, appear to have a slight groove or depression in the midline. The V₃ prominences then fuse in the midline to form the lower lip and mandible. During the fourth and fifth weeks, mesenchymal tissue proliferates into the midline groove between the growth centers and forms the primordium of the lower lip. The commissures of the lips and width of the mouth are finally formed when the lateral V₂ and V₃ prominences fuse.⁷

New evidence shows that IHs are benign stem cell tumors.⁸,⁹ What differentiates focal from segmental lesions, however, is unknown. Our data support the hypothesis that focal IHs seem to occur along embryologic lines of fusion: a focal IH in position 1 (Figure 1B) occurs along the line of fusion between the frontonasal placode and the anterior projection of the V₂ placode. A focal IH in position 3 occurs along the line of fusion between the V₂ and V₃ placodes and involves the distal edge of the V₂ placode. A focal IH in position 4 occurs along the line of fusion between the V₂ and V₃ placodes but involves the V₂ placode. The position of a focal IH involving position 2 occurs along the lower border of the V₂ placode (Figure 1).

The areas of involvement of segmental IHs also correlate with the facial placodes. Within these sites of distribution, involvement may be confluent or nonconfluent with skip areas. Although segmental IHs seem to be histologically identical to focal IHs, they are clinically much more aggressive and locally destructive. Recent evidence suggests that they grow for longer periods. This finding implies that a different origin for these lesions should be sought. In addition, given the association between segmental V₃ IH and airway lesions (30 [40%] of 75 patients with segmental IHs), all patients presenting with segmental V₃ lesions should be evaluated with direct laryngoscopy and bronchoscopy for airway involvement.³

Management of Lip IHs

Overall, IHs in the oral area should be monitored carefully. They often impede function (speech and feeding) and lead to aesthetic deformity. More important, there is a high incidence of ulceration. When this occurs, treatment should be swift because the ulcers can be painful, bleed, and be a site of infection. Traditionally, corticosteroids were the medical standard of care, but these have been replaced with nonselective β-blockers, most commonly propranolol.⁴ There is ongoing research studying selective β₁-blockers, such as atenolol.¹⁰,¹¹ In addition, topical formulations, such as timolol gel at various concentrations, are used for more superficial IHs.¹² However, corticosteroids still have a role when there is airway involve-

Table 2. Segmental Lip Lesions of the Patients

<table>
<thead>
<tr>
<th>Site</th>
<th>Lesions, No. (%) (n = 147)</th>
<th>Ulcerated Lesions, No. (%) (n = 82)</th>
</tr>
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<tbody>
<tr>
<td>Frontonasal</td>
<td>33 (22.4)</td>
<td>14 (17.1)</td>
</tr>
<tr>
<td>Maxillary</td>
<td>39 (26.5)</td>
<td>15 (18.3)</td>
</tr>
<tr>
<td>Mandibular</td>
<td>75 (51.0)</td>
<td>46 (56.1)</td>
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ment. Data included in this article extended from January 1, 2004, through December 31, 2011. Medical therapy before 2008 consisted of corticosteroids, whereas starting in 2008, our group transitioned to propranolol as the first-line medication.

Propranolol is a well-tolerated and useful medication that may shrink the IH or keep it from rapidly proliferating. However, our experience with focal IHs shows that in some cases a residual mass remains. We describe a surgical approach to the various types of focal and segmental lip IHs.

Regarding surgical treatment of these lesions, PDL (595 nm) may be used for superficial skin staining and to prepare the skin flap for surgical excision. When treated early, segmental lesions in particular respond well to a combination of propranolol and PDL.

Traditional surgical procedures for lip reconstruction have been developed for malignant lesions: cross-lip flaps (Abbé–Estlander flap), nasolabial flaps, oral circumference advancement flaps, free flaps, and perialar cheek or alar crescent flaps. The IHs are benign tumors whose growth causes tissue expansion. Many of these traditional procedures for lip reconstruction are not necessary or require modification for lip IHs.

Focal Lesions
By virtue of its location, the anatomical distortion caused by an IH can be predicted. With this in mind, we can then begin to develop surgical procedures to correct these problems.

Focal Upper Lip IHs (Position 1)
Lesions centered around the lateral pillar of the philtrum (site 1) frequently distort the philtrum and increase the vertical height of the upper lip (Figure 3 and Figure 4). These lesions will also increase the horizontal dimension of the involved hemilip. We typically use an incision that extends from the alar groove to the crease below the nasal sill and turns abruptly inferior at the lateral pillar of the philtrum, down to the VCJ, and then onto the vermilion. This modified alar crescent flap is based on the boundaries of the facial subunits, allowing for resection of the lesion and repositioning of the vertical and horizontal dimensions of the lip. A second incision parallels this but is situated laterally and inferiorly, depending on how much upper lip needs to be resected (Figure 4F ). The incision is carried through the epidermis and dermis. The IH tissue is usually encountered immediately in the dermal plane. Sharp dissection is used to raise a flap laterally. When the IH is superficial, some IH tissue may be left in this flap. As dissection proceeds laterally, the periphery of the IH will be more clearly defined. At this point, monopolar cautery (fine Colorado tip) is used to dissect around the capsule of the IH in all directions. The depth of the dissection is usually the muscle layer, although at times hemangioma tissue will infiltrate the muscle and periosteum as well. Once the lesion is removed, the flap is redraped toward the boundaries of the subunits and any redundant tissue is excised. A periosteal anchoring suture is placed at the lateral base of the ala to re-create the natural depression and to fixate the tissue in its correct position. The wound is then closed in 2 layers. The goal is to remove as much hemangioma tissue as possible to provide a symmetrical contour. Any remaining hemangioma skin can be treated with a PDL as a follow-up treatment. In addition, if the entire lesion is unable to be removed, a staged second excision can be planned. This maneuver will correct both the vertical height and the horizontal asymmetry. Lesions within the red portion of the lip may be treated with a horizontal incision along the wet-dry margin (Figure 5).

Focal Upper Lip IHs (Position 2)
Lesions involving the midlateral upper lip (site 2) tend to lengthen both the horizontal and vertical dimensions of the hemilip (Figure 6). In addition to this, the VCJ is frequently inverted by the mass. A wedge resection will correct the horizontal asymmetry, and an incision along the VCJ will also provide access to the IH and, at the same time, correct the vertical height (Figure 7). Alternatively, an incision along the wet-dry margin will correct any excess bulk.

Focal Upper Lip IHs (Position 3)
Lesions involving the lateral upper lip and lip corner tend to lengthen the vertical dimension of the hemilip and the thickness of the upper lip (Figure 8). The VCJ can be inverted by the mass. A carefully placed resection will correct the corner asymmetry. Depending on the exact location of the IH, the incision can be made either along the nasolabial fold, which often requires facial nerve monitoring (Figure 9), along the VCJ,
or through the vermilion. The vermilion approach will provide direct access to the IH tissue and leave only minimal scarring along the VCJ.

Focal Lip IHs on the Lower Lip (Position 4)
Lower lip focal IHs (site 4) are the most common focal lesions and tend to involve the lateral aspect of the lower lip (Figure 10). These lesions will frequently lengthen and evert the lower lip. The lip can be lengthened by as much as 50%, depending on the size of the IH. These lesions can almost always be resected via a wedge resection. Because the IH has, in most cases, lengthened the lip, considerably more than the customary 30% of lip can be resected without producing microstomia (Figure 11). The surgeon should use his or her discretion in these cases.

All these incisions are chosen because of their placement along boundaries of facial subunits, their easy access to the lesion, and the ability to remove redundant tissue with acceptable cosmetic results.

Segmental Lesions
Frontonasal Segmental Lip IHs
Frontonasal segmental lesions are the most difficult because they distort the philtrum (Figure 12). The vertical height of the upper lip is usually lengthened. These IHs can be approached via the VCJ and/or the inferior border of the columella and the nasal sill (Figure 13).

V2 Segmental Lip IHs
The V2 segmental lesions elongate the hemilip and invert the VCJ (Figure 14). They are usually approached using a similar incision as for focal upper lip hemangiomas, position 1 lesions along the VCJ that extends up the philtrum and across the nasal sill and ala (Figure 15 and Figure 16).

V3 Segmental Lip IHs
Segmental IHs, on the other hand, pose a different set of problems. The most common segmental IH involves the entire lower lip (V3 segment) (Figure 17). Because ulceration is frequent, the VCJ is usually distorted. Furthermore, the VCJ is often inverted, and the mass tends to obliterate the concavity between the VCJ and the labiomental crease. These lesions also lengthen the lower lip. A wedge resection of the lower lip will correct the horizontal lengthening. An incision along the VCJ will correct the inversion and the convexity below the VCJ (Figure 18). A specially modified suture technique will help to re-create the natural sulcus of the lower lip (Figure 19). An incision is created along the VCJ of the lower lip. A horizontal wedge of excessive tissue is removed with a fine-tip bovie cautery. A subcutaneous flap is elevated to the inferior limits of the mass. An 18-gauge hollow needle is passed anteriorly to posteriorly through all...
Figure 6. Upper Lip Focal Infantile Hemangioma (Position 2)

A through D, Examples. E, Focal pattern.

Figure 7. Upper Lip Focal Infantile Hemangioma (Position 2)

A through F, Surgical approach. A, Initial presentation at age 3 months. B, After pretreatment with 2 corticosteroid injections. (Note that today this patient would have been treated with oral propranolol, which accomplishes a similar effect.) C, Stage 1 surgical excision. The bulk is reduced through an elliptical horizontal incision centered along the wet-dry margin of the upper lip. Although some orbicularis oris muscle is invariably removed, the integrity of the muscle is preserved. Pulse dye laser treatment of the upper lip and the vermillion is performed. D, Stage 2 surgical excision 4 months later. A through-and-through vertical wedge (skin, muscle, and mucosa) excision is performed along with pulsed dye laser. The procedure is followed by fractional carbon dioxide laser treatment of atrophic scarring secondary to hemangioma. F, Postoperative presentation at age 2½ years taken 1 year after surgery. G, Surgical placement of incision to approach upper lip focal hemangioma (position 2).

Figure 8. Upper Lip Focal Infantile Hemangioma (Position 3)

A through D, Examples. E, Focal pattern.
Figure 9. Upper Lip Focal Infantile Hemangioma (Position 3)

A through D, Surgical approach. A, Three-month-old presents after intralesional corticosteroid injection. (Note that today this patient would have been treated with oral propranolol, which accomplishes a similar effect.) Pulsed dye laser treatment is performed at 3, 5, and 7 months of age to prepare the skin flap for surgery. B, Stage 1 surgical excision at age 10 months: direct elliptical excision of right nasolabial-commissure hemangioma with intraoperative facial nerve monitoring. Surgery was followed by suture removal and pulsed dye laser treatment to the right cheek. C, A large intraoral component remained after this surgery, producing a mass effect that displaced the commissure inferiorly and anteriorly. An attempt was made to reduce this effect with an intralesional steroid injection, which unfortunately failed. Pulsed dye laser treatments were performed to reduce the superficial cutaneous component left behind from the resection. D, The patient will undergo further pulsed dye laser treatment and fractional carbon dioxide laser treatment to reduce any residual cutaneous hemangioma and atrophic scarring. E, Surgical incision for focal pattern (position 3).

Figure 10. Lower Lip Focal Infantile Hemangioma (Position 4)

A through E, Examples. F, Focal pattern.

Figure 11. Lower Lip Focal Infantile Hemangioma (Position 4)

A through C, Surgical approach. A, Preoperative photograph: note ulceration of the left lower lip hemangioma. B, Surgical excision was performed at the age of 9.5 months. A wedge incision was made along the outlines of the hemangioma centered to a base just above the labiomental crease. C, Postoperative photograph 7 days after surgery. D, Wedge incision for focal pattern (position 4).
Figure 12. Frontonasal (FN) Segmental Lip Infantile Hemangioma

A through E, Examples. F, Segmental pattern. V2 indicates maxillary; V3 mandibular.

Figure 13. Frontonasal (FN) Segmental Lip Infantile Hemangioma

A through E, Surgical approach. A, A 3-month-old boy presented with an ulcerated, proliferating hemangioma and required a staged surgical approach to treatment. He had been treated with multiple laser treatments and corticosteroid injections. B and C, Surgical excision at 12 months: modified Weber-Ferguson excision of upper lip and paranasal hemangioma. D, Patient at 13 months. Further pulsed dye laser is performed. E, Patient at 2 years. Two-stage surgical excisions were performed (1) excision of nasal tip hemangioma and (2) perialar wedge excision to elevate the upper lip and vermillion wedge excision of the upper lip. F, Surgical incisions for segmental pattern (FN).

Figure 14. Maxillary (V2) Segmental Lip Infantile Hemangioma

A through E, Examples. F, Segmental pattern (V2, maxillary). FN indicates frontonasal; V3, mandibular.
A through E. Surgical approach (example 1). A, Preinterventional state. Note the right paranasal V2 segmental hemangioma involving the right paranasal area, the dorsum of the nose, and the upper lip. B, First surgical intervention: pulsed dye laser treatments to the right paranasal and upper lip segmental hemangioma at the age of 12, 13, and 14 months. C, Second surgical intervention: excision of right upper lip hemangioma. A horizontal wedge incision was made along the wet-dry margin of the right upper lip. Surgery was directly followed by pulsed dye laser to the right paranasal hemangioma. D, Postoperative presentation. The patient will need pulsed dye laser treatment and fractionated laser treatment for the scarring. E, Presentation after the third surgery in which the following was performed: excision of residual hemangioma of paranasal area, cheek advancement and correction of upper lip dimensions, and pulsed dye laser fractionated carbon dioxide laser treatment to right paranasal area. F, Placement of incisions for segmental pattern (V2, maxillary).

A through C. Surgical approach (example 2). A, Patient presents with a history of left upper lip and paranasal segmental infantile hemangioma. There is asymmetry in the face and cutaneous staining in the left paranasal area. The left upper lip is inferiorly displaced and elongated. There is some mucosal staining with the hemangioma and scarring (from ulceration) along the left nasolabial line with distortion of the corner of the mouth. B, Patient had undergone surgery with debulking of hemangioma tissue along the left hemilip and left lateral philtrum and laser treatment in the past. C, Postoperative stage 2 ½ weeks after surgery. The left upper lip area shows decreased bulkiness and symmetry. Carbon dioxide fractional laser treatment of the nasolabial scarring area will be performed.
Figure 17. Mandibular (V₃) Segmental Lip Infantile Hemangioma

A through H, Examples. I, Segmental pattern (V₃, mandibular). FN indicates frontonasal; V₂, maxillary.

Figure 18. Lower Lip Mandibular (V₃) Segmental Infantile Hemangioma

A through D, Surgical approach. A, Clinical presentation at age 6.5 months. B, The patient had undergone several pulsed dye laser treatments between the ages of 7 and 9 months. C, Excision of lower lip segmental infantile hemangioma at the age of 12 months. The hemangioma was excised through a vermillocutaneous incision. A second surgery at the age of 17 months was necessary to excise residual hemangioma and scar tissue of the lower lip. D, Postoperative stage at age 3 years. In the future, the patient might need another debulking operation of the lower lip and the special sulcus reconstruction technique that we developed, which is further described in the next case. E, Placement of horizontal incisions along vermillocutaneous junction.
A through S. Surgical approach and technique of sulcus reconstruction. A, Patient at initial presentation. Note the bilateral lower lip and neck involvement. B and C, Preoperative presentation at age 21 months. D, An incision is created along the vermililocutaneous junction of the lower lip. A horizontal wedge of excessive tissue is removed with a Colorado tip bovie cautery. A subcuticular flap is elevated to the limits of the mass. E and F, An 18-gauge needle is passed anterior to posterior through all tissue layers. F through H, A polyglactin 910 absorbable (Vicryl) suture is then passed posterior to anterior through the needle shaft. I through M, The needle is then retracted anteriorly up to the subcuticular plane. The needle tip ensnares a small segment of dermis and is then advanced back through all of the layers to a position adjacent to its previous one. The suture is then withdrawn from the needle and the needle is then withdrawn completely. N and O, As many of these stitches may be placed as deemed necessary. P, The suture is then tied on the mucosal surface. Q and R, The flap has been secured. The dead space has been reduced and the vermililocutaneous junction is now everted. S, The patient 4 months postoperatively. T, Placement of incisions for sulcus reconstruction.

Figure 20. Treatment Algorithm for Lip Infantile Hemangiomas (IHs)

Asterisk indicates may add PDL in segmental lesions.
tissue layers. A polyglactin 910 absorbable suture (Vicryl; Ethicon) is then passed posteriorly to anteriorly through the needle shaft. The needle is then retracted anteriorly up to the subcuticular plane. It is then repassed from the subcuticular plane to the mucosa. The suture is then tied on the mucosal surface. Two to 3 stitches in total are sufficient.

Each of these procedures may require a staged approach to prevent overresection, preoperative and/or postoperative PDL therapy for superficial areas with remnant IH, or dermabrasion of involuted IH and atrophic scarring. We offer an overall treatment algorithm for the management of lip infantile hemangiomas (Figure 20). In conclusion, there is a nonrandom distribution of facial IHs. Although focusing on lip IHs, our findings support previous observations that demonstrate the predilection of facial IHs to grow in distinct locations and patterns. On the basis of our findings, the anatomical distortion and correlating clinical significance can be predicted and influence surgical treatment.

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REFERENCES