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Surgical Treatment of Facial Infantile Hemangiomas: An Analysis Based on Tumor Characteristics and Outcomes.

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Abstract

Background. Surgical treatment of infantile hemangiomas may definitively interfere in patient appearance. The use of an algorithm is essential to select best candidates. The objective of this study is to evaluate outcomes of surgical treatment based on tumor characteristics.

Methods. Following an algorithm, 74 patients were surgically treated between 1997 and 2010. Demographic data, tumor characteristics, surgical approach and outcomes were evaluated.

Results. Female to male ratio was 5.7:1. Mean age and follow-up were 24 and 33 months. Surgery was elective in 83.8% and emergencial in 16.2% of patients. Most frequent locations were lips, nose, eyelids and cheeks. Surgery occurred during the proliferative phase in 43 patients (58.15%) and growth-related deformity was the main indication. No significant association between gender and presence of complications or treatment indication was observed. Patients who underwent emergencial procedures were younger (p=0.0031) and had a higher incidence of evolutional complications (p = 0.012. Also, they were more frequently operated during the proliferative phase (p = 0.011). Favorable outcome of surgical treatment was observed, both in simple and complex cases for facial contour, volume reduction and need for reoperation. Best candidates for elective surgery were patients with localized eyelid, nasal or lip hemangiomas, presenting growth related deformities during proliferative phase. For patients under emergencial indication best candidates were non-responders to pharmacological therapy with segmental periorbital hemangiomas, treated by partial resection.

Conclusions. A profile of patients and their specific surgical approach was established. Satisfactory results could be achieved following the proposed algorithm.

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Level of Evidence. 4 - case series with comparison

Key words: hemangioma, facial, surgery, treatment, indications, outcomes.

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Introduction

Infantile Hemangiomas (IH) occurring in the face may represent a real problem to a child. Clinical significance is ultimately determined by the degree of tissue deformation[1-4]. Large dimensions, specific locations and presence of complications like ulceration, bleeding or infection indicate active treatment to minimize morbidity. Treatment modalities include pharmacologic therapy (systemic or intralesional) and interventional procedures (surgical resection or intralesional laser)[5-12].

Surgical removal of IH is a fast and definitive solution. Surgical approach during proliferative or involutive phases has been extensively questioned, mainly after the established use of oral betablockers. On the other hand, treatment of residual deformities on involuted phase is easily justified since pharmacologic treatment is not effective anymore. Surgical treatment may definitively interfere in patient appearance and this scenario strengthens the elaboration of precise indications for surgery and a comprehensive protocol for its approach [5, 9-11, 13-17].

The combination of clinical features and response to pharmacologic treatment are the main standpoints to indicate surgery during active phases of IH. Planning must consider the indication for surgery (an emergencial procedure or electively planned), approach (direct to the lesion or through a distant incision) and type of resection (partial or complete).

Over the last decade an algorithm for surgical treatment was adopted. The goal of the present study was to evaluate outcomes of surgical treatment based on tumor related clinical features.

Methods

The present study was approved by the Institutional Ethical Committee (protocol number: 0931/09) and informed consents were obtained from parents or guardians.

From February 1997 to May 2010, 208 pediatric patients with cervicofacial hemangiomas were treated at our unit. Conservative follow-up was adopted in 86 patients (41.3%).

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Active treatment by exclusive pharmacologic treatment (oral corticosteroid or propranolol) was applied in 48 patients (23.1%). Surgical approach was performed in 74 patients, corresponding to 35.6% of cases. The indication of treatment modalities (Table 1) was based on dimensions, risk of growth-related deformities (resulting from mass effect caused by IH growth) and presence of complications (ulceration, bleeding or infection). Indications for surgical treatment followed an algorithm illustrated in Figure 1. In this series of 74 operated patients, 63 (85.1%) were female and 11 (14.9%) were male (female:male ratio: 5.7:1). Fifty-one patients (68.9%) were caucasian. The mean age at surgery was 30.9 months (median: 24 months, standard deviation: 27.2 months).

Specific IH characteristics were evaluated in operated patients according to the following parameters:

- *Anatomic distribution*: forehead, eyelids, nose, lips, cheeks, ear, cervicofacial and hemifacial.
- *Involvement in extension*: localized (respect anatomic unit) or segmental (compromise of more than two contiguous anatomic units or hemifacial).
- *Laterality*: right-side, left-side, central and bilateral. Unilateral cases in which the hemangioma slightly crossed the midline were not considered as bilateral.
- *Compromise in depth*: superficial (only skin), deep (only subcutaneous tissue) and mixed.
- *Evolutional phase at surgery*: proliferative, involutiva or involuted.
- *Presence of complications*: local nonspecific (ulceration, bleeding, or infection), local specific (visual or airway obstruction) or systemic (respiratory failure, heart failure, or systemic infection).

Indications for surgery were classified in:

- *Emergencial*: functional involvement of organs and systems with obstruction of the visual axis or the airway.
- *Elective*: presence of growth related deformities (GRD), recurrent complications and treatment of involuted hemangiomas.

Surgical tactic was evaluated considering:

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- *Access to IH*: direct (through perilesional or intralesional incisions) or indirect (incisions distant to IH with need of soft tissue undermining).
- *Type of resection*: partial (when no more than 50% of total volume was removed), subtotal (when more than 50% was removed) or total (complete excision).
- *Reconstruction method*: primary closure or local flaps.

Follow-up was registered, as well as number of procedures performed per patient and occurrence of post-surgical problems. To describe the profile of patients treated by surgery, all clinical characteristic and surgical information were crossed and statistical evaluation was performed.

Outcomes were analyzed by three independent plastic surgeons, not involved in patient treatment. Preoperative and latest postoperative photographic documentation (at least 6 months post-surgery) were used for analysis. In cases of patients with multiple lesions operated area was identified with arrows on preoperative imaging. Questions were answered regarding surgical difficulty (easy, medium or high), facial contour (worsening, slight improvement or great improvement), volume reduction (worsening, slight improvement or great improvement) and need of reoperation (not necessary, need of small additional procedures, need of similar or larger procedures).
Inter-observer agreement and scores attributed to each parameter were statistically evaluated.

Statistical Analysis

The statistical package STATA (StataCorp. 2007. Stata Statistical Software: Release 10, College Station, TX: StataCorp LP) version 10.0 for computers, was used to perform the statistical analysis in patients submitted to surgical treatment. Frequency distribution was used to describe categorical variables (gender, ethnicity, location, treatment categories, and evaluations) and measures of central tendency (mean and median) and variability (minimum, maximum, and standard deviation) were used to describe numerical variables (age and follow-up).

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Fisher's exact test was applied to verify association between categorical variables. For analysis of the numerical variables, the Mann-Whitney non-parametric U" test was applied for 2 category groups.

The chi-square test frequency was adopted to verify independence among scores of evaluators for quality of each item and the Kappa index to check the degree of agreement among raters.

A significance level of 5% was considered for all statistical tests.

Results

Surgery was the unique approach for 57 patients (77%). In the remaining 17 cases pharmacologic treatment was also used. Surgery was concurrent in 3 cases (4.1%) or followed drug therapy due to partial response (14 cases, 18.9%) or absence of response (2 cases, 2.7%).

A total of 90 surgical procedures were performed. The distribution of clinical variables at the moment of surgery (localization, extension, laterality, depth, evolutional phase and evolutional complications) is summarized in Table 2.

Anatomic distribution

The most frequent locations were lips, nose, eyelids and cheeks, totalizing 54 cases (73%). The lips were involved in 20 patients, the upper lip in 9 and the lower lip in 11 patients. Of the 9 eyelid lesions, 4 involved the upper eyelid, 3 the lower eyelid, and in 2 patients both eyelids were compromised. Nasal hemangiomas occured in 16 cases and exclusive involvement of the nasal tip was found in 10 patients. The perinasal area was affected in 5 patients, and in only 1 case it was restricted to the nasal dorsum.

Extension of the affected area

In 59 patients (79.7%), hemangiomas were restricted to a specific anatomic unit. In the remaining 15 cases (20.3%), either the hemangioma was larger than or affected more than one unit. IH was classified as localized in 64 (86.5%) and segmental in 10 patients (13.5%).

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Laterality and impairment of the midline

IH was unilateral in 49 patients (20 right-sided and 29 left-sided). In 22 patients (29.7%), lesions were centrally located and in 3 (4.0%), the hemangioma compromised both sides of the face. However, considering unilateral cases with slight involvement of the contralateral side, midline was compromised in 33 patients (44,6%).

Depth of the affected area

Mixed lesions were predominant and occurred in 41 patients (55.4%). Superficial IH were seen in 18 cases (24.3%) and deep lesions in 15 cases (20.3%). Nine of the deep hemangiomas (60%) were located in the nasal region.

Evolutional phase

When surgery was performed, 43 of the hemangiomas (58.15%) were in the proliferative phase and 22 (29.7%) in the involutive phase. Only 9 patients (12.2%) had hemangiomas resected in the involuted phase. The female-to-male ratio was respectively 6:1, 4:1, and 8:1 for patients operated in the proliferative, involutive, and involuted phases.

Presence of complications

Prior to surgical treatment, 15 patients presented local nonspecific complications, accounting for 20.3% of the cases. Ulceration occurred in all 15 patients, concomitantly with infection in 5 and bleeding in 1 case.

Concerning specific complications, obstruction of the visual axis (total or partial) occurred in 10 patients (13.5%) and upper airway obstruction in 3 (4.0%). No systemic complications occurred in patients submitted to surgical treatment.

Indications for surgical treatment

The majority of patients (62, 83.8%) were treated under elective conditions (Figures 2 and 3). Growth-related deformity was the indication in 44 patients. Lesions were located in lips (14), nose (11), cheeks (6), forehead (3), eyelid (2), ears (2), cervicofacial region

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(3) and 3 were hemifacial IH. Treatment due to recurrent complications was performed in 9 patients with IH located in forehead (2), eyelids (2), cheeks (2), lips (2) and cervicofacial (1). The remaining 9 patients had involuted IH, hemifacial in 3 cases or situated in the lips (3), nose (1), cheek (1) and cervicofacial region (1).

Emergencial removal was performed in 12 cases (16.2 %). Obstruction of the visual axis was present in 10 patients (13.5%) (Figures 4 and 5) and upper airway obstruction was the indication in 2 patients (2,7%) (Figure 6).

Surgical access and type of resection

Direct access was performed in 60 patients, through peritumoral incisions in 35 (47,3%) and transtumoral incisions in 25 cases (33,8%).

Indirect access, through cervicotomy (neck IH), open rhinoplasty approach (nasal IH), or transpalpebral access (eyelid IH) was performed in the remaining 14 cases.

Total resection was obtained in 49 cases (66.2%), subtotal in 9 cases (12.2%) and partial in 16 cases (21.6%).

Reconstruction method

When partial and subtotal resections were performed, reconstruction was done by primary closure (25 cases) (Figures 2, 3 and 5). In total resections (Figures 1 and 4), reconstruction was achieved by primary closure (14 cases), purse-string suture (8 cases), or advancement and rotation flaps (27 cases).

Patient follow-up

Mean follow-up was 33 months (median 24 months, range 6-60 months). Fifteen patients (20%) had postoperative follow-up longer than 5 years and 13 patients (17.6%) had postoperative follow-up shorter than 12 months.

Postoperative Surgical Problems

Wound infection occurred in 2 cases (2.7%), tissue necrosis in 2 cases (2.7%) and dehiscence in 1 case (1.4%). Aesthetic complains requiring additional treatment occurred

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in 3 cases (4.0%). In 1 case (1.3%), proliferation of the hemangioma was observed after partial resection, requiring additional pharmacologic treatment.

Surgical Patient Profile

Combined evaluation of demographic, clinical, and surgical data is summarized in Tables 3 and 4.

There was no significant association between gender and the presence of complications (ulceration, bleeding, or infection) or treatment indications.

Patients who underwent emergencial procedures were younger (p=0.0031) and had a higher incidence of complications (p = 0.012). Also, emergencial indications were more frequent in patients operated during the proliferative phase (p = 0.011).

In patients submitted to partial resections, the incidence of complications was higher (p = 0.001) and emergencial indication for surgery was more frequent (p<0.001). Patients with segmental hemangiomas had more complications than those with localized hemangiomas (p = 0.003) (Tables 3 and 4).

Most of the operated facial hemangiomas were centrally located. Palpebral and nasal lesions were predominantly associated with emergencial indications and the number of additional surgical procedures was higher at these locations.

Patient outcome

Concordance between evaluators was statistically confirmed. According to Kappa index, it was rated as satisfactory for "facial countour" (kappa=0,3706, p value=0,384) and moderate for "case difficulty" (kappa=0,4926, p value=0,442), "volume reduction" (kappa=0,4122, p value=0,432) and "need for reoperation" (kappa=0,5350, p value=0,388).

Considering the average values of evaluations, there was a balance between easy, medium and difficult cases. Changes in facial contour and volume reduction presented improvement in 99.5%. Regarding need of reoperation, it was considered "not necessary" in 40.8% of cases. The majority of suggested additional procedures (44.0%) were indicated for minor corrections (Table 5).

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Discussion

Continuous monitoring of patients until total resolution is crucial to assess outcomes[18-21]. Newer concepts and knowledge gained in recent decades on biological behavior of IH have directed therapeutic approach towards the pursuit of pharmacological measures that may block proliferation or accelerate involution[1, 22-24].

However, there will still be place for surgical treatment[25,26]. The most obvious examples are emergencial indications and treatment of residual involuted IH. There are advantages over pharmacological treatment alone, especially in dramatic conditions, where any fast improvement will be considered beneficial[14, 25-32].

Most studies report overall treatment rates around 20%, including surgical cases [1,5,7,8,14,16,26]. Otherwise, in the present study overall treatment rate was 58.6% (122/208 patients) with a high incidence of operated patients (74/122, 60.6%). Patients referred to our clinic were usually potential candidates for active treatment and more specifically for surgical approach, explaining in part this difference.

Emergencial resection is often performed during proliferation and therefore, in younger patients, as confirmed in this study. Essentially in segmental IH, partial resection is recommended, since the prime indication is functional. Confining surgery to the minimum necessary is an adequate and safe alternative for preventing sequels arising from active surgical treatment.

Among elective cases, decision must be considered under a protocol that includes all treatment alternatives. Although there has been a tendency towards pharmacological treatment, it is important to emphasize that there are cases where the best treatment is still surgery. The adoption of an algorithm allows directing treatment in a more predictable fashion.

From all possible locations, surgery is a real option for cervicofacial hemangiomas[1,21]. The indication is focused on cases with *growth related deformities* and removal of the tumor potentially would allow adequate facial development. This condition is frequently seen in the nose, lips and eyelids, and even with complete involution permanent

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deformities may develop. Surgical treatment, in the author's opinion, prevent deformities caused by the interposition of IH and are associated with satisfactory long term results.

Supporting surgical approach, there are studies suggesting that centrally located facial IH may present lower regression rates[8,18,28-33]. Considering that central lesions are associated with increased psychosocial problems[9,34,] the predominance of surgical treatment in the eyelids, lips, and nose is justified.

A predominance of surgeries performed during the proliferative phase differed from more conventional treatment philosophies of delayed surgery[11,16,32]. Several overlapping aspects may explain and validate early approach: consolidation of an algorithm for surgical indications, safety of anesthetic procedures and a positive evaluation of outcomes.

The judicious selection of access, type of resection and reconstruction method is fundamental to obtain the best scar[9,14,26]. The concept of minimal possible scar is relevant and the use of purse-string sutures, initially proposed by Mulliken et al. (2002), was applied promoting real reduction in the final scar dimensions[35]. When not appropriate, positioning of scar lines in strategic hidden locations is an alternative.

A clinical profile of candidates for surgery was defined: under elective circumstances patients with proliferative localized eyelid, nasal or lip hemangiomas with growth related deformities are best candidates for total resection under direct (superficial or mixed IH) or indirect (deep IH) approach. For patients treated as emergencial indication the best candidates are those non-responders to pharmacological therapy presenting complications, with segmental lesions, treated by partial resection under direct approach (Figure 1).

The objective survey performed by experts resulted in favorable outcomes both in simple and complex cases. Laymen, parents, and health care professionals with or without expertise can perform outcomes evaluation. Laymen generally tend to favorably overestimate results, particularly when clinical improvement is evident. It may downgrade a more critic evaluation. The surgeon who performs the procedure, by contrast, tends to be overly demanding in his results and may underestimate them.

When the objective of a study is to evaluate technical result, specific knowledge is required and experts not involved in treatment appear to be the best choice. The

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proportion of cases rated as “without need of reoperation” or “requiring small additional procedures” corroborates the impression that treatment goals have been achieved.

There are limitations in the study that should be considered. First, the retrospective design lead to an evaluation of cases treated before the first publications on the effectiveness of betablockers. In this condition, patients who underwent surgery had as alternative pharmacologic treatment with steroids. It could direct the option of surgery, considering side effects and lack of efficacy using corticosteroids. Moreover, it was not carried out a comparative study of the various forms of treatment, but the study focused on the analysis of surgical outcomes. Nowadays, with the possibility of pharmacological treatments with fewer side effects there is a need for new prospective comparative studies evaluating the outcome between the use of propranolol and surgery. However, there is still no response if the use of propranolol reduces the number of operations, decreases the morbidity of procedures or only postpones the moment of definitive surgery. Considering the concern with growth related deformities, the indication of surgery since grounded in clear and efficient criteria still seems a suitable alternative.

Conclusion

The results obtained in this study helped in establishing the profile of patients treated by surgical resection and the specific surgical approach for each situation. Satisfactory results could be achieved in both simple and complex cases when accurate indication criteria were followed.

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FIGURE LEGENDS

Figure 1. Algorithm for indication of surgical treatment based on clinical features.

Figure 2. Patients submitted to elective direct total resection of proliferative infantile hemangioma. A and B, direct closure and appearance after 1 year, in a patient with 6 months old non responsive to pharmacologic treatment. C and D, use of purse-string sutures and appearance after 8 months in a patient with 8 months old, non-responsive to propranolol treatement.

Figure 3. A, patient with involuting hemifacial infantile hemangioma after partial response to pharmacologic treatment . B, first surgical treatment was performed at 3 years old by direct access with partial resection and primary closure. C, final appearance after secondary procedure of tissue expansion.

Figure 4. A, patient with proliferative segmental orbital infantile hemangioma. B, treatment was considered an emergencial indication and was performed in conjunction to oral corticosteroid therapy by direct access with partial resection and primary closure at 6 months of age. C, appearance after 6 years, showing involution of the non-resected portion of the hemangioma.

Figure 5. A, Five months-old patient with proliferative orbital infantile hemangioma. B, Magnetic resonance imaging showing periorbital involvement. C, treatment was considered an emergencial indication for surgery and was performed by direct access with total resection and primary closure at. Appearance after 5 years.

Figure 6. A, B and C, patient presenting a proliferative nasal hemangioma with airway obstruction. Surgical treatment was indicated at 2 years-old due to absence of resposnse to pharmacologic therapy. Treatment was performed in 3 sequential procedures, the first with subtotal resection and the two remaining for lining and minor correction. D, E and F, late appearance after 5 years.

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TABLE LEGENDS

Table 1. Indications for treatment of Infantile Hemangioma

Table 2. Distribution of cases according to the intraoperative surgical variables.

Table 3. Relationship of demographic and clinical variables according to complications (ulceration, bleeding or infection).

Table 4. Relationship of demographic and clinical variables according to treatment indication.

Table 5. Treatment outcomes based on experts survey.

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Table 1. Indications for treatment of Facial Infantile Hemangioma

Treatment	Indication
Conservative (Expectant)	IH < than 10mm in diameter **AND** Absence of growth-related deformities **AND** Absence of systemic and local complications
Pharmacologic	IH > 10mm in diameter **AND** Presence of growth-related deformities except eyelids, nose and lips **OR** Presence of systemic or local complications
Surgical	Presence of growth-related deformities in eyelids, nose and lips **OR** Presence of growth-related deformities in other locations, not responding to pharmacologic treatment **OR** Presence of systemic or local complications not responding to pharmacologic treatment **OR** Involuted lesions with deformities

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Table 2. Distribution of surgical cases according to the intraoperative variables.

Variable	*Category*	*Frequency (%)*
Involvement	Localized	64 (86.5)
	Segmental	10 (13.5)
Localization	Forehead	5 (6.8)
	Eyelids	9 (12.2)
	Nose	16 (21.6)
	Lips	20 (27.0)
	Cheeks	9 (12.2)
	Ear	2 (2.7)
	Cervicofacial	5 (6.8)
	Hemifacial	8 (10.8)
	Superficial	18 (24.3)
Involvement in depth	Deep	15 (20.3)
	Mixed	41 (55.4)
	Proliferative	43 (58.1)
Evolutional phase	Involutive	22 (29.7)
	Involuted	9 (12.2)
	Right	20 (27.0)
Laterality	Left	29 (39.2)
	Central	22 (29.7)
	Bilateral	3 (4.0)
	Yes	33 (44.6)
	No	41 (55.4)
Involvement of the midline	Yes	59 (79.7)
	No	15 (20.3)
Lesion restricted to the anatomical unit		

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Table 3. Relationship of demographic and clinical variables according to complications (ulceration, bleeding or infection).

Variable	Category/Measure	Complications		p-value
		No	Yes	
		N (%)/Measure		
Age (months)	N	59	15	0.0327
	Range	4–156	3–72	
	Median	24	12	
	Mean (SD)	33.5 (28.3)	20.9 (19.9)	
Indication	Emergencial	6 (50)	6 (50)	0.012
	Elective	53 (85.4)	9 (14.6)	
Gender	Female	50 (79.4)	13 (20.6)	0.999
	Male	9 (81.8)	2 (18.2)	
Involvement	Localized	55 (85.9)	9 (14.1)	0.003
	Segmental	4 (40.0)	6 (60.0)	
Midline involvement	Yes	24 (72.7)	9 (27.3)	0.246
	No	35 (85.4)	6 (14.6)	
Restriction to anatomical unit	Yes	50 (84.8)	9 (15.2)	0.066
	No	9 (60.0)	6 (40.0)	
Type of resection	Partial + subtotal	14 (56.0)	11 (44.0)	0.001
	Total	45 (91.8)	4 (8.2)	

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Table 4. Relationship of demographic and clinical variables according to treatment indication.

Variable	Category/Measure	Indication		
		Emergencial	Elective	p-value
		N (%)/Measure		
Age (months)	N	12	62	0.0031
	Range	3–32	3–156	
	Median	11	24	
	Mean (SD)	14 (9.8)	34.2 (28.2)	
Extent of involvement	Localized	8 (12.5)	56 (87.5)	0.050
	Segmental	4 (40.0)	6 (60.0)	
Evolutional phase	Proliferative	11 (25.6)	32 (74.4)	0.011
	Involutional + Involuted	1 (3.2)	30 (96.8)	
Midline involvement	Yes	7 (21.2)	26 (78.8)	0.352
	No	5 (12.2)	36 (87.8)	
Restriction to anatomical unit	Yes	7 (11.9)	52 (88.1)	0.059
	No	5 (33.3)	10 (66.7)	
Complications	None	6 (10.2)	53 (89.8)	0.012
	Bleeding, ulceration, or infection	6 (40.0)	9 (60.0)	
Type of resection	Partial + subtotal	10 (40.0)	15 (60.0)	<0.001
	Total	2 (4.1)	47 (95.9)	

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Table 5. Treatment outcomes based on experts survey.

Question	Rating	Results (%)
Surgical difficulty	Easy	35.0
	Medium difficulty	33.0
	High difficulty	32.0
Facial contour	Great improvement	75.9
	Slight improvement	23.6
	Worsening	0.5
Volume Reduction	Great improvement	80.5
	Slight improvement	19.0
	Worsening	0.5
Need of reoperation	Not necessary	40.8
	Need of small additional procedures	44.0
	Need of similar or larger additional procedures	15.2

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Figure 1.

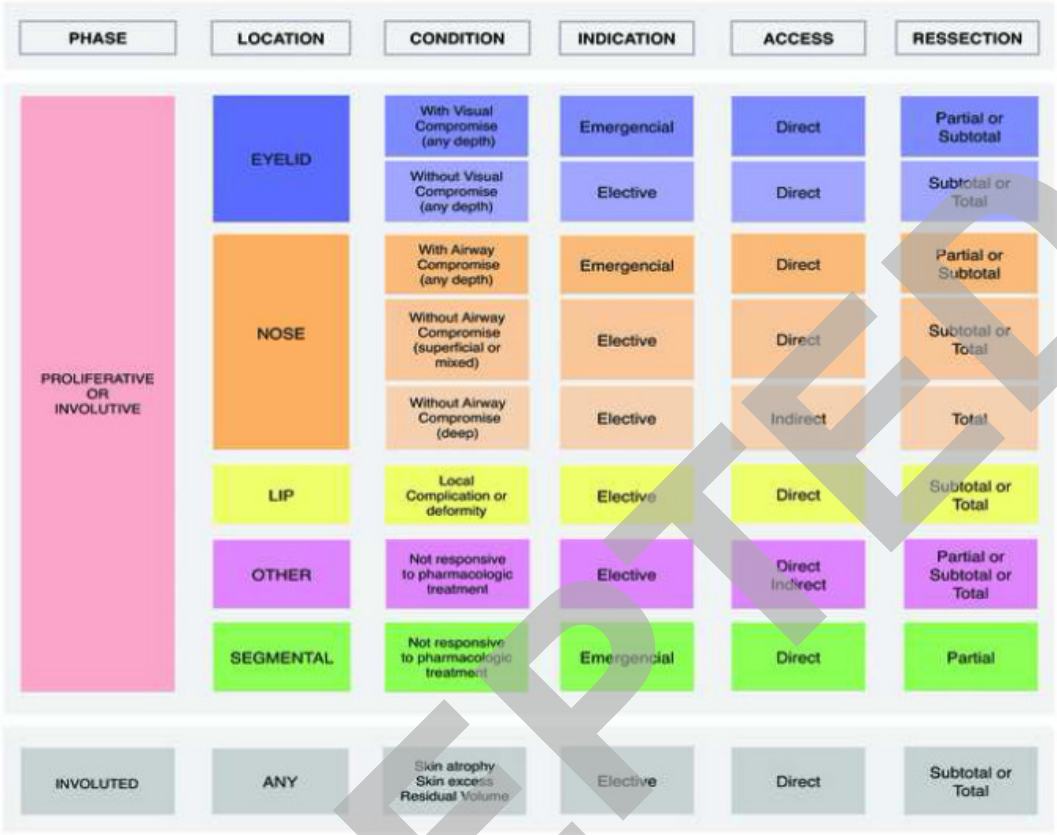

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Figure 5.

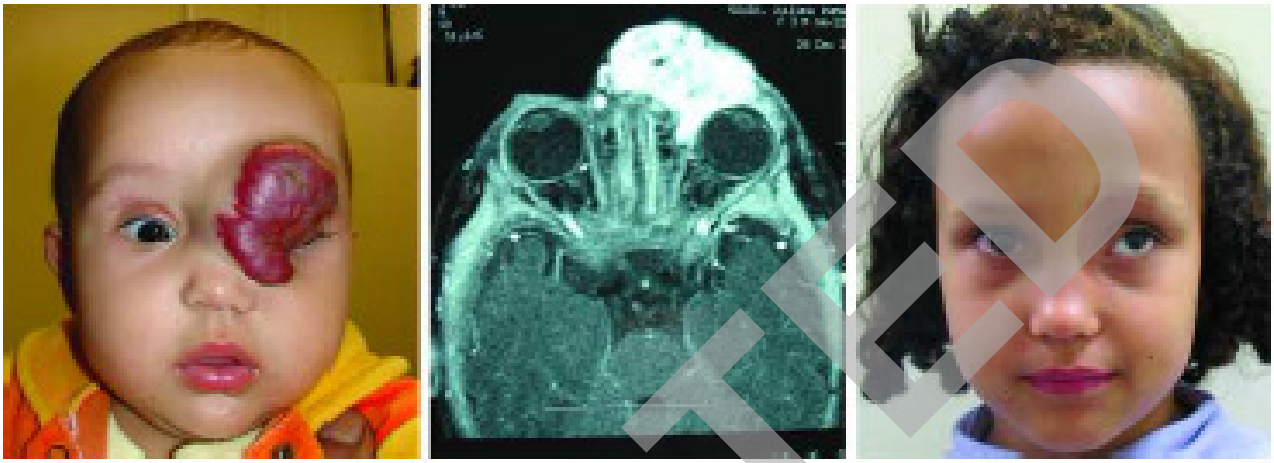

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Figure 6.

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