Liposuction and Lipoinjection Treatment for Congenital and Acquired Lipodystrophies in Children

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Background: The purpose of this clinical study was to establish liposuction and lipoinjection as a noncosmetic procedure in children to correct lipodystrophies.
Methods: Liposuction, fat injection, or a combination of both was performed on 30 patients between 1994 and 2006 at Roberto del Rio Hospital or Clinica Alemana, Santiago, Chile. Liposuction was indicated in patients with excessive amounts of fatty tissue or tumor-like swelling. Combined liposuction and lipoinjection was performed on patients with deficit and excess in soft tissues. Lipoinjection was used for patients with soft-tissue insufficiencies. Samples of fat obtained by liposuction were submitted to histopathologic examination. Traditional tumescent technique was used for liposuction. The supernatant obtained by simple filtration was used for fat injection. Short- and long-term postoperative follow-up included registration of complications and assessment of aesthetic and functional outcome. The kappa test was used for statistical analysis.
Results: Thirty patients, nine boys and 21 girls, were operated on, with an average age of 11 years (range, 4 to 17 years). A total of 43 procedures were performed: 27 liposuctions, 10 lipoinjections, and six combined procedures. Average hospital stay was 1.1 days. Of a total 20 patients who underwent liposuction, six required revision. Histopathologic study showed 19 lipomatoses and one lipoblastomatosis. Cosmetic outcomes based on Strasser scale were as follows: six excellent, 19 good, four mediocre, and one poor.
Conclusions: Liposuction and lipoinjection as sole or combined procedures are safe methods for the pediatric population. They are well tolerated, with a low rate of complications and satisfactory aesthetic results. (*Plast. Reconstr. Surg.* 124: 134, 2009.)

Liposuction and lipoinjection are widely used as safe and reliable procedures in aesthetic surgery of the body and facial outline. They have been demonstrated to achieve excellent cosmetic outcome and a high level of patient satisfaction.[1–11] According to the American Society for Aesthetic Plastic Surgery 2005 statistics, a total of 455,489 liposuctions were performed in the United States, making it the most frequently performed procedure in plastic surgery.[12]

Since its original description in 1982, liposuction has been applied mainly for cosmetic purposes; however, its uses in reconstructive surgery have been constantly expanding. This technique has been described to successfully treat lipomas, benign lipomatosis, bulky flaps, gynecomastia, as a secondary procedure in breast reduction, lipodystrophies secondary to the use of steroids or insulin resistance,

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lymphedema, involuted hemangioma, hematoma drainage, decompression of cervical fat airway obstruction, and hyperhidrosis.[13–31]

Despite the safety, versatility, and efficacy offered by both liposuction and fat injection, studies regarding its use in the pediatric age group are rare and are mainly limited to case reports.[32–37] In the following clinical study, we present liposuction and lipoinjection in children as alternative noncosmetic procedures for the treatment of body lipodystrophies of diverse causes.

PATIENTS AND METHODS

Between the years 1994 and 2006, a total of 30 patients with an average age of 11.48 years (range, 4 to 17 years) with the diagnosis of body or facial congenital or acquired lipodystrophy were operated on by means of either liposuction, lipoinjection, or a combination of both techniques. Appropriate informed consent, including authorization for photographic imaging, was signed by parents or guardians in all cases before surgery. Procedures were performed in a hospital setting at Hospital

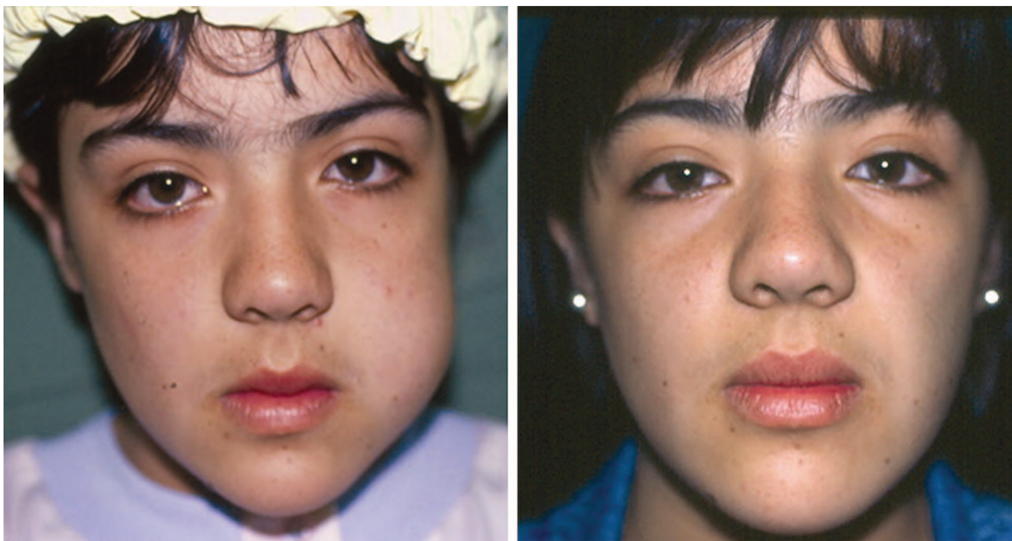

Fig. 1. Liposuction was performed on a female patient with a hemangioma sequela. Total aspirate volume was 50 cc. The final cosmetic outcome was considered excellent (Strasser scale score, 0).

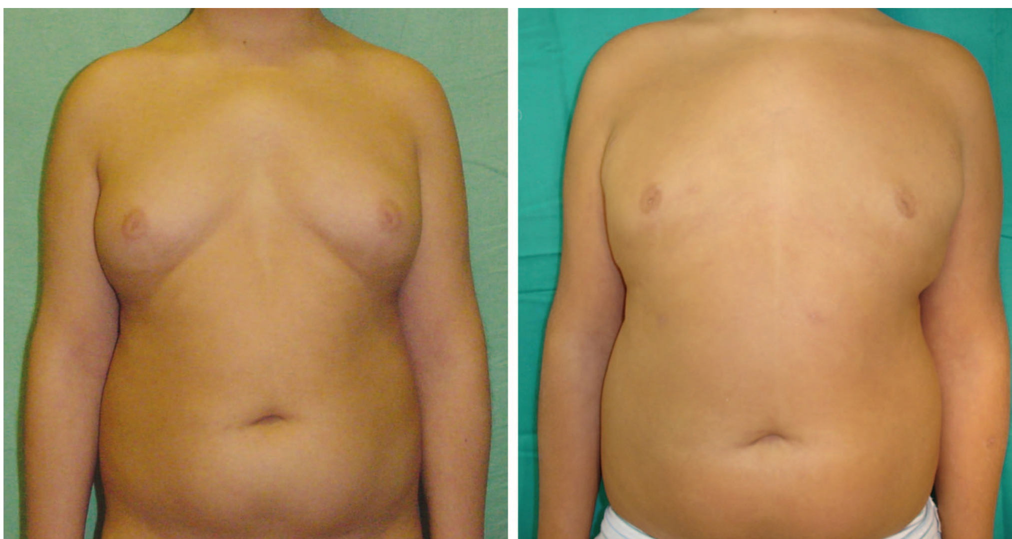

Fig. 2. Liposuction was performed as a two-stage procedure on a male patient with breast lipodystrophy in Weber syndrome. Total aspirate volume was 500 cc on the left side and 540 cc on the right side. The final cosmetic outcome was considered excellent (Strasser scale score, 2.75).

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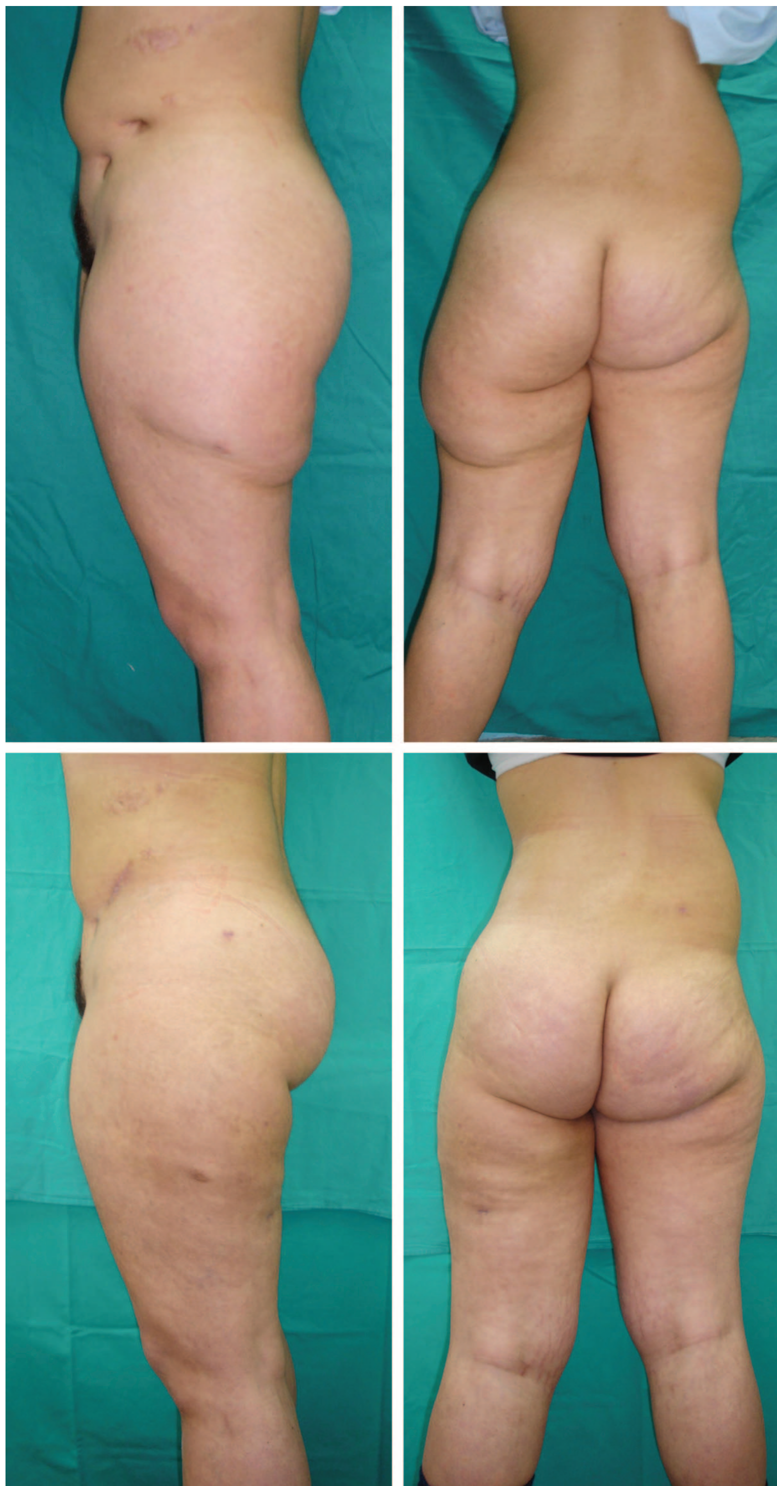

Fig. 3. Liposuction was performed on a female patient with multiple trauma sequelae. Total aspirate volume was 1650 cc. The final cosmetic outcome was considered excellent (Strasser scale score, 2.5).

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Roberto del Rio or Clinica Alemana in Santiago, Chile. Preparation for surgery included preoperative photographs and markings of the body zones to be corrected either by liposuction, fat injection, or a combination of both. All surgical procedures were performed under general anesthesia, and a protocol of prophylactic antibiotics based on a three-dose scheme of cefazolin (50 mg/kg) was used.

A traditional tumescent technique was used for liposuction in the following manner: infiltration cannulas were introduced through small (3 to 5 mm) incisions in the vicinity of the affected body zones, and a standard solution containing 1000 ml of saline solution, 2 to 3 mg/kg of 2% lidocaine, and 2.5 ml of epinephrine diluted 1:10,000 was infused subcutaneously. The total volume infused varied from one case to another, depending on the patient's age, size, and estimated final aspirate. Syringe-assisted liposuction with blunt-tipped 3- or 5-mm cannulas was performed in a deep subcutaneous plane until clinical parameters such as symmetry, regularity, and adequate pinch test were achieved.

Fat for lipoinjection was harvested with the same tumescent technique and later routinely cleansed of blood and tumescent solution products by means of decanting. The supernatant was then retrieved and reinjected with a Coleman 1.5-mm cannula. In the lipoinjection cases, considering there would be an unpredictable amount of fat reabsorption, excessive amounts of fat were injected to achieve a hypercorrection of approximately 20 to 30 percent.

Tissue samples for biopsy were obtained in all cases of liposuction. The samples were examined thoroughly by an experienced pathologist under the precaution of considering each sample as fragmented tissue.

Postoperative care included elastic compression, ultrasound therapy, and physiotherapy in every patient. Early postoperative follow-up was carried out for the first 48 hours to register immediate complications, and long-term follow-up was considered a minimum of 3 months to allow adequate assessment of aesthetic and functional outcome, including recurrence and late postoperative complications.

Follow-up was performed by clinical and photographic evaluation of each patient, and the results were later submitted for an objective analysis by three external surgeons using the Strasser scale. The kappa test for interobserver concordance was used in the statistical analysis.

RESULTS

Between January of 1994 and July of 2006, a total of 30 patients, nine boys and 21 girls with an

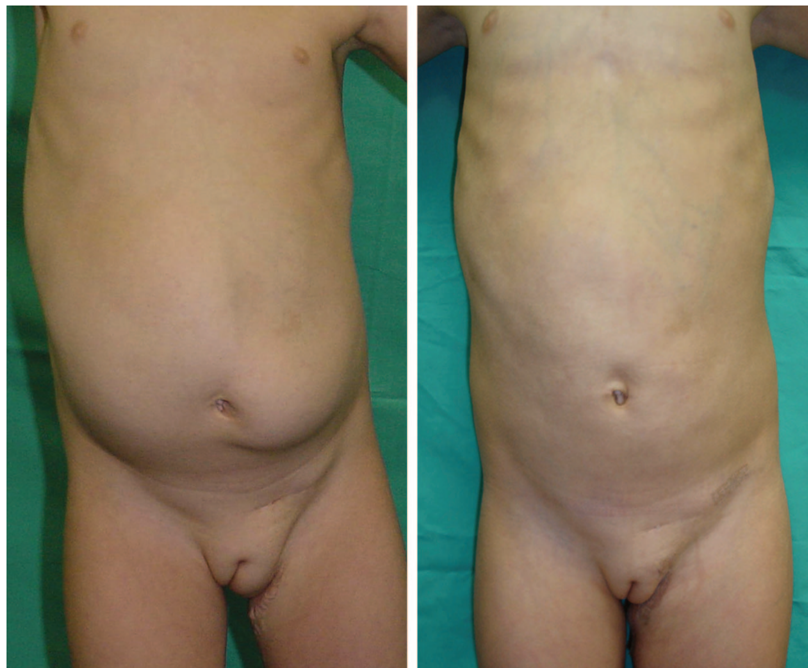

Fig. 4. Liposuction was performed on a female patient with a diffuse lipoblastomatosis. Total aspirate volume was 315 cc. The final cosmetic outcome was considered excellent (Strasser scale score, 0.75).

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average age of 11 years and ranging from 4 to 17 years, were operated on to correct a congenital or acquired lipodystrophy. Liposuction as a sole procedure was indicated for patients with anomalies characterized by excessive amounts of fatty tissue or tumor-like swelling (Figs. 1 through 4). The combined procedure of both liposuction and fat injection was chosen for patients whose defect included areas of deficit and excess in soft tissues (Fig. 5). In this second group of patients, fat for injection was obtained from the areas with excessive but otherwise normal fat; therefore, no tissue samples were sent for biopsy because fat was not pathologic. Finally, lipoinjection alone was used to correct irregularities based on insufficient amount of soft tissue (Figs. 6 and 7).

A classification conceived as an attempt to organize the numerous defects found in a relatively

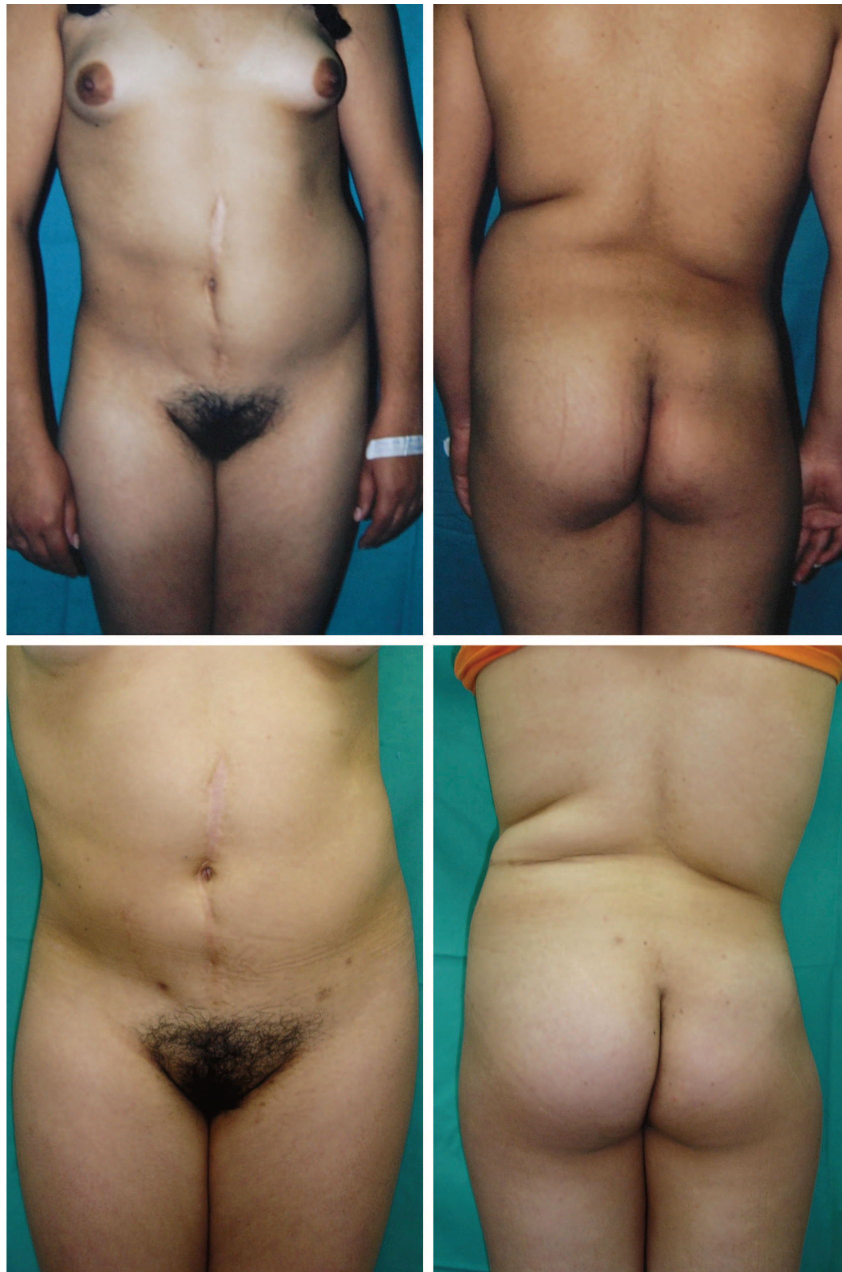

Fig. 5. Combined liposuction and lipoinjection was performed on a female patient with stage IV ganglioneuroblastoma treated surgically and with adjuvant chemotherapy and radiotherapy. An aspirated fat volume of 950 cc was used entirely for injection. The final cosmetic outcome was considered good (Strasser scale score, 4.25).

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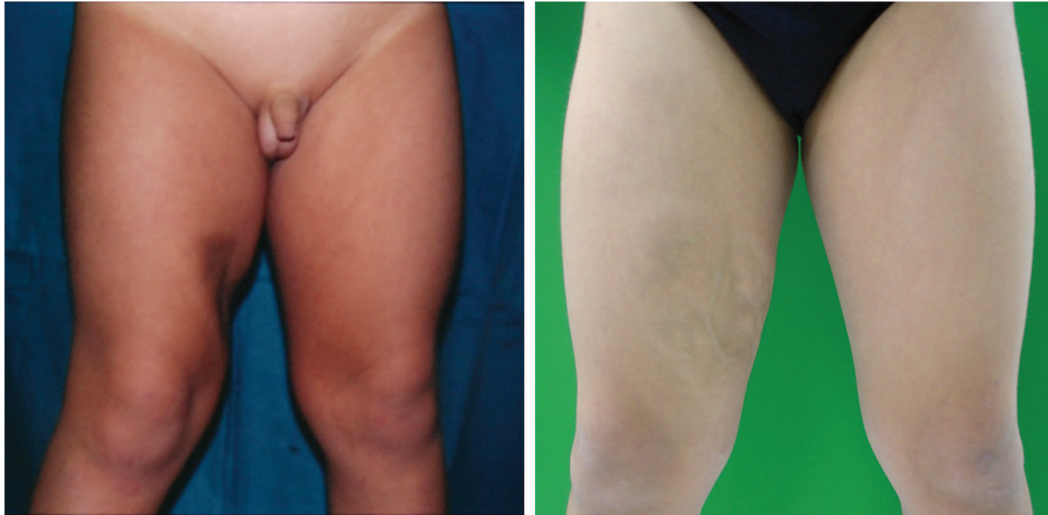

Fig. 6. Lipoinjection was performed on a male patient with amniocentesis sequelae. Total injected fat volume was 210 cc. The final cosmetic outcome was considered excellent (Strasser scale score, 0).

small series of patients was used basically considering as congenital any anomaly that was found at the moment of birth and acquired any defect that was not evident until the child began its growth and therefore the diagnosis was not made at an early age. Diagnoses with their corresponding surgical indications are detailed in Table 1.

A total of 43 procedures were performed, with 27 liposuctions, 10 lipoinjections, and six combined procedures consisting of liposuction and fat injection. All procedures were performed in an inpatient setting with an average stay of 1.1 days (range, 1 to 2 days).

Lipoaspirate volumes ranged from 2 to 1650 cc, with an average of 202.1; whereas for lipoinjection the volumes were between 10 and 200 cc, with an average of 88.8 cc. There were no immediate postoperative complications.

Clinical follow-up went from a minimum of 3 months to a maximum of 104 months. Late postoperative complications for liposuction included one residual lipodystrophy in a patient with lipomastia, one asymmetry in facial trauma sequelae, one persistent postoperative deformity, and two lipoma recurrences. In terms of lipoinjection, there was one late postoperative complication observed consisting of complete reabsorption of the injected fat in a case of morphea. In all cases, resolution was achieved by repeating the initial procedure.

Of a total 20 patients who underwent liposuction, six required revision. Two cases were initially programmed as two-stage procedures, whereas four were underwent reoperation because of late postoperative complications (two recurrences, one asymmetry, and one residual lipodystrophy).

Samples of the fat obtained by liposuction were submitted to histopathologic examination, permitting adequate visualization of cell structures in each case. Biopsy results showed 19 lipomatoses and one lipoblastomatosis.

Assessment of global results for long-term outcome was based on the Strasser scale, which classifies results as excellent with a score of 0 points; good, 1 to 4; mediocre, 5 to 14; and poor, over 15. Based on the Strasser scale, six cases were considered excellent, 19 were good, four were mediocre, and only one was classified as a poor result. Details of the Strasser scale and score for each observer and patient with their corresponding diagnosis and procedure performed are shown in Table 2.

The Strasser scale score was also applied to assess outcome for each surgical technique. Liposuction scored an average 2.08 points (range, 0 to 9); fat injection, 2.75 (range, 0 to 6.5), and combined procedures, 3.2 (range, 1.5 to 4.25). Statistical analysis was calculated on the basis of the frequency with which all three observers agreed in each of the four categories (excellent, good, mediocre, and poor).

Kappa values for each category and for global kappa values were quite high, meaning that there was a high level of concordance among all three observers. This was especially noticeable for the "mediocre" category and to a

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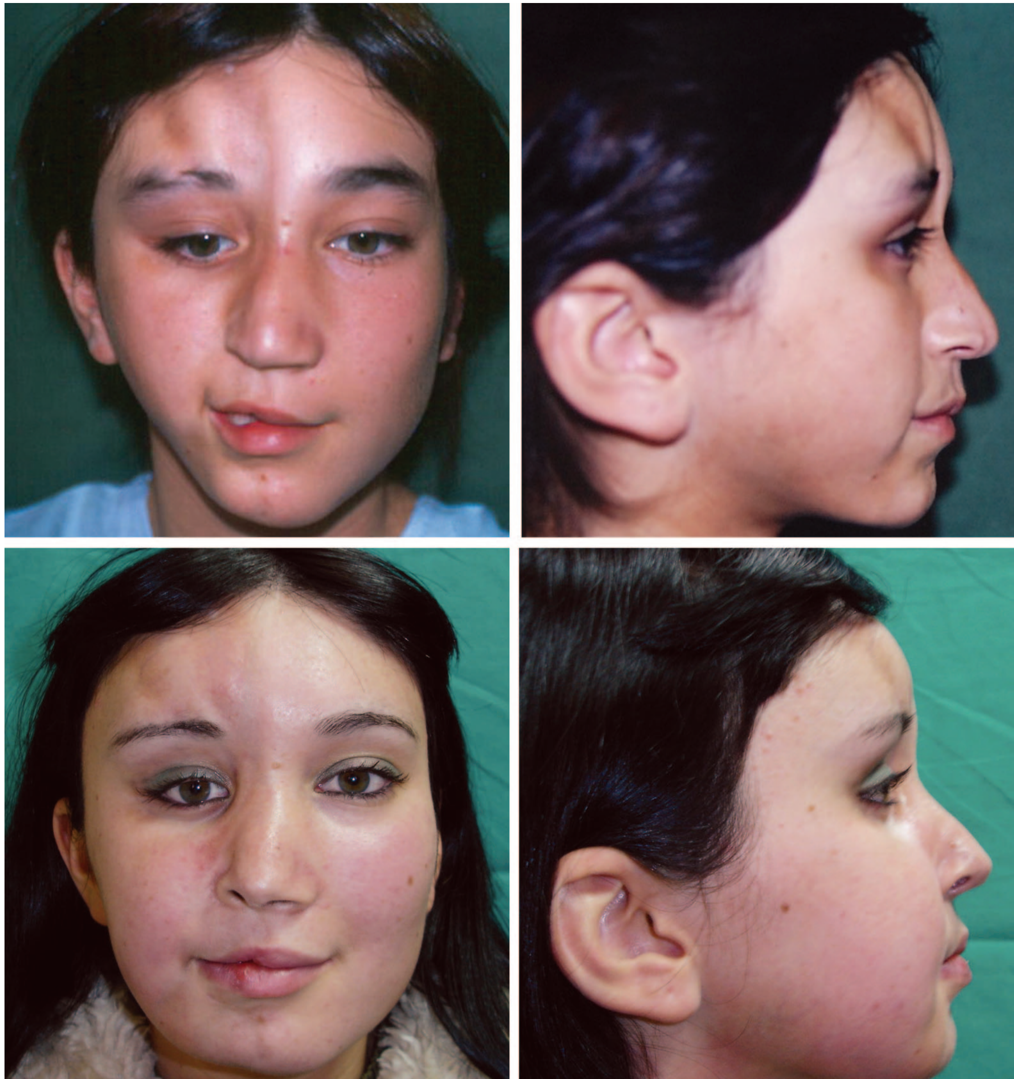

Fig. 7. Lipoinjection was performed on a female patient with Romberg syndrome. Total injected fat volume was 170 cc. The final cosmetic outcome was considered good (Strasser scale score, 3.75).

Table 1. Diagnosis

	No.
Acquired lipodystrophies	18
Postoperative deformities (cancer/tumors/others)	6
Lipoma	3
Lipomastia	3
Trauma sequelae	2
Lipomatosis	1
Diffuse lipoblastomatosis	1
Morphea	1
Romberg syndrome	1
Congenital lipodystrophies	12
Vascular anomalies	5
Hemangioma sequelae	3
Vascular malformation	2
Body contour lipodystrophy	4
Treacher Collins syndrome	1
Hemifacial microsomy	1
Amniocentesis sequelae	1

lesser degree for the "good" category. All results were statistically significant (Table 3).

DISCUSSION

Liposuction and fat injection techniques have been used successfully in reconstructive plastic surgery as adjunctive procedures in a diversity of clinical scenarios such as the regularization of asymmetries caused by lipodystrophies, involuted hemangiomas, and flap thinning.[13,14] Our study was based on applying a safe, reliable, and efficient technique widely used in adult plastic surgery to children.[3,4,6,8,9] In the pediatric population, publications related to the use of liposuction and/or lipoinjection to correct soft-tissue defects are scarce and generally limited to case reports or clinical series with small numbers.[32–37]

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The classic tumescent technique was chosen because it is a safe, reliable, and efficient technique, with minimal blood loss and a minimal complication rate.[38–40] Syringe aspiration was preferred over pump-assisted liposuction because we considered it an easier method with which to control low-volume aspirates in small areas, reducing the risk of irregularities and asymmetries. We did not attempt to use ultrasound or laser-assisted liposuction because of the uncertainty of the molecular impact on growing fat cells in children.[41–46] Also, these techniques do not provide an adequate tissue sample for pathologic examination which, in a pediatric population, seemed to be an important issue. Finally, neither of these two alternatives allows fat harvesting for later injection, which would have left out 10 of our 30 patients that required simultaneous lipoinjection.

The minimum number of long-term complications with no immediate postoperative complications shown in our study turned out to be under the rates published for adults. This may be explained by the fact that aspirate volumes are very low in children when compared with adults and therefore operative times are significantly shorter in otherwise healthy, very young patients. We had two patients in the liposuction group with recurrences after treatment of a lipoma, which we attributed to a technical problem probably caused by insufficient aspirate of the complete structure of the lipoma.

When comparing liposuction in children and adults, we found many differences. In children, liposuction and fat injection as individual or combined procedures were proposed exclusively for reconstructive purposes, whereas in adults the main indication is cosmetic. We do not believe it is necessary to extend the indication for cosmetic purposes alone in the pediatric population.

Regarding technical aspects, low-pressure syringe–assisted liposuction was preferred over other methods because we considered it to be more precise, with less risk of postoperative irregularities, especially in children, where aspirate volumes were generally small. The syringe technique also allowed us to obtain samples for biopsy in all cases

Table 2. Strasser Scale Scores

Patient	Observer 1	Observer 2	Observer 3	Average
1	4	4	3	3.6
2	1	2	0	1
3	2	2	3	2.3
4	1	1	1	1
5	4	4	4	4
6	0	0	1	0.3
7	3	3	3	3
8	>15	>15	>15	>15
9	0	0	1	0.3
10	0	0	0	0
11	0	0	0	0
12	8	8	7	7.6
13	5	4	4	4.3
14	1	1	1	1
15	2	1	1	1.3
16	3	1	1	1.6
17	4	4	4	4
18	3	4	3	3.3
19	0	0	0	0
20	1	1	0	0.6
21	8	8	7	7.6
22	9	8	6	7.6
23	0	2	3	1.6
24	0	0	0	0
25	5	4	5	4.6
26	11	9	7	9
27	0	0	0	0
28	4	4	4	4
29	3	4	3	3.3
30	0	0	0	0

Table 3. Kappa Test for Interobserver Concordance

Outcome	Kappa	Z	Probability > Z
Excellent	0.7231	6.86	0.0000
Good	0.6883	6.53	0.0000
Mediocre	0.8400	7.97	0.0000
Poor	1.0000	9.49	0.0000
Combined	0.7496	10.27	0.0000

Table 4. Main Differences between Liposuction in Adults and in Children

Liposuction	Children	Adults
Indications	Reconstructive procedure	Predominantly aesthetic over reconstructive
Technique	Syringe-assisted liposuction	Conventional liposuction motor or syringe assisted; ultrasound or laser liposuction
	Small aspirate volumes	Large aspirate volumes
	Short operative time	Extended operative time
	Procedure under general anaesthesia always	Local anaesthesia may be used in small-volume aspirate liposuction
Assessment	Morphologic variations attributable to growth and associated weight changes	Morphologic variations attributable only to weight changes
Literature	Scarce	Abundant
Complications	Minimum	Low rate
	Local	Local and general

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of exclusive liposuction. In the cases where the aspirated fat was needed for injection, the fat obtained was saved in the syringe and decanted with minimal manipulation to optimize graft survival. The main differences between adults and children are summarized in Table 4.

Comparison of the cosmetic results obtained in children to those obtained in adults seems inappropriate to us because all of the procedures in children were performed for reconstructive purposes; whereas in the adult population, most indications for liposuction are purely cosmetic. In our assessment, it is important to note that morphologic variations in normally growing children such as size and weight variations may have an influence on postoperative evaluation. The intention of using an objective grading system (Strasser scale) was to correct subjective factors such as this one. The Strasser scale for the assessment of cosmetic outcome was considered the most objective method to evaluate results, because any numeric parameter that obviously might have been even more objective is destined to suffer alterations because of the effect of growth and natural weight variations in normal growing children.[47] Most of our scores on the Strasser scale were either good or excellent (25 of a total 30 cases). The highest score was for the combined procedures, which averaged 3.2 (range, 1.5 to 4.25). Therefore, in general, we considered our results as adequate for liposuction and fat injection performed separately or as combined procedures.

We did notice, though, that even after using a standardized and uniform technique in each case, we obtained poor or mediocre results in five of 30 patients. After analyzing these cases thoroughly, we may infer that the initial diagnosis was a determining factor in postoperative outcome. The worse results were for those patients with vascular malformations and postoperative sequelae who had also undergone chemotherapy and radiotherapy. The common factor in all of these patients was a considerable preexisting vascular damage; therefore, we do not recommend liposuction or fat injection in any of these cases. Otherwise, we consider liposuction a safe and reliable procedure in children.

In contrast to the unfavorable results obtained in vascular malformations, the results for liposuction of remnant fat of involuted hemangiomas proved to be a good alternative. This difference might rely on the fact that, in an involuted hemangioma, the treatment is orientated to solve a residual lipodystrophy and not the active vascular malformation, which is in an inactive stage.

Biopsy analysis was performed by an experimented pathologist, who considered the sample equivalent to fragmented tissue, finding no malignancies in our study. Even though tissue samples obtained by liposuction were not ideal, the histopathologic method was considered reliable because there was no problem in visualization of cell structures. In our series, tissue samples for biopsy analysis were obtained in all 20 liposuctions, with benign results for each case. These results are consistent with the literature because liposarcoma is found more in adults older than 60 years and is an exceptional finding in children younger than 10 years. As demonstrated in the studies by Ezinger and Weiss, only 15 of 2500 biopsies performed for lipomas resulted in liposarcoma.[48,49] The only arguable result is that of a lipoblastomatosis in our series that corresponds to an evolutive stage of local or diffuse lipomatosis. In adults, this may be considered a premalignant lesion; however, these cells that are atypical in adults are considered normal immature cells in children.

CONCLUSIONS

Liposuction and fat injection as sole or combined procedures are safe and effective methods to be used in the pediatric age group. They are both well-tolerated surgical interventions with low rates of complications and satisfactory aesthetic results. Therefore, liposuction and fat injection should be recommended as procedures to be used in pediatric reconstructive surgery.

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