

Implementing Fat Grafting in the Management of Complex Facial Reconstructive Patients

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ABSTRACT

Exhibiting many of the qualities of the ideal filler, fat grafting has been embraced among the most popular procedures in facial aesthetic surgery. This work emphasizes the implementation of fat grafting in the management of difficult facial reconstructive cases. Coleman's principles for structural fat grafting were used to replenish volume in different aesthetic units of the face in 27 patients with age ranging from sixteen till twenty eight years presenting with facial soft tissue deficiencies and/or skeletal deficiencies. Three patients had only soft tissue deficiencies and they all belonged to the hemifacial atrophy category and were operated upon, with fat grafting only, after they have been in their stable phase of the disease for at least one year. The remaining 24 patients had both skeletal and soft tissue deficiencies. They included 7 repaired cleft lip and palate patients, 5 patients with hemifacial microsomia, 4 orthognathic and jaw deformity cases, 3 patients with Treacher Collins syndrome, 2 frontal plagiocephalic patients, 2 patients with anophthalmic sockets, and another patient with hemifacial atrophy. Out of these twenty-four patients, twenty underwent reconstruction of their bony framework prior to fat grafting. The remaining four whom declined the bony work underwent only fat grafting as a camouflage tool. Facial analysis was performed on all cases to determine the areas of facial disproportions. Individualized planning was formulated for each patient to achieve realistic aesthetic goals. The results of this work demonstrated 83.8% high satisfaction rate of patients at one year follow-up. Fat grafting offered simple, natural, and highly predictable outcomes. It restored volume and enhanced the results in patients with different craniomaxillofacial deformities with overall regain of facial balance.

In Conclusion: The versatile application of fat grafting can be extended extensively and efficiently into the difficult and complex facial reconstructive patients to treat those with only soft tissue deficiencies, those with combined skeletal and soft tissue deficiencies after establishing the bony foundation, or as a camouflage tool.

INTRODUCTION

Autologous fat transplantation has been used predominantly by several authors for facial reconstructing in esthetic surgery [1,2]. It has become the

workhorse for soft-tissue augmentation because autologous fat is readily available, inexpensive, host compatible, and can be harvested easily and repeatedly, with minimal trauma to the donor sites [3,4]. Plastic surgeons most experienced with fat filling procedures have reported satisfactory clinical results suggesting short- and long-term survival of transferred grafts, and promoted autologous fat as the ideal filler in esthetic surgery [1-3,5,6].

In reconstructive surgery, several techniques were used to correct primary soft tissue deficiency of the face, including dermal fat grafts [7], free silicone injections [8], free omental transfer or free groin [9], parascapular [10,11], and anterolateral thigh flaps [12], with varied degrees of successes and problems. Inigo & colleagues [11] reported significant reabsorption in the grafted site following dermal fat grafting. Severe soft-tissue complications of the face were documented from silicone treatment of facial contour [13]. Microvascular free flaps can be bulky, have a tendency to sag due to gravity, and often require subsequent procedures for thinning and resuspension. In addition, they also inherit several problems such as donor-site scar and morbidity, a lengthy operation and higher cost to patients, and possibility of total flap loss [14].

Compared with other reconstructive surgical procedures, autologous fat transfer represents a relatively simple option and a logical approach for soft tissue reconstruction. Some surgeons have attempted its use in treating reconstructive cases with soft tissue deficiencies such as hemifacial atrophy cases, but with conflicting results. There have been reports of noticeable improvement during follow-up by some authors [15,16], while others reported significant resorption that has occurred

in the grafted site [11]. Furthermore, reports of the use of fat grafting in the more complex deformities with skeletal deficiencies, other than hemifacial atrophy, is scarce and limited in the literature [17,18]. The aim of the current study is to extend the application of fat grafting into a variety of craniofacial deformities with both soft tissue and/or skeletal deficiencies and to report the results of its application.

PATIENTS AND METHODS

Patients presenting to the out-patient clinic at Ain-Shams University Hospitals and suffering from craniofacial deformities with soft tissue and/or skeletal deficiencies had been considered potentially eligible for the study. These patients were broadly divided into 2 groups; the first being those with facial soft tissue deficiency only, the second with combined soft tissue and skeletal deficiencies. The second group was further subdivided into those whom underwent earlier reconstruction of the bony framework, or those who elected to undergo fat grafting only without reconstructing the bony framework (Fig. 1).

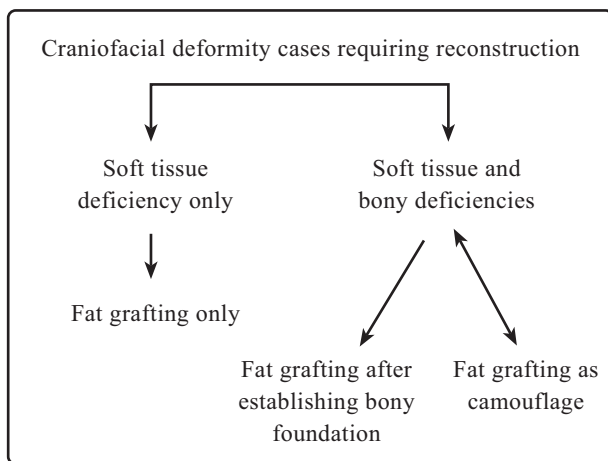


Fig. (1): Types of deficiencies in craniofacial anomalies and management alternatives provided.

All the patients were well informed about autologous fat transplantation including its potential benefits, limitations, and possible complications. They were also informed about the postoperative course, their responsibilities during recovery, and expected sequelae. Each patient fully understood that she or he could potentially require fat re-injections, with at least 3 to 6 months intervals.

Individualized planning was formulated for each patient to achieve realistic aesthetic goals. This process started by listening carefully to the

patient’s desires and expectations. Facial analysis was performed on all cases to determine the areas of facial disproportions and disharmony. Additional attention was paid during the preoperative visit to confirm the extent and thickness of facial recon-touring required and to determine the quantity of autologous fat grafts needed. Marking of the recipient areas was then done and discussed with the patient. The standard preoperative photos were taken for each patient and used for intraoperative reference. A map of all injection sites was then drawn for intraoperative volume estimation. The weight of each patient was recorded preoperatively and at each follow-up visit.

Additionally, cases of hemifacial atrophy were only operated upon after they have been in their stable phase of the disease for at least 1 year. Cases with combined soft tissue and skeletal deficiencies were offered reconstructing the bony framework first, followed by soft tissue reconstruction using fat grafting. Those who declined were offered a camouflage solution through fat grafting only.

Surgical technique:

The same surgical principles of injecting fat grafts were applied to all cases of the study population and in accordance with Coleman’s technique [1,3,19,20]. Briefly, harvesting sites were chosen for ease of accessibility and to improve the patient’s body contours. Coleman blunt tip harvesting cannula was attached to a 10-ml Luer-Lok syringe and inserted through a 3-mm incision at the harvest site to obtain parcels of fat. The harvested fat was then centrifuged at 3000 rpm for 3 minutes. Following centrifugation, the lower liquid layer was released and the upper oily layer was decanted. The remaining middle layer that consisted of refined fat was then transferred into a 1-ml Luer-Lok syringes. The syringe was then attached to a blunt 17-gauge infiltration cannula, which was inserted through 2-mm incisions and advanced through the recipient tissues into the appropriate plane. Fatty tissue was deposited while retreating the cannula. The placement was done by several passes starting deep directly over the periosteum then passing superficially into the muscle, the subcutaneous layer, and finally into the dermal layer. Should there be any adhesions; a sharp cannula was used to free them up.

Postoperative care and follow-up:

The postoperative care for the injected area(s) was conducted following Coleman’s recommendations [1,3,19,20]. To decrease bruising and swelling,

taping and light iced compresses were used for the first 48 hours. Massage was discouraged in the first 2 weeks, and only pressure for normal gentle washing was allowed. In an attempt to promote the lymphatic drainage, there was no restriction on facial movements. However, vigorous movement of facial muscles such as frontalis, temporalis, and masseter was discouraged in the first couple of weeks to avoid traumatizing the newly formed blood vessels around injected fat grafts. Full course of antibiotics were given to all patients. All patients were seen by the end of the second week postoperatively, at 1 month, 3 months, 6 months, and 1 year. Standard photos were taken during each visit. These photos were used to compare the facial contour in the injected site(s) with those taken preoperatively.

Evaluation of results:

In this study, the patients, the plastic surgeon and the nursing staff evaluated the final results. Patients and the plastic surgeon's evaluation were done according to what they considered as the degree of improvement. As for the nursing staff, it was based according to the comparison of pre- or postoperative photos for the degree of improvement. The degree of improvement was classified as highly satisfactory, satisfactory, and unsatisfactory without very much improvement. Any complication related to fat grafting was recorded.

RESULTS

Twenty seven patients were included in this study. Their age ranged between sixteen and twenty eight years. They were fifteen females and twelve males. All patients were followed-up for at least one year. The patients' distribution was as follows: Three patients had only soft tissue deficiency and they all belonged to the hemifacial atrophy category (Fig. 2). The remaining 24 patients had both skeletal and soft tissue deficiencies (Figs. 3,4,5). They included 7 repaired cleft lip and palate patients, 5 patients with hemifacial microsomia, 4 orthognathic and jaw deformity cases, 3 patients with Treacher Collins syndrome, 2 frontal plagiocephalic patients, 2 patients with anophthalmic sockets, and another patient with hemifacial atrophy. Out of these twenty-four patients, twenty underwent reconstruction of their bony framework prior to fat grafting. The remaining four underwent only fat grafting as a camouflage tool (Fig. 6).

The overall rate of satisfaction at one year postoperative visit was recorded to be (83.8%) highly satisfactory (with 85% by patients, n=23; 74% by plastic surgeon, n=20; and 92.5% by the nursing staff, n=25), (12.5%) satisfactory (with 11% by patients, n=3; 18.5% by plastic surgeon, n=5; and 7.4 % by the nursing staff, n=2), and only (3.7%) unsatisfactory (with 3.7% by patients, n=1; 7.4% by plastic surgeon, n=2; and 0% by the nursing staff, n=0).

The total amount of refined fat injected in one surgical setting ranged between 8ml and 98ml with a mean of 42cc per injection. When comparing postoperative photos with preoperative ones, the volume of soft-tissue augmentation in the injection site stabilized around the third month postoperatively. No obvious absorption was further evident after 3 months, and the injection site(s) appeared to be stable throughout the long-term follow-up. None of the cases was overcorrected. Fat graft re-injection was done in seven patients out of the twenty seven patients. Five patients had re-injection once; two of them had hemifacial atrophy, one cleft patient, one patient with hemifacial microsomia, and the last one with Treacher Collins syndrome. The remaining two patients belonged to the hemifacial atrophy group, who were severe forms of the deformity, for which one had two re-injections and the other had three re-injections.

It was observed that transplanted fat not only adjusted their facial proportion but also improved surrounding tissues into which the fat was placed. An enhancement in the quality of their skin was also noted. Furthermore, not only were the scars reported to have looked better by the patients, but also a remarkable improvement in the color of the hyperpigmented skin on the diseased side was recorded in the hemifacial atrophy patients.

The main sequence of fat grafting was bruising and swelling. Although, bruising lasted from one to three weeks and swelling up to four weeks, the patients were not overly concerned since they were properly informed preoperatively. Two cases had discolouration under the eyelid that lasted for six months and nine months respectively. They were managed by topical vitamin E ointment along with concealing make-up. None of the cases developed infection, subcutaneous nodules, cysts, or any other complication. No donor site morbidity was recorded.



Fig. (2): A 17-year-old patient with minor degree of hemifacial atrophy confined to the left paramedian region of midface and forehead with characteristic coup de saber and perialar deficiency which started at early adolescence and has been stable for one year. (A) front pre-injection view (B) oblique lateral pre-injection view (C) lateral pre-injection view (D) areas marked for injection of a total of 17cc of pure fat (E) 6-months post-injection oblique lateral view (F) 6 months post-injection lateral view demonstrating a well balanced forehead and perialar regions.



Fig. (3): An 18-year-old female with Treacher Collins Syndrome (A,B) which is characterised by absent zygoma and downward slanting of eyelids. (C) 3 months following reconstruction of malar eminences by calvarial bone grafts. (D) 1 year later after undergoing a palatal mucosal graft to reconstruct inner lid lamella, lateral canthopexies and 21cc of pure fat injection into the malar, submalar, and upper lids to further improve on her facial aesthetics.

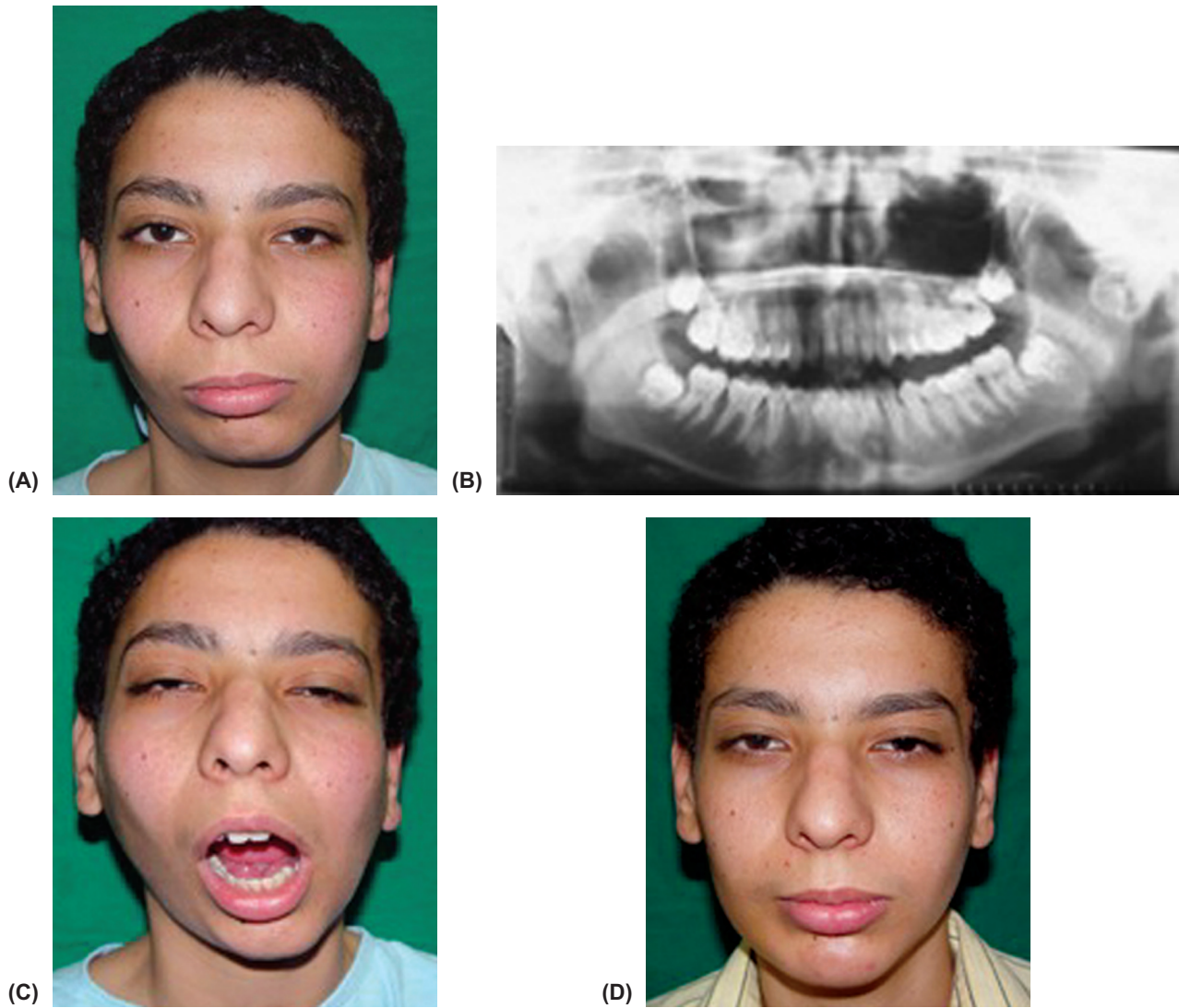


Fig. (4): A 16-year-old male presenting with maxillofacial asymmetry (A) which resulted from an old trauma to his left temporomandibular joint (B). There was a good adapted functional occlusion with good range of mouth opening (C) and the patient sought only cosmetic correction of the chin and declined any major bony correction. (D) Result 1 year after performing only a transverse sliding genioplasty that was further complemented by fat grafting of 12cc restoring a balanced chin to the rest of the face.



Fig. (5-A)



Fig. (5-B)

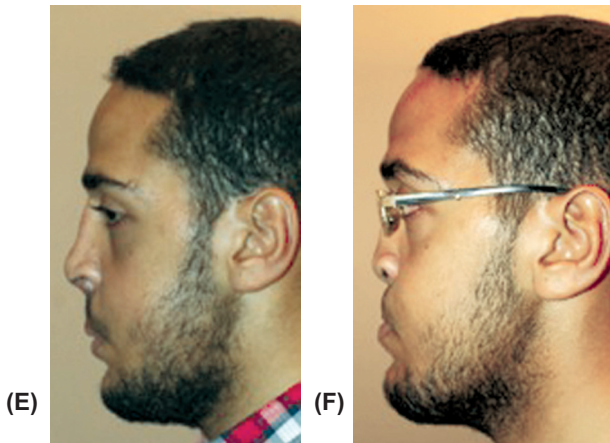
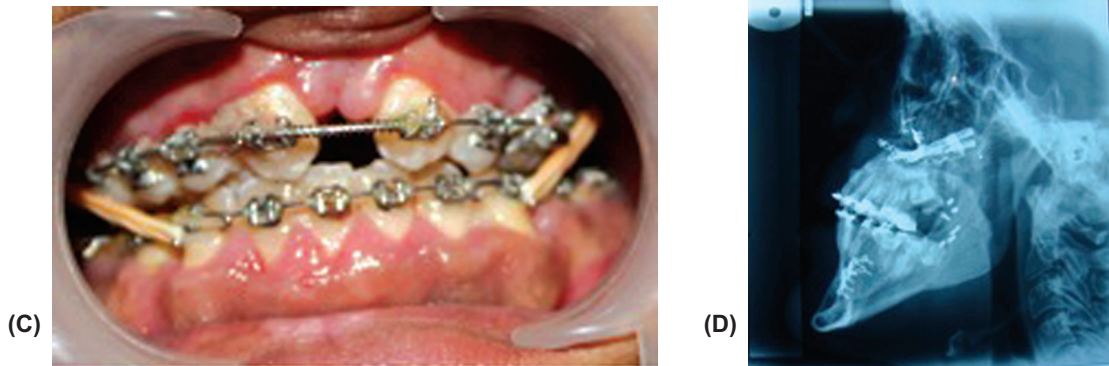


Fig. (5): A 23-year-old cleft male patient with relapse following a double jaw procedure performed elsewhere when he was 15 years old and exhibiting all stigmata of bilateral clefts in the form of severe retrusion of the maxilla and class III malocclusion (A,B). Re-advancement of the maxilla was performed using Lefort I distraction to achieve this type of occlusion (C) at the end of consolidation period and just prior to removing the distractor as seen on cephalometry (D). Although the occlusion achieved was satisfactory, the upper lip was still receding (E). 6 months following a rhinoplasty and fat grafting of 8cc to the upper lip with further improvement of his profile along with restoration of upper and lower lip relationships (F).



Fig. (6): A 25-year-old male patient who underwent eye enucleation during childhood for treating a retinoblastoma which resulted in microphthalmia along with bony and soft tissue hypoplasia of the whole left side of the face (A,B). The patient declined major bony reconstruction and elected to undergo fat grafting. (C&D) 3 months post-injection following grafting of a total of 98cc of pure fat into left orbital, temporal, malar, submalar, cheek and mandibular angle regions. (E,F) Eye socket reconstruction was performed using a prefabricated temporal flap. (G) Final appearance at one year with applied artificial prosthesis.

DISCUSSION

The transfer of autologous fat has been performed as whole grafts since the 1890s [21] and as injectable grafts since the 1920s [22]. However, because of the unpredictable results due to high rates of resorption and replacement by fibrous tissue, fat grafting and injection fell from favor and became neglected [23,24]. The development of liposuction for body contouring in the 1980s by Illouz [25] awakened interest in autologous fat transfer because of the natural tendency of grasping the opportunity to use the removed fat to augment or restore areas of the face with volume loss or contour irregularities that occur with aging. Although, several reports within the plastic surgery literature documented this rising interest of using fat transfer for facial recontouring [16,26,27], it is Sydney Coleman who refined the technique and is being credited for popularizing it [1,3,19,20].

With the rising interest in using fat injection and with the ideal goal being the "replacement of like with like", autologous fat graft injections become a logical approach for treating reconstructive cases with soft tissue deficiencies. This technique can be used for restoration of primary facial soft-tissue deficiency that has atrophied from disease as in the current study, and can also be used for replacement of soft-tissue loss from accident, infection, or surgery.

In compliance with Coleman [19], harvesting sites were chosen for ease of accessibility and to improve the patient's body contours. This is because the published studies have not indicated increased viability from any one donor site [28,29]. Furthermore, the weight of each patient was recorded preoperatively and at each follow-up visit to detect any weight fluctuations.

A wide variation in fat grafting outcomes has been reported with different processing methods, different surgeons and with different clinical indications. The results of this study with complex facial deformity patients are consistent with other clinical studies [30,31]. Similarly, re-grafting was required in seven patients of this study. This was carried out at least three months after the first treatment since the augmentation stabilized around that time with no further loss observed. Because there is no standardized rating scale to evaluate the outcome in these studies, a second or even third fat grafting procedure performed in two of the most severe cases out of the seven was carried out according to the subjective assessment of the

patient and the surgeon when both considered the achieved result unsatisfactory. Comparable with Xie et al. [32] clinical observations, it appears that more fat grafts might survive each time with the repeat of fat grafting injections. Billings & May [33] attributed it to neovascularization and improved vascularity in the recipient site after each time of autologous fat transplantation, while Coleman [19] explained it through the accumulation of preadipocytes into the recipient site each time after fat grafting.

Although the role of fat grafting in these reconstructive cases was to restore contour defects, fill localized atrophy and to adjust facial proportions, additional benefits were perceived. We have observed an improvement in the overlying and the surrounding tissues into which the fat was injected similar to recent studies by Coleman [19] and Phulpin & colleagues [31]. Furthermore, not only were the scars reported to have looked better by the patients, but also a remarkable improvement in the color of the hyperpigmented skin on the diseased side was recorded in the hemifacial atrophy patients. Fat grafting also served a functional purpose as in the two patients with anophthalmia. It was used to augment the atrophic periorbital soft tissue preceding the fitting of the ocular prosthesis [34]. Where, after one session of fat injection the orbital prostheses were successfully fitted.

Apart from the prolonged edema and temporary discoloration, none of our patients had minor or major complications from the fat injection procedures. Allali and coworkers [35] presented a patient with visual loss following autologous refined fat injection into the glabellar area to treat wrinkles. They explained it as a direct consequence of the surgery, by retrograde arteriolar microembolus into the ophthalmic artery via peripheral anastomoses with the arteries of the face. Similarly, Mori and colleagues [36] reported on a similar case of blindness due to occlusion of the ophthalmic artery following injection of autologous fat into the glabellar region for cosmetic purposes. Injection of autologous fat into the nasolabial fold has been also reported by Park and associates [37] to have resulted in sudden unilateral visual loss. The autologous fat injected was thought to have entered the dorsal nasal artery and the retrograde migration of the emboli to the ophthalmic artery might have caused the multiple occlusions of the short posterior ciliary artery. This catastrophic complication was not seen in our study, although all cases required injection of fat into various facial planes and sometimes around the eyes.

In Conclusion: The versatile application of fat grafting can be extended efficiently into the difficult and complex facial reconstructive patients. Its use becomes a logical approach for treating cases with only soft tissue deficiencies with the ideal goal being “replacement of like with like”, cases with combined skeletal and soft tissue deficiencies after establishing the bony foundation to further enhance on aesthetic outcome and refine upon the bony work done, or as a camouflage tool being an alternative modality for cases declining major surgeries.

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