Mini Review

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Journal of Dental and Craniofacial Research
ISSN 2576-392X

2021
Vol. 6 No. 4: 91

Fat Grafting and Cleft Lip Repair: A Concise Literature Review

Shohreh Ghasemi[1*], Parsa Firoozi[2], Fargol Mashhadi Akbar Boojar[3], Nooshin Yazdani Panah Dehnavi[4], Rathindra Nath Bera[5], Mahmood Dashti[6] and Delaram Pourkazemi[7]

[1]Department of oral surgery, Augusta University, USA
[2]Department of Oral and Maxillofacial Surgery, Zanjan University of Medical Sciences, Iran
[3]Dentistry Department, Esfahan Dental University, Iran
[5]Department of Oral and Maxillofacial Surgery, GNIDSR Kolkata, India
[6]DDS, Private practice, Tehran, Iran
[7]DDS, Mazandaran University of Medical Sciences, Iran

Corresponding author:
Shohreh Ghasemi, Department of oral surgery, Augusta University, USA

sghasemi@augusta.edu

Citation: Ghasemi S, Firoozi P, Boojar FMA, Dehnavi NYP, Bera RN (2021) Fat Grafting and Cleft Lip Repair: A Concise Literature Review. Dent Craniofac Res Vol.6 No.4

Abstract

Lips have a principal esthetical effect on a person's face. Patients with congenital cleft lip may have various deformities, including cleft lip, cleft palate. Both the environmental and genetic factors are responsible for these deformities. A variety of surgical operations and options are present with a high success rate for treating these abnormalities. The methodology and technologies mentioned here are aimed at attaining the goal of a normal-appearing lip and nose. Primary cleft lip repair by fat grafting is performed as the primary treatment surgery. In contrast, secondary cleft lip repair by fat grafting involves the revision and correction surgeries required to bring the lip and nose near a normal stricture. The surgeries involve some essential steps and advanced technologies and methodologies. The number and types of surgeries depend upon the type and extent of deformation.

Keywords: Cleft lip; Reconstruction; Fat graft; Aesthetic

Received: July 10, 2021; **Accepted:** July 17, 2021; **Published:** July 28, 2021

Introduction

A cleft lip is the most common craniofacial anomaly [1]. The cleft lip may be present in different degrees of severity with or without associated cleft palate [2]. The failure of the fusion of maxillary and nasal processes in embryo development results in this abnormality [3]. This malformation has a wide range of clinical symptoms, which vary according to the anatomical structures involved: cleft lip, cleft lip, and palate. The etiology is multifactorial and includes both genetic and environmental factors [4]. The goal of cleft lip repair is asymmetrical and balanced lip with the minimal scar that restores the natural contours of the face and correct functional anatomy. Many repair techniques and surgical protocols are designed with conserved targets to align the lip and nose in the correct formation. The most natural results must compile, re-establishing the nasolabial area's normal contours, minimizing the scar, and perfecting the incision [3]. While some surgical procedures showed satisfactory outcomes, patients with a history of cleft lip repair often experience ridicule and bullying by their peers with subsequent anxiety or depression [5]. Neuber performed the first allogeneic adipose tissue grafting in 1893 with an open approach, followed by Hollander in 1912, Neuhof in 1921, and Josef in 1931. In the early 1980's, closed liposuction was introduced by Illouz and Fournier. In 1987 Coleman published a new method of atraumatic fat transplantation [6].

Nevertheless, fat grafting has gained widespread popularity among plastic surgeons in the last few decades. It has been used as a treatment for aesthetic and reconstructive contour defects [7]. Previous studies showed that fat grafting efficacy improved skin softness and skin appendage, epidermis, and dermis architecture [8]. This review aimed to evaluate the feasibility and efficacy of fat grafting in cleft lip repair.

The scar is an unavoidable and noticeable feature of the wound healing process. Some factors may contribute to the scar caliber, like the suture type, how long the suture is placed, tissue elasticity, and the skin's wound healing capacity. Unwanted scarring from the cleft lip repair surgery may be the reason for secondary deformities of the nasolabial area. Even a properly operated cleft

lip may result in scars, but now technical and adjunctive measures are investigated to decrease the burden of scar formation [3].

Methods and Materials

Searches were performed in PubMed, Scopus, and Google scholar electronic databases in April 2020. Searches were limited to peer-reviewed articles in the English language published from 2000 to 2020. The following main keywords, "Cleft-lip," "fat-graft," "fat-harvest," "fat-transplantation," and "fat-transplants," were checked with the MeSH (Medical Subject Headings) database than were used. The reference lists of all primary studies were searched manually for additional relevant publications.

Current Approaches to Cleft Lip Repair

A multidisciplinary follow-up is needed for cleft lip repair over a child's life [9]. Cleft lip repair divides into two main categories: Primary cleft lip and Secondary cleft lip. Primary lip repair is usually done in the first few months of life. During growth, it may change due to dehiscence or scarring during muscle restoration, alteration of the underlying alveolar place, tooth extraction, and orthodontic tooth movement [10]. The most highlighted reasons for secondary cleft lip reconstruction include hypertrophic or expanded scars, whistle deformity, asymmetric philtrum, and shortening of the horizontal and vertical lip. New secondary reconstruction strategies can be subdivided into muscle-based and straightforward methods. The latest recommendations for surface reconstruction include local flap reconstruction, silicone gel sheeting, botulinum toxin injection, and CO_2 laser ablation. Suggestions for muscle repair include pedicled prolabial flaps, modified abbe flap, and orbicularis-oris eversion [11]. Also, fat grafting is a new technique for both primary and secondary cleft lip repair [9].

Autologous Fat Grafting

Preoperative evaluations

Like any other surgical procedure, medical history and physical examination should be considered before a surgical operation. History of bleeding or clotting disorders, smoking and tobacco use status, antibiotic resistance, taking anticoagulants, and previous surgical procedures are needed to be evaluated before surgical operation. Also, the photographic study involves preoperative evaluations based on Coleman guidelines [12]. It is recommended that patients be informed about any possible complications, and finally, consent be taken. Fat harvesting and fat grafting areas should be marked with colored markers preoperatively [13]. The usual preoperative blood tests, including hemoglobin estimation, urea, electrolyte creatinine levels, and electrocardiography, are performed for every patient. The preoperative photographs are also taken before the surgeries for the record and comparison of results after the surgeries are performed [14].

Donor sites

Zhen et al. in 2019 used the thighs, abdomen, or buttocks as the donor sites with a 1:1 tumescence to aspirate ratio. There was no donor site morbidity during the fat grating in the primary cleft lip surgery, and no contour deformities were observed. The incisions at the donor sites healed well and remained unnoticed [15].

Fat harvesting

Manual liposuction was used for the fat harvesting from the lipoaspirate from the donor sites [14]. Abdali et al. performed the surgical correction of upper lip deficit using dermis fat graft by general anesthesia via nasotracheal intubation. A surgical incision was made along with the vermilion, forming a submucosal pocket. This pocket acted as a recipient site for the DFG. The amount of the DFG required depends upon the length of the lip and the deformity's extension. The amount of the graft was outlined on the groin area. The graft was harvested after de epithelialization. The donor site was closed, and extra subcutaneous fat was removed. Keeping the amount to get resorbed more significant amount of graft tissue was used. By keeping the dermis, comprehensive, more significant augmentation was obtained [16]. Bae et al. performed micro fat grafting by first determining the incision site in which the cannula is inserted. Then the donor site is selected at the abdominal region where the fat is harvested from.2% lidocaine, and 1:100000 epinephrine was used as topical anesthesia. The incision was made with a scalpel, and the tumescent solution is applied. Fat was harvested by the use of a 10 mL Luer lock syringe [17]. Balkin et al. performed fat grating for primary cleft lip repair in which the fat was harvested from one or both thighs using a manual suction process. 1-3 cc of 1% lidocaine was injected at the donor site. The aspirated fat was transferred to a white and dense syringe without much heme [3].

Fat processing

Fat aspiration involved a tipped catheter on a 20-ml syringe. The decanted and purified fat is reloaded on a syringe and injected with a 1.5 mm grafting needle. The fat aliquots are injected into the subcutaneous, submucosal, and muscles depending upon the contour of the lip deformation [14]. Bea et al. centrifuged the harvested fat for 3 minutes at 3000 rpm to purify the fat. The purified fat is transferred to a 1 mL syringe by a Luer lock. The patient was given anesthesia, and three sites were selected for the graft—the vermilion of the upper lip, the nasolabial fold, and the oral commissures. After the application of local anesthesia, the separated fat was injected at the incision site. The fat was injected into the submucosal layer, the intramuscular layer, and then the subcutaneous layer. The extra fat was injected into the deficit in volume, and the grafting procedure was completed [17]. During the upper lip's surgical correction, Abdali et al. introduced the appropriate amount of graft into the tunnel created by the incision. The graft was placed in a way to face outward, bulging the secondary lip defect bulge. At the incision point, a proper bed for the graft was prepared [16]. Balkin et al. injected the fat graft into the cleft side philtril columns, piriform, vermilion, and ala using a gauge needle with a 1 cc syringe. The fat was injected submucosally, subcutaneously, preperiosteal, and intramuscularly.

Complications

Normally, the fat grafting surgeries of various forms of lip and nose did not observe any complications in the recovery. There

was no bleeding or problems at the donor site nor pain, infection, or wound breakdown; however, there was some difficulty fitting the nasal stents [3]. The complications associated with cleft palate repair surgeries are not common, but outstanding records of airway obstruction have been reported requiring the removal of fat. Fatty hypertrophy causing obstructive sleep apnea was observed in 3 cases in Australia. The fat injection was done into the posterior pharyngeal wall and soft palate and in the posterior pharynx alone in one patient. The patients also had syndromes associated with hypotonia. Although this is the only complication of hypertrophy observed so far, it is a warning for future cases. Other applications of facial fat grafting caused some cases of blindness and stroke due to fat embolism. Injection to the soft palate is a safer option to avoid issues involving middle cerebral artery embolism [18].

Postoperative care

Many patients that do not have any other complications are discharged on the same day of operation [19]. The postoperative care of the surgery involves ointment and taking a soft diet for about a week or so. Swelling is observed for about two weeks which gets better over time. The final results can be observed after 2-4 months of the surgery [20]. The surgery results were evaluated after four months. The follow-up treatment includes an annual visit to the surgeon to observe the growth and formation of lip structure [16]. Scar care for the fat grafting operation involved the use of steri strips for two weeks, silicone gel and vitamin E for two weeks, and a gentle massage for some months [15].

Nano and micro fat grafting

In some patients, the upper lip is deficient in volume after the cleft lip repair operation. The overall three-dimensional volume of the upper lip is attempted to increase by autogenous micro fat grafting. The upper lip protrusion increased by 46.7% after the surgeries. The autogenous micro fat grafting proved to be effective for upper lip volume correction. However, we cannot predict the expected volume and corrections in the upper lip volume as fat resorption often occurs. Furthermore, long-term follow-ups may be required to evaluate and assess the autologous micro fat grafting procedure results [17].

Advanced and improved techniques are evolving to decrease hypertrophic scar formation after the cleft lip repairs. These methods include silicone gel sheeting, meticulous soft-tissue handling, botulinum toxin injection, topical mediators, fat grafting, and laser treatments. Minor revisions of the scar on the patient's desire include local Z-plastics at the alar sill and the vermillion border and the vermillion mucosal excisions [11]. The various surgical methods available are used according to the size of defects and the clinical characteristics of the patients. The advantages and disadvantages of each method must be understood well to get the best results [16].

It is safe to perform primary cleft lip repair via fat grafting. Moreover, we can get optimized results in soft tissue augmentation and minimizing scar formation. Prospective comparisons are mandatory to further elaborate on our findings [3].

Primary Cleft Lip Repair via Fat Grafting

Primary cleft repair is the first essential surgery performed within the first months of a patient's life. It involves the lower third of the nose's primary repair, comprising the nasal tip, nostril symmetry, and the alar bases. Long-term patient follow-ups are required to monitor and evaluate the area's growth and symmetry and decide if any revision surgery is required. The revision surgeries come in the category of secondary cleft lip repair. The primary lip repair may need a revision during growth due to scar gapping, tooth eruption and extraction, changes in the underlying alveolar position, and orthodontic tooth movement. Grading scales represent to decide the success rate of the nasolabial outcomes after the primary lip repair. These scales help get better nasolabial esthetics. The patients with cleft lip alone get better esthetics and need fewer revision surgeries than the patients with a cleft lip and a cleft palate [11]. Fat grafting has many benefits in the field of plastic surgery, including scar modulation and contour augmentation. This may be due to the transfer of adipose-derived stem cells, which promote angiogenesis, re-epithelialization, and healing. Fat grafting is proved to perform augmentation, improves skin quality and scar appearance, and improves contour and structure. Studies show that fat grafting improves the skin softness and the texture of the dermis, epidermis, and skin appendages. Fat grafting has the flexibility to be used with any anatomic repair treatments. It was also seen that infant medial thigh contained high fat to harvest and clinical use without any complications and minimum donor site morbidity. Therefore fat grafting is a safe option in infants for the treatment of cleft lip repair [15].

The advanced fat transfer techniques use a soft tissue augmentation process to correct the deformities. Recent developments prove that stem cells called adipose-derived stem cells are producers of factors promoting wound healing and regeneration. This autogenous tissue may also have a role in scar improvement and minimizing the scar burden. Research shows that the adipose-derived stem cells (ADSCs) of infants are biologically robust as compared to adult tissues [3].

Secondary Cleft Lip Repair via Fat Grafting

The secondary cleft lip deformities are mainly superficial or muscle-related. On this basis, the patients are generally divided into two groups depending upon the type of deformity.

Group 1: Superficial deformities

These deformities include vermillion border irregularities, poor scarring, irregularities of wet and dry vermillion, excess vermillion, and minor alar sill asymmetries. The superficial issues can be treated through minor treatments involving local scar revisions, laser, mucosal excision, small local flaps, and fat grafting.

Group 2: Muscle deformities

These include philtral asymmetry; vertically short lip, whistle notch deformity, abnormal and asymmetric lip movement, lateral

lip bulge. The muscle deformities need a total lip revision to obtain permanent improvements in lip formation and function. The occurrence of secondary lip operations is now raised from 16 to 56.9%. The main reasons being widened scar and irregular vermillion cutaneous border [11].

After the unilateral or bilateral cleft lip repair, patients often face upper lip vermillion deficiencies that hinder the aesthetic outcome they desire. This deficiency is on the side of the lip after unilateral CL and in the center after a bilateral CL. These vermillion deformities can be corrected by invasive, minimal, or a combination of both techniques depending upon the type and amount of deformity. The invasive techniques used for the purpose may include V-Y advancement, Z-plastics, and W-plasty. A variety of mucosal or myomucosal flaps may also be involved [21]. The main target of reconstruction and revision is to restore the symmetry and functionality of the lip [11].

Other techniques reported for this correction are dermal fat grafting, implantation of a cellular dermal matrix, autologous fat injection, and temporoparietal fascia. The fat injection techniques and dermal fat grafting are successfully used for cosmetic lip enhancement and uniform. Symmetrical cosmetic lip enhancement, but these techniques are not that successful for patients with vermillion deficiency after CL repair. The external and internal scarring of these patients interferes with the graft positioning. Lip augmentation using precision dermal fat grafting to make up the volume in the upper lips in the patients having a unilateral or bilateral CL repair has given considerable results. This technique can give long-lasting results in fewer surgical procedures to maintain a facial balance and lip harmony [20]. The free fat in the autologous free fat technique has various benefits, being non-infectious, cheap, biocompatible, non-allergenic, variable in size, and having few complications. If needed, several autologous fat transplantations can be conducted within six months [16]. The complete redo lip revisions are better be postponed until the end of the growth phase unless requested by the patient. The cleft lip revision should be planned according to the patient's concerns and desires and designed in a proper timeline to uplift the patient's psychological well-being and social integration [11].

Whistle deformity is often observed after the surgical operations of unilateral or bilateral cleft lip. It may be due to tumor excision or trauma. It is characterized as a deficit in the vertical length of the lip, so the upper and lower lips do not touch in that area, giving a whistling appearance. Despite the advanced surgical techniques, whistle deformity remains one of the common problems that need surgical correction. 29 out of 35% of the cases 0f secondary surgeries for cleft lip patients are associated with whistle deformity. Autologous free fat grafting operations for the treatment of whistle deformity is a reliable method with low complication risks. The whistle deformity leads to many psychological problems, including lowering of self-esteem and confidence. The patient needs help and support regarding rehabilitation issues like breathing, eating, speech, certain hobbies like playing an instrument, etc. Different surgical techniques, including lateral vermilion, V-Y plastics, Z-plastics, W-plastics cross-lip flaps, are used for the treatment.

Postoperative care involves rest, local cooling, and massage of the area. Possible complications may be infection, hematoma, fistula, chronic or recurrent pain, liquefaction of the transplant, resorption, and muscle soreness, and the patients are discharged on the third postoperative day. The patients are examined weekly for up to six months until the surgeon and the patient [21].

Sasson et al. introduced a novel passage for the dermis fat graft augmentation for repairing the vermilion deficiency after the cleft lip repair. The needle can deliver the dermis fat graft within the dry vermilion through the submucosal tunnel without exposing the adjacent soft tissues by the use of a red rubber catheter. This is a more reliable and targeted method for vermilion augmentation than any other techniques making the graft delivery more simple, fast, and predictable [22].

The cleft lip repair surgery often results in a notch in vermilion. This deformity may result from the primary surgery or due to a defect before the first surgery. In some patients, this deficit is so marked that they need secondary surgeries or volume enhancer operations to readjust and make a beautiful appearance. Numerous materials are available for filling the free vermilion of the upper lip like dermofat, fat, dermis, and labial minor grafts. Because dermis fat graft (DFG) is available abundantly in the body, the techniques using DFG are relatively convenient to perform. The harvesting from the donor sites has no serious morbidity results having sufficient volume and less resorption. It is a perfect volume enhancer with durable clinical results [16].

The augmentation of thin lips can be performed by various techniques, including autologous tissues, using alloplastic materials like alloderm, gore-Tex, polytetrafluoroethylene, and fillers. The volume deficit correction using fillers is comparatively simple to perform. Still, the three-dimensional increase in volume is difficult to obtain using this method. There are risks of infections and foreign body reactions. In comparison to fillers, autologous fat grafting can perform permanent and durable correction of volume deficit with relatively lesser complications. In the areas of frequent movement like lips, there are greater chances of resorption, and it is difficult to predict the accurate results of the surgeries. In the fat graft operations, the patients maintained the engrafted fat tissues in their upper lips for more than two years [17].

Conclusion

The cleft lip nasolabial corrections have altered and reformed many times for restoring the facial structures in their routine and proper anatomic position. This maximizes the functional and aesthetic outcomes minimizing the burden of secondary deformities. These developments have lessened the need for secondary deformities. Still, the requirement of secondary or revision surgeries may exist. Fat grafting treatments and technologies have proved to be a magical solution for patients with cleft lip solving their medical—psychological, and social issues at the same time. The patients with cleft lips now can dream of having an average face and hence an everyday life. These

technologies have freed them from social stigmatization and complexes. Utilizing structural fat grafting is a secure and efficient way to improve the symmetry and facial balance in patients with cleft lip. Due to the greater extent of patient satisfaction, low complication, and reasonable durability, far grafting has several benefits for secondary cleft palate treatments. Several methods and specific secondary cleft lip surgeries by fat grafting lead to removing all deformities and scars in the treatment process and producing a balanced and proper facial impression.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

Ethical Responsibilities of Authors

The manuscript has not been submitted to more than one journal for consideration. The manuscript has not been published previously (partly or in full) unless the new work concerns an expansion of previous work; there is no transparency on the re-use of material to avoid the hint of text-recycling ("self-plagiarism").

Funding

This study was not funded by any organization or institution or any research grant company.

Ethical Approval

This literature review does not need any approval by any administration committee or any organization.

Statement of Human and Animal Rights

This article does not contain any studies with human participants or animals performed by any of the Authors.

Consent Form

For this type of study, informed consent is not required.

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