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A CASE SERIES: MICRO AND NANO FAT GRAFTING FOR THE TREATMENT OF TESSIER 3 AND 4 CRANIOFACIAL CLEFTS VOLUME DEFECT

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ABSTRACT

Introduction: Patients with craniofacial clefts who have had reconstructive surgery often develop problems, such as contour deformity that will cause psychological issues. Micro and nano fat grafting are various methods utilized to overcome these issues.
Case Illustration: This case series describes two patients with facial contour deformities due to Tessier 3 and 4 craniofacial clefts, respectively. Each patient underwent secondary reconstruction correction surgery followed by a combination of micro and nano fat grafting.
Discussion: Results on day 7 after surgery were promising. Growth factors and stem cells in nano fat complemented the micro fat properties, thus increasing the survivability rate.
Conclusion: This case series demonstrates that the combination of micro and nano fat shows promising results for overcoming facial contour deformity.

Highlights:

1. Combination of micro and nano fat grafting shows promising results for correcting facial contour deformities caused by Tessier 3 and 4 craniofacial clefts.
2. Nano fat grafting, which contains growth factors and stem cells, complements the properties of micro fat grafting, leading to increased survivability rate and better outcomes.

INTRODUCTION

Patients with craniofacial clefts who have had reconstructive surgery often develop problems such as facial contour deformities, scar tissue from previous surgeries, and uncorrected previous congenital defects. These physical issues will cause psychological problems for the patients later.

One of the methods for overcoming facial contour deformities on the face is fat grafting. Fat (specifically micro fat grafting) is ideal for transplant and other body remodeling due to its high availability, non-immunogenic properties, low donor tissue morbidity, and regenerative function. In addition, fat grafts provide natural results, last for long periods, and rejuvenate the skin[1-3].

Micro fat, measuring 1.2 mm or less, contains many live adipocytes. Micro fat is used to fill defects. Nano fat, measuring 400 to 600 μm, contains stromal vascular fraction cells (SVFs), free fatty acids, and fragmented adipocytes. The advantages of nano fat include the potential uses for stem cells and its rich content of growth factors[4].

One of the limitations of fat grafting is viability variation during the grafting process at the recipient site. This limitation challenges the state of current fat grafting procedures. Various techniques have been developed to overcome this problem, including the combination of micro and nano fat grafting[5].

This case series describes two patients with facial contour deformities due to Tessier 3 and 4 craniofacial clefts, respectively. Each underwent secondary reconstruction correction surgery followed by micro and nano fat grafting. The rarity of these cases suggests groundbreaking applications for the results. This case report was written following the PROCESS 2020 guidelines[6].

CASE ILLUSTRATION

The two patients were evaluated and treated within two different periods. Each received consultation and planning sessions prior to surgery. Consent for the procedure and scientific publication was obtained by the signature of the patients' caretakers. All surgical procedures were carried out in a hospital. Both patients underwent a one-step procedure and secondary reconstruction of micro-nano fat grafting under general anesthesia conducted by a plastic reconstructive and aesthetic surgeon.

Micro fat and nano fat preparation

Tumescent solution (Lidocaine 1000 mg/liter and adrenaline 1:1,000,000, 250–500 cc) was injected into the lower abdomen to facilitate liposuction. Lipoaspirate was collected manually via negative pressure created by manually pulling a Tonnard cannula (Tulip Medical Products, San Diego, CA) connected to a 10 mL syringe. About 50 mL of harvested lipoaspirate was centrifuged at 1,300 rpm for 5 minutes. Three-layer sedimentation was formed: (1) oil, (2) adipose (middle layer), and (3) liquids and blood. Emulsification was carried out a second time for the (2) adipose layer after removing oil, liquids, and blood from the sedimentation. The process was carried out using a Luer-lock connector with a size of 2.4 mm and a size of 1.2 mm. The result of this emulsification was micro fat. Half of the micro fat was further filtered using nanofiltration to produce nano fat.

Case 1

The first patient was a six-year-old girl from Papua, Indonesia, with a facial contour deformity due to Tessier 3 right-

sided craniofacial cleft and bilateral cleft lips palate, which had previously undergone a reconstruction surgery to the facial soft tissue. No other previous surgery was reported. No other relevant medical history was reported by the patient. The physical examination revealed that the right medial canthus was inferior to the healthy side. There was visible volume deficiency in the right cheek area due to soft tissue deformity of the Tessier 3 craniofacial cleft or potentially as a residual defect after the initial surgery. Vermillion and white skin roll on the lips were not well approximated (Figures 1A and 1B).

Figure 1. Pictures of patient 1. (1A). Antero-posterior (AP) view of patient 1 before surgery. (1B). Oblique view of patient 1 before surgery. (1C). AP view of patient 1 after surgery. (1D). Oblique view of patient 1 after surgery.

Corrective surgery was performed on the lips to obtain symmetry and a better approximation of the vermillion and white skin roll. Medial epicanthoplasty by performing multiple z-plasty was conducted on the skin around the medial canthus. Afterward, the medial canthus was repositioned and fixed on the nasal bone using a snare wire and a 0.3 mm screw. The skin was sutured using a 5.0 size non-absorbable thread. A combination of micro and nano fat was injected to improve facial cheek contour on the right side and right inferior eyelid. An adjusted amount of micro and nano fat in combination (approximately 5- 10 cc to fit the volume defect) was directly injected using a Micro Autologous Fat Transplantation (MAFT)-gun.

Antibiotics and analgesics were administered post-operatively. Follow-up and suture removal were performed on the seventh day after surgery. The evaluation results were promising (Figures 1C and 1D). There were no intra- or post-operative complications.

Case 2

The second patient was a ten-year-old girl from Papua, Indonesia, with a facial contour deformity due to a Tessier 4 craniofacial cleft on the left side, which had previously undergone primary soft tissue reconstruction with no other reported surgery. No other relevant organ or systemic abnormalities were found. There was no family history of similar congenital abnormalities, nor a history of illness or drug use during pregnancy. Physical examination revealed that the medial canthus of the left side was lower than that of the contralateral side. There was a volume deficiency around the left cheek and the lower area of the left inferior palpebra (Figures 2A and 2B).

A canthopexy procedure was performed to elevate the left medial canthus and achieve symmetry to the healthy side. Following the procedure, an adjusted amount of micro and nano fat was injected directly using a MAFT gun (approximately 10 cc to fit the volume defect).

Antibiotics and analgesics were administered post-operatively. Follow-up and suture removal were carried out on the seventh

day after surgery, where the evaluation results were promising (Figures 2C and 2D). There were no intra- or post-operative complications.

Figure 2. Pictures of patient 2. (2A). AP view of patient 2 before surgery. (2B). Oblique view of patient 2 before surgery. (2C). AP view of patient 2 after surgery. (2D). Oblique view of patient 2 after surgery.

DISCUSSION

Day 7 post-operative follow-up is a pivotal time for short-term evaluation. Day 7 is the point at which the grafted fat necrosis phase ends, the proliferative-regenerative phase begins, and swelling starts to reduce. Arguably, a longer follow-up period (of more than seven days) is considered to be the standard for evaluating graft survivability, although short- term evaluation is as important, especially when evaluating such surgical techniques for rare cases as presented in this report. Hence, the 7-day period is ideal for conducting a short- term evaluation[7,8].

In the first case (Figure 1), the facial contours appear more symmetrical post-surgery. The patient's right medial canthus is higher towards the contralateral side, and the vermillion lips are better approximated. In the second case (Figure 2), the position of the left medial canthus was raised to the position of the medial canthus of the contralateral side after surgery. Additionally, the intercanthal distance was corrected so that it appears more proportional.

In this case, micro and nano fat grafting was carried out to fill the facial contour volume due to soft tissue defects caused by craniofacial clefts. A study by Chkadua et al. (2019) treated hemifacial atrophy patients with a combination of micro and nano fat grafting, resulting in increased blood flow and network volumes and vasomotor activity on the treated side, mimicking that of the healthy side. This suggests that the combination of micro and nano fat grafting becomes a potential method in our case compared to others.

Unpredictable levels of viability and reabsorption make fat grafting challenging. Therefore, we combined the use of micro and nano fat to increase the fat viability and suppress subsequent reabsorption[7,8]. Adipose-derived stem cells (ASCs) and adipose progenitor cells (APCs) contained in nano fat and growth hormones from fragmented adipocytes act as supplements for micro fat. The combination of these two preparations facilitates the proliferative and regenerating phases of the fat transplant process[10,11].

In this case, liposuction was facilitated by the infiltrated tumescent solution in the donor area. In this series, the tumescent solution was formulated by diluting Lidocaine and adrenaline (to a concentration of 0.1% and 1:1,000,000, respectively). According to several previous

studies, tumescent solution does not have a detrimental effect on graft viability. Generally, a dose of 4.5 mg/kg (without adrenaline) and 7 mg/kg is recommended for local anesthesia. However, a considerably high dose between 35-55 mg/kg is widely used in tumescent anesthesia for liposuction, followed by minimal complications and excellent safety. On the other hand, the use of tumescent solution has several advantages, such as reducing post-operative pain, reducing bleeding, and facilitating the liposuction process[5,12,13,14].

The MAFT gun accurately controls the volume of each injection at a predetermined location (Figure 3) so that each injection is consistent in size, small enough to achieve plasma imbibition and diffusion, and has a better margin surface area. According to the study by Carpaneda et al. (1994), only 40% of the marginal zone (1.5±0.5 mm of the grafted margin) can survive. A study by Yoshimura et al. (2008) showed similar results, with a radius of 1.2 mm from the margin consisting of survival and regenerative zones flanked by a necrotic zone[11,15,16].

Research conducted by Krastev et al. on fat grafting in patients with facial contour abnormalities obtained a high satisfaction rate and showed minimal complications. Similarly, there was no notable complication observed or reported by the patients in this case series[3].

Figure 3. Injection site with predetermined location in patient 1

A study by Kato et al. demonstrated that the stabilization of fat reabsorption at the recipient site begins in the third month post- surgery and continues until the end of the first year. This suggests that a one-year follow-up may indicate long-term outcomes in micro and nano fat grafting practices. However, both patients in this study came from a remote area in Papua, so it was challenging to maintain contact and establish a one-year follow-up appointment[4].

CONCLUSION

Combining micro and nano fat grafting with the use of a MAFT gun is a promising method for overcoming facial contour deformities.

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CONFLICT OF INTEREST

All authors declare that there was no conflict of interest in this article.

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AUTHOR CONTRIBUTION

All authors made the same contribution in writing on the results of the study.

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