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ORIGINAL PAPER

Forehead biconvexity enhancement with fat grafting

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Abstract

Background Frontal biconvexity is a key criterion for an attractive forehead. Fat injection as an effective, safe and reliable method for soft tissue augmentation could be used to enhance forehead contour. We report our experience with combined platelet-rich plasma (PRP) and fat grafting to create or restore frontal biconvexity and to reduce wrinkles.

Methods Fifty-seven females and 4 males (mean age, 40.2 years) underwent the combined PRP and fat injection. Fat mixed with PRP on the ratio of 5:1 was injected in small aliquots in the space between the dermis and underlying frontalis muscle. Patient satisfaction with the cosmetic result was evaluated by a questionnaire using pre- and postoperative photos and a four-point grading scale.

Results All patients who underwent three injection sessions ($n = 5$) evaluated the esthetic result as excellent. In patients who had two injection sessions ($n = 36$), 36% evaluated the result as excellent, 50% as good, and the remaining 5 as moderate. In patients who had a single injection session ($n = 15$), 27% evaluated the result as excellent, 40% as good, and the remaining 5 as moderate. Concerning frontal wrinkles, 25 of 34 (73.5%) patients reported good improvement and the remaining 9 (26.5%) reported moderate improvement.

Conclusion Fat injection combined with PRP should be considered as an effective tool to improve forehead biconvexity.

Level of evidence: Level IV, therapeutic study.

Keywords Lipofilling · Forehead · PRP · Fat grafting

Introduction

The forehead is an important constituent of facial esthetics. This anatomic region contributes significantly to the overall appearance of the face and apparent age of individuals [1].

The forehead occupies approximately one third of the face and is one of the major determinants of a feminine or masculine look. A broad, convex and smooth forehead is considered more feminine and attractive than a flat or concave one [2]. A mild forehead biconvexity in the frontal, oblique, and lateral views renders the face even more attractive and youthful. Loss of subcutaneous tissue is often the main reason of convexity reduction with aging. Deviations from a pleasant outline can be addressed by both reductive and augmentative procedures. Historically, bone advancement, bone grafts, and silicone or methyl methacrylate implants have been used to augment frontal contour [1].

Although there is a paucity of reports, autologous fat grafting for frontal augmentation is gaining popularity [3–5]. Autologous fat can be easily harvested from patients and transferred to a recipient site as an autologous filler with a long-lasting result, without the potential risks of synthetic fillers [6]. One of its main disadvantages is the difficulty to inject fat compared to other fillers, particularly in thin subcutaneous tissue such as the forehead. The other disadvantage is the unpredictability of fat survival after injection. To make fat injection more safe, simple, and

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effective, it has suggested to combine fat graft with autologous platelet-rich plasma (PRP) [6].

We report here our experience with the restoration or creation of frontal biconvexity using autologous fat combined with PRP in male and female patients to improve forehead and overall facial esthetics.

Patients and methods

Among all patients who presented to our clinic between May 2009 and July 2015 requesting forehead enhancement, 61 patients underwent fat grafting combined with PRP. Fat was harvested mainly from the lower abdomen, flanks, lateral thigh, and medial thighs using 3-mm blunt cannulas connected to 10-mL Luer-lock syringes. The harvested fat was then centrifuged for 3 min at 3000 rpm and the supernatant oil and liquids were removed.

To prepare PRP, a 30-mL sample of venous blood was drawn and collected in a BD Vacutainer (Becton, Dickinson and Company, Franklin Lakes, NJ) tube and centrifuged for 10 min at 2400 rpm. The plasma was transferred to another tube and centrifuged for 10 min at 2400 rpm. The upper two thirds of the resultant fluid was then discarded. The remainder was used as PRP and mixed with fat in 5:1 (fat: PRP) ratio. Areas for lipofilling were marked prior to injection while the patient was in a standing or sitting position. When general anesthesia or sedation was not needed for other procedure, regional nerve bloc with lidocaine 2% was used.

The injection was performed using a 23-G cannula attached to a 2.5-mL Luer-lock syringe. An 18-gauge needle was used to puncture the skin and provide access for the cannula entry. Fat was injected in small aliquots in the space between the dermis and underlying frontalis muscle under nerve block or sedation. Care was taken to avoid injury to the superficial veins. Excessive fat was expelled with digital pressure. Any lumps that might have remained after injection were immediately aspirated with the 19-G cannula during the same operation time. In patients with frowns and/or frontal lines, microfat grafting was injected intradermally using a 23-gauge needle. Microfat was prepared as described by Tonnard et al., i.e., aspirated fat was passed from one syringe to another approximately 20 times via a disposable connector, to remove large particles [7]. In patients with deeper dermal wrinkles, to enhance the clinical result, botulinum toxin treatment was performed concurrently or 1 week prior to fat grafting.

Patients were asked to evaluate the esthetic results using a two-section questionnaire, which assessed the improvement of the forehead shape for all patients and frontal wrinkles for those who had only wrinkle correction. The Global Esthetics Improvement Scale (GAIS) grading was used to evaluate the results as poor, moderate, good, or excellent. Patients received pre- and post-treatment photographs before submitting the questionnaire.

Results

Of 61 patients, 5 patients were lost to follow-up and excluded from the study. There were 52 females and 4 males (mean age, 40.19 years [range, 19–76]); mean follow-up duration was 12.42 months [range, 6–30]). Main indications were for concave, irregular, or flat forehead. Thirty-four patients complained of deep frown lines and transvers frontal furrows in addition to forehead biconcavity. Fat injection was performed in one to three sessions. The interval between multisession injections was 5 to 6 months. Single injections were done in 15 cases (14 females, 1 male) and two injections were performed in 36 cases (33 females, 3 males). Five female patients had three injections. The mean volume of fat and PRP for each session was 6.8 mL (range, 4–9 including 20% of PRP).

Frontal esthetic shape

All patients who had three injection sessions ($n = 5$) evaluated the esthetic result as excellent. In patients who had two injection sessions ($n = 36$), 13 evaluated the result as excellent, 18 as good (Fig. 1), and the remaining 5 as moderate. In patients who had a single injection session ($n = 15$), 4 patients evaluated the result as excellent, 6 as good, 4 as moderate, and 1 as a poor improvement (Table 1).

Frontal wrinkles

Twenty-five of 34 (73.5%) female and male patients reported a good improvement of the frontal wrinkles (Fig. 2) and the remaining 9 (26.5%) female patients reported as a moderate improvement.

Discussion

Similar to the nose and chin, which have critical esthetic interrelationships in the profile and oblique views [8, 9], the forehead has particularly important relationships with the nose in these views and can add or subtract to overall facial attractiveness. In patients with a flat or concave forehead, facial attractiveness is significantly reduced with an apparently older appearance. The presence of mild biconvexity in the forehead together with convexity and prominence of the cheeks and chin results in an attractive facial harmony and congruence.

Fig. 1 A 31-year-old man complaining of frontal concavity (**a**). He underwent two sessions of fat graft mixed with 20% PRP. **b** 1 year after the first session of 9-cc fat/PRP injection. **c** 1 year after the second session of 9 cc fat/PRP injection. The results were evaluated as "good"

Fat and PRP grafting is a useful and effective method to create frontal biconvexity and improve the forehead aspect. We believe that the importance of forehead fat grafting has not been appreciated as much as that performed in the lower two thirds of the face. Fat grafting is frequently performed in adjacent anatomical regions, such as the temples and lateral areas of the eyebrow [10]. According to the forehead deformity, we had to repeat the fat injection twice in 36 cases and three times in 5 cases. This multiple treatment was mainly required for patients with a more important convexity; and due to insufficient space between the dermis and the frontalis muscle, it was not possible to inject a high-fat volume. Interestingly, these patients reported the highest rate of satisfaction, probably because they obtained the most important modification.

We injected a combination of fat and PRP for two main reasons: (1) easier injection through small cannula and less risk of lumps as the mixture of fat and PRP is more liquid than pure fat and (2) better uptake of fat grafts as demonstrated in other studies [6].

Fat injection is an increasingly popular method for the creation of frontal convexity. Isik and Sahin reviewed forehead contour restoration through lipofilling in 9 patients. The follow-up time was 1 to 2 years. All patients were satisfied with the results and showed good retention of the fat grafts and improved overlying skin quality. No complications were noted, with the exception of one patient who required repeated lipofilling [4].

The influence of local muscular tone is an important consideration for successful frontal fat grafting. The glabella is unique in that when the corrugator supercilli muscles are intact, fat graft take is suboptimal. However, if the underlying muscle has been deactivated either surgically or chemically, higher retention rates of grafted fat are achieved [3, 5]. In our series, we injected botulinum toxin at least 10 days before fat grafting for patients with overactive muscles to paralyze muscles and thus optimize the fat grafting outcome.

While fat can be valuable filler in the forehead with an antiwrinkle effect, a critical consideration is the depth of injection. Among different methods described [9], we chose to inject in the space between the dermis and underlying frontalis muscle to maximize wrinkle effacement. This effect could be accentuated by the fact that fat was injected as a micrograft when wrinkle improvement was needed.

Of note, we observed inferior results in males. A possible explanation may be the presence of a more prominent superior orbital rim due to a larger frontal sinus, relative hyperactivity of the frontal expression muscle, and a thicker skin. Thus, it appears that fat grafting should be more frequent in male patients to be effective.

Although we did not observe any significant complications in our patients, fat injection of the forehead and face may lead to several complications, including visible lump, uneven contour, and hematoma. Rare, serious, and potentially fatal complications, such as skin necrosis, infection, central retinal artery occlusion, and cerebral infarction, have also been reported [8, 11].

Table 1 Patient assessment of the cosmetic result of the procedure to restore frontal biconvexity

Number of surgical sessions	Total	Excellent improvement	Good improvement	Moderate improvement	Poor improvement
1 injection	15 (14 F, 1 M)	4 (26, 7%) (4 F, 0 M)	6 (40%) (4 F, 0 M)	4 (26, 7%) (4 F, 0 M)	1 (6, 7%) (0 F, 1 M)
2 injections	36 (33 F, 3 M)	13 (36.1%) (13 F, 0 M)	18 (50%) (16 F, 2 M)	5 (13.9%) (4 F, 1 M)	0
3 injections	5 (5 F, 0 M)	5 (100%) (5 F, 0 M)	0	0	0

F female, *M* male

Fig. 2 A 33-year-old woman complaining of forehead wrinkles and a flat forehead shape. **a**, **b** Before the treatment. **c** Peroperative image after 8-cc fat and 20% PRP injection to the forehead and infraorbital region and 2 cc of micro-fat graft injected intradermally to frown and transverse forehead lines. **d**, **e** 3 years after the procedure. The results were evaluated as "good"

Conclusions

The forehead is an important component of patients' facial esthetics apparent age. Fat injection is a useful technique to create mild cephalocaudal and mediolateral frontal biconvexity in order to improve attractiveness, reduce wrinkles, augment the harmony with the other facial components, and decrease the apparent age.

Compliance with ethical standards

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Conflict of Interest Mohammadhossein Hesamirostami, Ali Modarressi Amir Lebaschi, Abbas Kazemi, and Ashtiani declare that they have no conflict of interest.

Ethical approval This study has been approved by local institutional board review.

Informed consent All patients recognizable in pictures and figures have signed informed consent for publication of this article.

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