

Influential Factors in Autologous Fat Transplantation - Focusing on the Lumen Size of Injection Needle and the Injecting Volume

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Introduction

Fat graft survival depends on the delicate handling during fat harvesting, processing and, most importantly, precise fat placement. Dr. Coleman emphasized that the key to successful fat grafting placement is to maximize the contact surface area between the fat parcel and the recipient tissue. To achieve this goal, especially to make fat survive in the face without potential complications such as lump and irregularity, it is suggested that at least 30 parcels in 1 mL fat¹ be delivered. Moreover, when fat grafting is done in the peri-orbital areas (like sunken eyelid, nasojugal groove/palpebro-malar junction), each fat parcel should be tiny and even less than 1/50 mL. Technically, it is quite difficult for an inexperienced surgeon to perform the procedure.

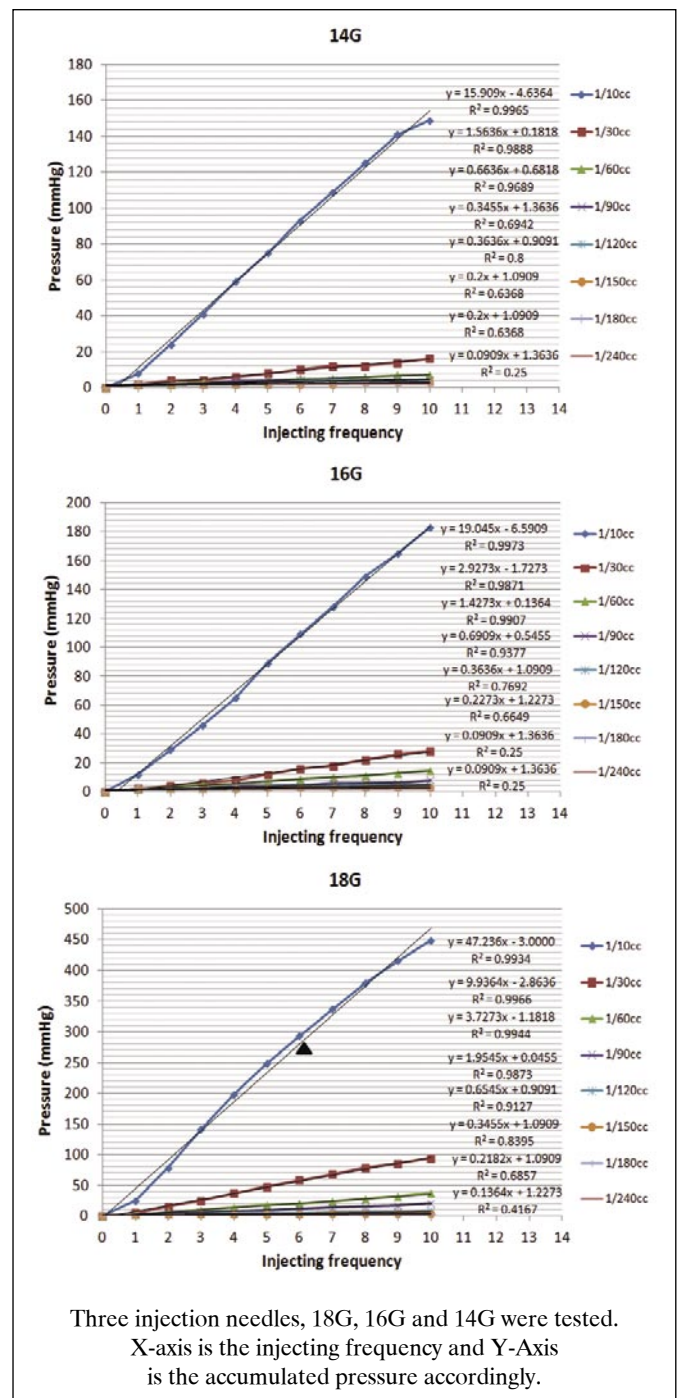
Many kinds of needles/cannulas have been used in fat injection for decades. In the book "Complementary fat grafting", the authors suggested 3 kinds of cannulas for different facial areas. The usual amount of fat injected per pass was suggested to 1/10 cc. In the superficial area such as the orbital rim and around the eyelids, the amount per pass was 3 to 5 per 1/10 cc, compatible with Dr. Coleman's² concept. Regarding these injection techniques and choice of different needles/cannulas, fat placement becomes even more technique-demanding. Nonetheless, another important variable, injecting pressure, is less addressed in literature.

Purpose

The aim of this study was to monitor the pressure produced during harvesting and injection (placement) of fat and to demonstrate the pressure difference between the variable sizes of cannula (diameter) and volume of fat parcel per pass.

Materials and Methods

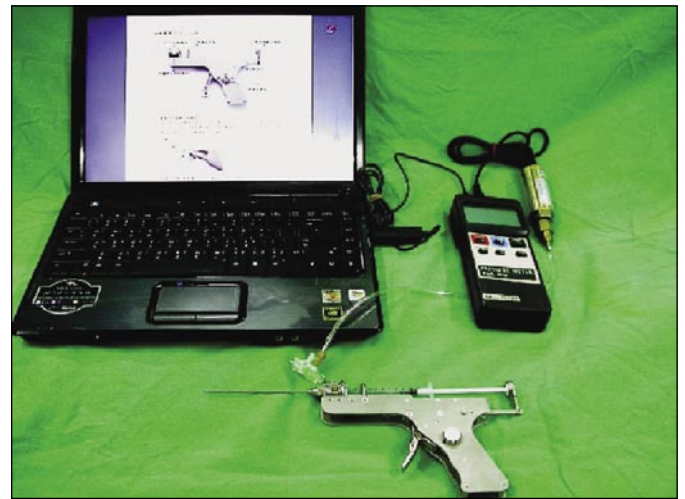
First we measured the aspiration pressure during fat harvesting. Aspiration pressure was recorded respectively, in a 10 cc and a 60 cc syringe connected to a real-time



pressure meter. While pulling back the plunger at different volume levels, the negative pressures were produced and recorded (Fig. 1). With a 10 cc syringe, we checked the negative pressure for every 1 cc of 10 cc; however in the 60 cc syringe, negative pressure for every 10 cc out of 60 cc was monitored. Then using the MAFT Gun®, the injection, the pressure of 3 different sizes of needles with variable injecting volume per triggering (volume of



The negative pressure while pulling back of the plunger of a 10 cc syringe was shown during liposuction procedure.



Setting of the experiment

fat parcel per pass) were detected accordingly. Injection pressure was recorded with monitoring of the MAFT-Gun® loaded with 1 cc medical gel-filled syringe, which transduced the same pressure to a real-time pressure meter. The injecting volume of each triggering could be

Table 1. Negative pressure during harvestin og fat (liposuction) by a 10 cc syringe

Back Pulling of plunger/10 cc	1 cc /10 cc	2 cc /10 cc	3 cc /10 cc	4 c c/10 cc	5 cc /10 cc	6 cc /10 cc	7 cc /10 cc	8 cc /10 cc	9 cc /10 cc	10 cc /10 cc
Negative pressure	-150 mmHg	-270 mmHg	-330 mmHg	-380 mmHg	-420 mm Hg	-450 mmHg	-470 mmHg	-490 mmHg	-500 mm Hg	-510 mm Hg

Table 2. Negative pressure during harvestin og fat (liposuction) by a 60 cc syringe

Back Pulling of plunger/60 cc	10 cc/60 cc	20 cc/60 cc	30 cc/60 cc	40 cc/60 cc	50 cc /60 cc	60 cc/60 cc
Negative pressure	-530 mmHg	-630 mmHg	-660 mmHg	-680 mmHg	-700 mmHg	-710 mmHg

Table 3. Accumulated pressure at the end of 1cc fat injection by different size of injection needle vs. fat parcel delivered per triggering

Parcel volume per-triggering / Injection needle	1/10 cc	1/30 cc	1/60 cc	1/90 cc	1/120 cc	1/150 cc	1/180 cc	1/240 cc
14G	154 mmHg	47 mmHg	40 mmHg	32 mmHg	45 mmHg	31 mmHg	37 mmHg	23 mmHg
16G	184 mmHg	86 mmHg	86 mmHg	64 mmHg	45 mmHg	35 mmHg	18 mmHg	23 mmHg
18G	469 mmHg	295 mmHg	222 mmHg	176 mmHg	79 mmHg	53 mmHg	40 mmHg	34 mmHg

adjusted by the switch button on the handle of MAFT-Gun®. The injecting volume was adjusted from 1/10, 1/30, 1/60, 1/90, 1/120, 1/150, 1/180, to 1/240 cc per-triggering (Fig. 2). Three injection needles, 18G, 16G and 14G were tested and the injection pressures were recorded separately.

Results

Aspiration pressure: Since most surgeons agree to keep a 2 cc volume out of a 10 cc syringe while performing the liposuction, our data showed the negative pressure to be around -270 mmHg (Table 1). The negative pressures of different 10 cc intervals out of a 60 cc syringe were shown to be relatively high (Table 2).

Injection pressure: In Figure 3, the X-axis is the injection frequencies (passes) and the Y-axis is the accumulated injecting pressure accordingly. These two variables showed a linear progression. Different color lines stand for different injecting volume per triggering from 1/10 cc to 1/240 cc. With 14- & 16G needles, the injection pressures at the end of 1 cc injected are all under 200 mmHg. However, with the 18 gauge needle, after pulling the trigger for 6 times (□), the injection pressure rises over 270 mmHg (reaching around 300 mmHg) which is the pressure limit which should not be surpassed while performing lipo-aspiration in fat harvesting (Fig. 3).

Comparing the three different needles at the end of 1cc gel injection, (not just pulling the trigger 10 times), when using 18-G needle, the pressure of 1/10cc and 1/30 cc per-triggering were both over 270 mmHg. Therefore, while 18-G needle is chosen for fat placement, the per-pass volume of fat parcel is suggested to be less than 1/60 cc per-triggering (Table 3).

Discussion

The medical gel used in this study is a reliable material for conducting fat graft related experiments. The homogeneous character of the medical gel makes the data show regression/progression in a linear way, though the processed human lipoaspirates may be not totally the same in viscosity and homogeneity. With the inhomogeneity and higher viscosity of grafted human fat tissue, the injection pressure is expected to be higher than the data shown in this study. The concept of Micro-Autologous Fat Transplantation (MAFT) proposed the senior authors, Lin et al. in 2006, with a central dogma that each fat parcel be smaller than 1/100 mL, is further documented in this study.

Conclusion

In this study, the pressure generated by 2 cc back-pulling of the plunger out of a 10 cc syringe during fat harvesting is about -270 mmHg (0.36 atm). Using the MAFT Gun® filled with medical gel, the injection pressures of both 14- and 16-G needles are below 270 mmHg, no matter the injecting volume per triggering. However, with the 18-G needle, injecting a volume greater than 1/60 cc per-trigger will induce a higher pressure of over 270 mmHg. In human fat tissue with higher viscosity and tissue resistance, a higher injection pressure could be expected and encountered consequently. The fact injecting technique during placement is advised to deliver at least 60 passes for each 1 cc fat volume when a 18-G needle is used.

References

1. Structural fat grafting. SR Coleman. Quality medical publishing (2004).
2. Complementary fat grafting. SM Lam, MJ Glasgold, RA Glasgold. Lippincott Williams & Wilkins (2006).