



# The Role of Cannula Diameter in Improved Adipocyte Viability: A Quantitative Analysis

**Zafer Özsoy, MD; Zekeria Kul, MD; and Ayhan Bilir, MD**

Drs. Özsoy and Kul are from the Department of Plastic Surgery, Vakıf Gereba Hospital, Istanbul, Turkey. Dr. Bilir is Professor, Department of Histology, Istanbul University.

**Background:** Fat injection for soft tissue augmentation is a common procedure in plastic surgery. Because the limitation of fat injection is its resorption, understanding how different handling techniques affect adipocyte survival is crucial to optimizing long-term results.

**Objective:** In this study; we sought to determine the effect of aspiration and injection cannula diameters on adipocyte viability.

**Methods:** Fat aspiration samples were obtained from 6 female patients undergoing abdominoplasty. Viable adipocytes were counted at fat suspension, which was obtained with 2-, 3-, and 4-mm-diameter aspiration cannulas and injected with 1.6-, 2-, and 2.5-mm-diameter injection cannulas.

**Results:** A greater number of viable adipocytes were detected using a 4-mm-diameter aspiration cannula ( $419 \times 10^4$  cell/1 mL,  $P < .05$ ) and a 2.5-mm-diameter injection cannula ( $410 \times 10^4$  cell/1 mL,  $P < .05$ ).

**Conclusions:** The use of wider-diameter cannulas can potentially improve fat graft survival and reduce fat graft resorption. (Aesthetic Surg J 2006;26:287-289.)

Fat injection was first reported by Neuber<sup>1</sup> in 1831, but it was Lexer<sup>2</sup> who first documented and published his results. Since then, much clinical experience has been gained concerning the application of different techniques of fat grafting. Following the development of the lipoplasty techniques that enabled harvesting of fat via a cannula under vacuum, the use of aspirated fat for soft tissue augmentation became widespread in plastic surgery.<sup>3-7</sup> But unfortunately, fat injection often has unreliable long-term results because of resorption and volume loss.

Various studies have demonstrated that specimen handling, type of cannula, body region aspirated, and anatomic characteristics of patients all affect the degree of resorption of injected fat.<sup>5-9</sup> In particular, reduction of trauma during aspiration appears to result in harvesting of a greater number of viable adipocytes and, consequently, in more consistent long-term volume maintenance. Lastly, histologic studies have confirmed the presence of more viable cells when a graft has been harvested using wider-diameter cannulas at lower negative pressures.<sup>7</sup> Our quantitative study was conducted to investigate the effect of cannula diameters on adipocyte viability during the process of aspiration and injection.

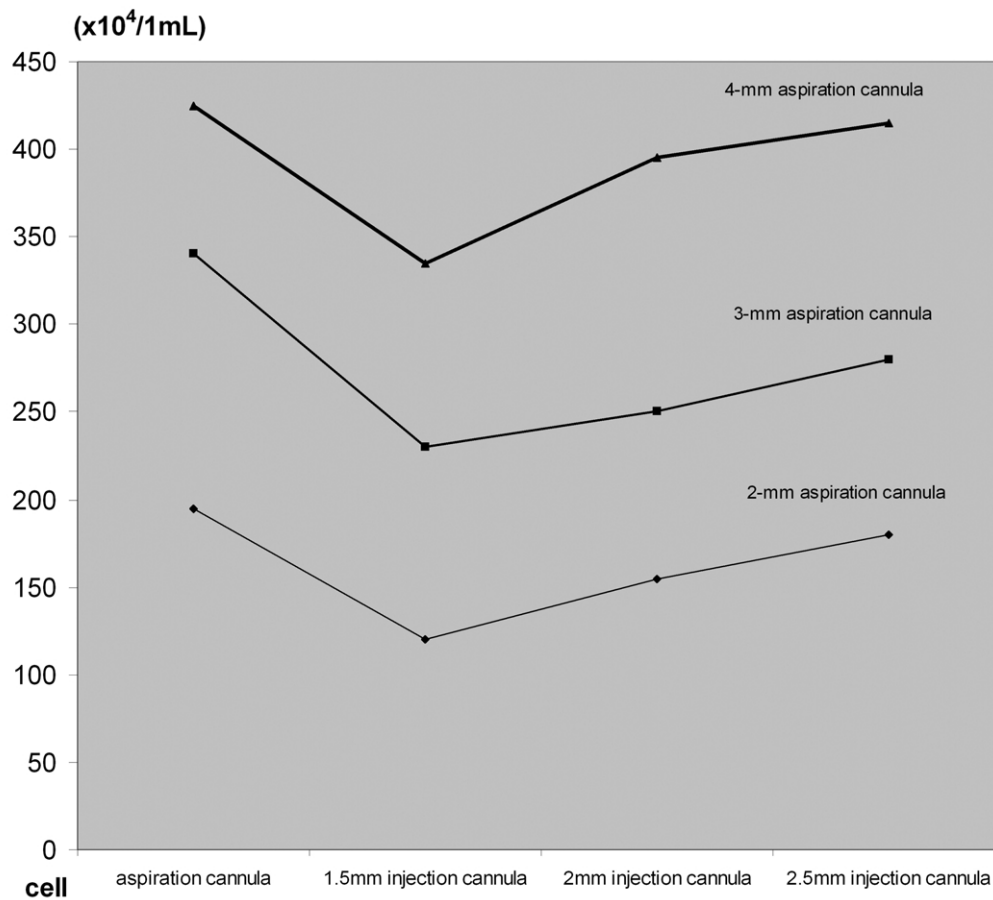
## Materials and Methods

Fat aspiration samples were harvested from 6 healthy women, ranging in age from 31 to 56 years (mean, 36.7 years), who were undergoing selective abdominoplasty. Aspiration was performed using a 65-cc syringe and Accelerator-type 2-, 3-, and 4-mm aspiration cannulas with a blunt tip and 1 hole proximally (Figure 1). Dry technique was used in the aspiration because many authors have noted the negative effect of local anesthetic on the survival of fat cells.<sup>10-11</sup>

First, the 2 cc of fat obtained with the aspiration cannulas was injected into the 3 different tubes using these same cannulas. The aspirated fat was sequentially injected to 9 different tubes (2 cc fat suspension for each tube), using a 10-cc syringe and Coleman-type 1.6-, 2-, and 2.5-mm injection cannulas with a blunt tip and 1 hole proximally. Then 2 mL of DMEMF-12 cell culture medium fluid was added to each of the tubes, and the fat suspensions were centrifuged at 1000 rpm for 5 minutes. The triglyceride layer was extracted and a 1-cc sample of adipose aspirate was taken from the top layer of the fat segment. After 1 hour of collagenase digestion, the specimens were stained with 1:1 diluted trypan blue vital stain 0.4% solution, and the number of viable adipocytes were counted with a hemocytometer under  $\times 40$  magnifi-



**Figure 1.** Aspiration and injection cannulas with different diameters. (L, 2, 3, and 4 mm; liposuction cannulas with 3 different diameters, I, 1.6, 2, and 2.5 mm; injection cannulas with 3 different diameters.)



**Figure 2.** Note that more than 2 times as many viable cells were found in fat that was aspirated with a 4-mm-diameter cannula compared with the 2-mm-diameter cannula ( $P < .05$ ), and more than 1.5 times as many viable cells were found in fat injected with a 2.5-mm-diameter injection cannula compared with the 1.6-mm-diameter cannula ( $P < .05$ ).

cation. Statistical analysis was performed with Wilcoxon matched-pairs signed rank test.

## Results

A total of 12 fat injection specimens for each individual were obtained, for a total of 72 specimens available for analysis. The fat suspension that was aspirated with a 4-mm-diameter aspiration cannula had 216% more viable adipocytes than the fat suspension that was aspirated with a 2-mm-diameter aspiration cannula ( $P < .05$ ). The fat suspension that was injected with a 2.5-mm-diameter injection cannula had 150% more viable adipocytes than the fat suspension that was injected with a 1.6-mm-diameter injection cannula ( $P < .05$ ). No significant differences were detected between 1.6- and 2-mm-diameter injection cannulas (Figure 2). The obtained results provided quantitative proof that fat suspension obtained and injected with wider-diameter cannulas had more viable adipocytes.

## Discussion

Although the use of aspirated fat as a fat graft for tissue augmentation has become very popular, partial resorption and less than completely satisfactory results have led to the development of several techniques directed at decreasing trauma affecting the adipocytes. Fournier<sup>9</sup> compared the No. 10, 12, and 14 cannulas with respect to fat graft survival and stated that best results were obtained with the No. 14 cannula. We believe the highest number of viable adipocytes is found in aspirated and injected fat harvested using wider-diameter cannulas, because adipocytes that undergo cellular disruption as a result of mechanical manipulation or osmotic forces will be less dense if wider-diameter cannulas are used.

## Conclusion

Increasing the diameters of aspiration and injection cannulas to minimize trauma on the adipocytes may improve the number of viable transplanted adipocytes and, therefore, improve fat graft survival. ■

## References

1. Neuber GA. Fettransplantation. *Dtsch Ges Chir* 1893; *Chir Kongr Verh* 1893;22:66.
2. Lexer E. Freie Fettransplantation. *Dtsch Med Wochenschr* 1910;36:640.
3. Ullman Y, Haymes M, Ramon Y, Beach D, Peled IJ, Lindenbaum ES. Enhancing the survival of aspirated human fat injected into nude mice. *Plast Reconstr Surg* 1998;101:1940.
4. Smahel J. Experimental implantation of adipose tissue fragments. *Br J Plast Surg* 1989;42:207-211.

5. Billings E Jr, May JW Jr. Historical review and present status on free fat graft autotransplantation in plastic and reconstructive surgery. *Plast Reconstr Surg* 1989;83:368-381.
6. Moore JH, Kolaczynski KW, Morales LM. Viability of fat obtained by syringe suction lipectomy: effects of local anesthesia with lidocaine. *Aesthetic Plast Surg* 1995;19:335-339.
7. Rubin A, Hoefflin S. Fat purification: survival of the fittest. *Plast Reconstr Surg* 2002;109:1463-1464.
8. Shiffman MA, Mirrafati S. Fat transfer techniques: the effect of harvest and transfer methods on adipocyte viability and review of the literature. *Dermatol* 2001;27:819S-826S.
9. Fournier P. *Liposculpture: The Syringe Technique*. Paris: Arnette Blackwell; 1991.

Accepted for publication July 25, 2005.

Reprint requests: Zafer Özsoy, MD, Department of Plastic Surgery, Vakıf Gereba Hospital, Vatan Cad Fatih Istanbul, Istanbul, Turkey.

Copyright © 2006 by The American Society for Aesthetic Plastic Surgery, Inc.

1090-820X/\$32.00

doi:10.1016/j.asj.2006.04.003