How technique-dependent is fat graft viability?

**FAT ASPIRATION** using a syringe has not only been a long-accepted technique of harvesting autologous fat in fat grafting procedures, but has also been widely viewed as atraumatic to the patient's tissues — including the aspirated fat tissue itself. A recent as-yet unpublished study, presented at the recent 54th Annual Meeting of the Plastic Surgery Research Council, shows that the hand-held syringe technique is not as atraumatic as once believed and that an alternate method using a liposuction device to harvest the fat may, in fact, be more advantageous in maintaining fat tissue viability.

**A PREMISE IS 'NEEDED'** "The syringe is the most popular technique used in fat grafting procedures worldwide and most plastic surgeons believe and accept that the technique is gentle and does not cause any fat cell destruction when aspirating," study investigator Kamran Khoobehi, M.D., F.A.C.S., clinical associate professor of surgery, Division of Plastic and Reconstructive Surgery, Louisiana State University Health Sciences Center School of Medicine, New Orleans, Louisiana, tells Cosmetic Surgery Times.

Dr. Khoobehi put this long-accepted premise to the test and conducted a study quantifying the negative pressures generated in Luer-Lock syringes and compared them to those generated from a conventional liposuction machine.

Negative pressures were measured in vitro and in situ within 1, 3, 5, 10, 30 and 60 cc Luer-Lock syringes, as well as with conventional liposuction machine at -10, -15 and -30 inches of Hg. To evaluate the viability of the adipocytes harvested in both procedures, the liposaprate samples from the in situ liposapiration were analyzed for LDH, triglyceride and G3PD assays and were stained with fluorescent dyes for imaging using scanning electron and confocal laser electron microscopy.

Results showed that the negative pressure generated by the liposuction device at low setting was less than that generated by 10 cc and 60 cc syringes. Furthermore, Dr. Khoobehi found that there was much less LDH and triglycerides in the serum at the lower negative pressures when using the liposuction device, according to the results of the biochemical assays and microscopic analyses. Though these parameters are nonspecific for fat cell damage, Dr. Khoobehi contends that if their levels are elevated in the serum, this is an indication of increased adipocyte damage. He adds that the G3PD assay is the most specific for adult, intact living adipocytes, and assay results showed that the enzyme uptake was higher with the liposuction-assisted aspiration technique, indicating more intact adipocytes.

"We found that, compared to the syringe technique, the liposuction device could not only harvest the fat much faster, but also proved to be the less traumatic and a therefore gentler technique, which is in stark contrast to the current conventional wisdom," Dr. Khoobehi explains.

**FAT FRAGILITY** According to Dr. Khoobehi, on average, a plastic surgeon will pull back about 5 cc to 6 cc to allow for enough...
Dr. Coleman, M.D., can take about an hour to aspirate approximately 100 cc fat whereas the liposuction device is three times faster, taking only 20 minutes for 100 cc fat, he estimates. "We believe that the liposuction technique allows any surgeon to harvest the fat in a timely, predictable, reproducible and less traumatic fashion so that the procedure would not change from patient to patient. This could likely lead to more uniform aesthetic results," Dr. Khoobehi says.

Dr. Coleman concurs that if the plunger of a 10 cc or 60 cc syringe is pulled back all the way, the resultant negative pressure is much higher than that of a liposuction device set at its lowest setting. He also discourages the use of special syringes in which the plunger is already pulled back until such devices are graduated. However, he says, if the plunger is pulled back slowly and gently, the negative pressures created are much lower and basically, nontraumatic to the fat cells. And in terms of "productivity," the amount of adipocytes a surgeon can harvest depends entirely on the donor sites. Dr. Coleman notes that patients with a higher BMI can have 800 cc or more harvested in an hour.

"I have tried the liposuction aspiration technique and found that, at low settings, the technique is not only too slow but also not as efficient as carefully aspirating by hand using a hand-held syringe," Dr. Coleman contends. "Furthermore, the liposuction technique allows the aspirate to be exposed to the air for longer periods of time, which is not good."

Dr. Khoobehi is currently conducting a fat grafting study including over 120 patients exclusively using the liposuction aspiration technique and finds that harvesting the fat using the lower pressure of the liposuction approach also results in less bruising when compared to the syringe technique. According to Dr. Khoobehi, plastic surgeons should look at both techniques and decide for themselves which technique is superior.

**A SYRINGE SPECIALIST** According to Sydney R. Coleman, M.D., Tribeca Plastic Surgery, New York, New York, if the plunger of the syringe is gently pulled back upon aspiration "as careful plastic surgeons who perform fat grafting procedures do," the negative pressure created will not unduly damage the adipocytes. Typically, the surgeon will need to pull back about 5 cc to 6 cc on the plunger to get the suction going and then revert back to 1 cc to 2 cc. However, Dr. Coleman allows that some surgeons may pull back on the plunger too much when using syringe suctioning. For the last 20 years, Dr. Coleman has been using the hand-held syringe technique to aspirate fat and has consistently achieved excellent cosmetic results in his fat grafting patients without any issues concerning the destruction of the adipocytes as a result of the aspiration technique. "The enzyme levels of the fat in fat grafting procedures often usually reflect the presence of the fat itself but do not pay attention to stem cells or primitive cells, which I, as well as leading plastic surgeons around the world, believe to be one of the most important constituents of the aspirate," Dr. Coleman explains. "In my opinion, the cellular part of the aspirate is more important than the lipid-filled adipocytes."
stem cells and the extracellular matrix was made without any mature adipocytes, a differentiation of stem cells into mature adipocytes resulted. Therefore, according to Dr. Mojallal, stem cells and the extracellular matrix are the keys to successful fat grafting.

Dr. Khoobehi's finds Dr. Mojallal's conclusion reasonable. "I have not explored in-depth the use of stem cell technology in fat grafting procedures," Dr. Khoobehi notes. "But logically, if you traumatize the tissue less, you are not going to separate the stem cells from their native environment. Possibly the reason I am achieving positive aesthetic results in my patients is because perhaps the stem cells and the adipocytes are less disturbed or damaged with the liposuction technique."

MORE STUDIES WARRANTED

According to Dr. Khoobehi, the question remains as to whether less damaged fat cells ultimately translate into less damaged stem cells and whether this has an impact on the final aesthetic outcome, an aspect of fat grafting technique he thinks merits further exploration in comparative studies. Dr. Mojallal explains that mature adipocytes, adipose-derived stem cells and extracellular matrix are the three components that contribute to successful fat grafting results, and each of these components has to be in sufficient quality and quantity.

Recently, Dr. Mojallal conducted a small three-patient study evaluating the influence of pressure on the yield of stromal-vascular fraction (SVF) cells in relation to the gold standard hand-held syringe aspiration technique. Using a 3 mm cannula, Dr. Mojallal compared several different aspiration techniques including a 10 mL syringe (Coleman technique), wall suction and a pump alone or power-assisted aspiration regulated to -350 mmHg, then -700 mmHg. Study patients were 36, 43 and 58 years of age without associated pathologies and with a BMI under 30. The cannula width, donor site (trechteran region) and volume harvested were identical.

Results showed that using a pressure of -350 mmHg — power-assisted or not — was superior to that obtained at -700 mmHg (likely due to the small sample size) and significantly superior to the hand-held syringe aspiration technique. At -350 mmHg, the use of power-assisted liposuction showed better results for two out of three patients when compared to non-power-assisted liposuction. Results also showed that the yield of stem cells from the SVF per mL of adipose tissue was 2.8 times greater than that yielded when using a syringe. Dr. Mojallal found that, for all of the techniques tested, the cells were capable of proliferation and acquired the same morphology.

DOES DAMAGE MATTER? "I think that more cells are damaged when using the 3 mm cannulas and manual syringe aspiration techniques," says Dr. Mojallal. "However, it makes no difference in the end because you still have enough viable adipose cells to perform the fat grafting."

Stem cells are a critical part of the aspirate and may ultimately play a role in achieving more superior aesthetic results in fat grafting procedures. Using lower negative pressures when harvesting fat tissue can avoid damage to the stem cell portion of the aspirate. However, the damage to the stem cell portion can likely only play a role when the overall yield of fat tissue aspirate is low.

"The cells that have been damaged during harvesting are eliminated after centrifugation anyway," adds Dr. Mojallal. "The damaged adipocytes, and therefore also some SVF cells, are less important particularly when large amounts of adipose tissue are harvested. Regardless of the harvesting technique used, the overall yield of normal and healthy cells may be lower due to a portion of the cells that are lost through damage, but still enough to complete fat grafting procedures without compromising aesthetic outcomes."

However, negative pressure is not the only factor that can influence cell yield, Dr. Mojallal continues. Any trauma to the fat tissue — as well as its exposure to air — is as important as a low negative pressure. And therein lies the problem in his view. There is no low-pressure fat harvesting device available on the market that does not harvest the fat without trauma or exposure to air and, according to Dr. Mojallal, all the devices that use a filter, damage the cells more than the manual Coleman technique.
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