

Man vs. Machine

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How
technique-dependent
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viability?

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31-year-old female patient before (left photos in panels A, B and C) and nine months following (right photos in panels A, B and C) mastopexy, fat grafting and tummy tuck procedures. All photos credit: Kamran Khoobehi, M.D., F.A.C.S.

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 A recent as-yet unpublished study, presented at the recent 54th Annual Meeting of the Plastic Surgery Research Council, shows that the hand-held syringe technique is not as atraumatic as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

"However, the negative pressure produced during aspiration can vary greatly from surgeon to surgeon and the problem is that there is no consistency here, which can make it difficult to guarantee reproducible and constant results."

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 lipoaspirate samples from the *in situ* lipoaspiration 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



48-year-old female patient before (photos A and B) and three months following a single fat grafting session (photos C and D). Implants were deflated two weeks before fat grafting procedure.

room for the fat cells to be aspirated when performing a fat grafting procedure. This will generate high negative pressure (more than 550 mmHg negative pressure), which is detrimental to the survival of the fragile fat cells. Additional cell damage may also take place with the industry-invented syringe that contains an already-pulled-back plunger to counter the fatigue that many surgeons experience as a result of pulling back on the plunger of the syringe in performing multiple fat grafting procedures on a daily basis.

"My research has shown that negative pressures exceeding -260 mmHg cause cell damage and, therefore, I do not advocate the use of these special syringes as they can create high negative pressures ranging from -450 mmHg to -560 mmHg," Dr. Khoobehi notes.

TOWARDS STANDARDIZED OUTCOMES

Liposuction via device, Dr. Khoobehi holds, offers the possibility of producing a standardized negative pressure that is applied to the fat cells upon aspiration. Dr. Khoobehi believes that this technique not only removes the human error factor of pulling back too hard on the plunger and creating too much negative pressure, but also addresses the hand fatigue factor for the surgeons who perform many of these procedures every day. He adds that the syringe technique, pioneered by Sydney R. 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 be able 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. 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



Dr. Coleman

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."

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."

STEM CELL BOOST? In terms of boosting fat graft viability, Dr. Khoobehi tells *CSJ* that currently, there is no scientific data that conclusively supports the idea that the mixing of stem cells with the fat aspirate will help the aspirated fat cells survive or be an advantage in achieving superior fat grafting results.

In further exploration of the possible viability advantage stem cells may present, French plastic surgeon Alain-Ali Mojallal, M.D., assistant professor of the Department of Plastic Surgery at the University of Lyon, France, recently conducted a study (submitted for publication) on fat culturing with and without the addition of adipose-derived

“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.”

stem cells. In the study, Dr. Mojallal made a component fat culture and observed that, if mature adipocytes are isolated without any stem cells or extracellular matrix, a total failure of the graft resulted. However, if a culture of stem cells and 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. Mojallal

Dr. Khoobei's finds Dr. Mojallal's conclusion reasonable. "I have not explored in-depth the use of stem cell technology in fat grafting procedures," Dr. Khoobei 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. Khoobei, 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 (trochanter 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.

DEMANDING PROOF Dr. Khoobei believes that plastic surgeons need to take the initiative and claim exploration of this and other cosmetic procedures to remain the frontrunners in the aesthetic field, lest this area of science fall into the hands of other specialties vying for position. "We need to approach our procedures and techniques not only by hearsay and word-of-mouth but also need to back up our methodology with proven techniques and solid basic science," Dr. Khoobei stresses. "This liposuction technique study could be one step towards a more scientific fashion of approaching fat grafting." ◀



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