HUMAN MED®

Application Of Adipose Tissue Harvested With Water-Jet Assisted Liposuction (WAL)

WAL FOR THE HARVEST OF ADIPOSE TISSUE

What are the advantages of WAL for the patient and for the tissue quality?

HIGH QUALITY OF ADIPOSE TISSUE HARVESTED WITH WAL

Is the high viability of the adipocytes harvested with the body-jet® devices and LipoCollector® scientifically evidenced?

AUTOLOGOUS USE OF ADIPOSE TISSUE HARVESTED WITH WAL

What are the properties of adipose tissue needed for the autologous transfer and can WAL deliver them?

Made in Germany

Water-jet assisted liposuction (WAL) for the harvest of adipose tissue

What are the advantages of WAL for the patient and for tissue quality?

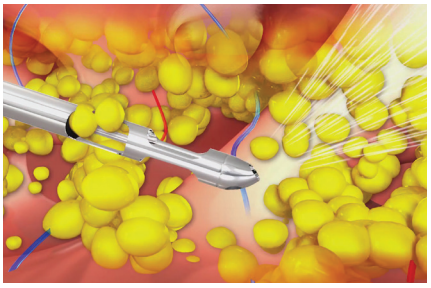
The gentle procedure of WAL is favourable in two aspects.

First and foremost, it is favourable for patients. WAL is a liposuction procedure that applies the tumescent solution as a thin fan-shaped, pulsating jet. In multiple scientific publications it has been shown that patients experience less pain, have lower rates of hematoma, have a lower need for post-operative pain medication and require less time until in convalescence compared to conventional liposuction techniques [1,2].

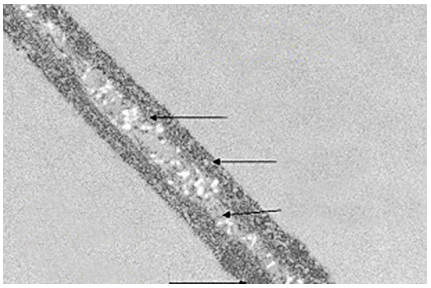
Secondly, WAL is a procedure that preserves the viability of the harvested adipose tissue. Because of their morphology, adipocytes are very fragile. They can be very easily damaged or destroyed if they are not handled appropriately. Thus, the technology used for harvesting and subsequent processing of adipose tissue has an enormous effect on the outcome of the autologous fat transfer. The application of the water-jet loosens the adipose tissue structure while leaving the adipocytes, major blood and lymph vessels as well as delicate nerve strands intact [3].

The operating principle of the water-jet

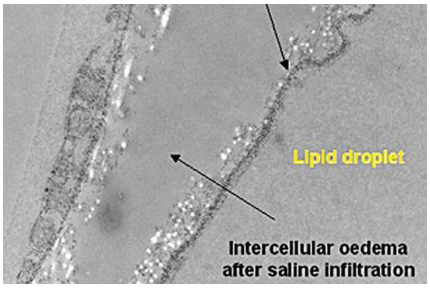
Special cannulas were developed for the application of the water-jet during liposuction. Double lumen cannulas allow a simultaneous irrigation and aspiration of the adipose tissue. The gentle, adjustable spray jet of the body-jet® devices loosens the tissue structure and ensures that the adipocyte clusters are aspirated atraumatically.



Gentle dispersion of the water-jet within the subcutaneous adipose tissue



Cellular connection between adipocytes within native adipose tissue (electron microscopic image)



Gentle separation of intracellular connections after the irrigation with the water-jet. (adipocytes remain intact)

Beside the gentle action of the water-jet in loosening the connections between the adipocytes and thus making them available for atraumatic aspiration, the water-jet also serves as a vehicle for the delivery of the local anaesthetic and vasoconstrictors. Due to the possibility of the simultaneous irrigation and aspiration these active substances are delivered into the tissue long enough to take effect but for such a short period of time that it is lenient on the patient's circulation system and upholds the integrity of the adipocytes for subsequent application in aesthetic and/or regenerative treatments.

The influence of local anaesthetics and pH

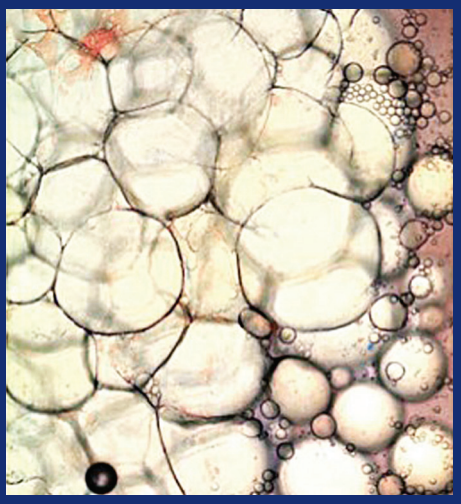
Substance	pH	Mean viability unbuffered	+/-% buffered
Lidocation	6,0	76.5 +/- 10.5	69.1 +/- 9.7
Articaine+adrenaline epinephrine)	4,4	65.3 +/- 11.2	53.0 +/- 12.9
Ropivacaine	4,8	58.8 +/- 14.2	55.6 +/- 14.5
Prilocaine	4,2	21.7 +/- 12.8	44.3 +/- 12.5
Tumescent solution (small)	5,2	89.4 +/- 7.4	80.4 +/- 8.3
Saline solution	7,2	92.8 +/- 3.5	80.1 +/- 10.1

High quality of adipose tissue harvested with WAL

Viability of the adipose tissue harvested with the water-jet scientifically proven

"Water-Assisted Liposuction for Body Contouring and Lipoharvesting: Safety and Efficacy in 41 Consecutive Patients" Gordon Sasaki et al., Aesthetic Surgery Journal (2011); 31:765

- Histological study of the viability of the adipocytes harvested with body-jet® and LipoCollector®
- 41 patients underwent small volume or moderate volume liposuction
- uneventful recovery periods with minimal side effects and no significant complications
- Almost all patients were able to resume their presurgical routines by the seventh postoperative day, depending on the extent and number of treatment sites



90 % of adipocytes absorbed and expelled trypan blue dye within one hour of exposure, indicating viability of cells.

"Immuno-histological study of the effect of the water-jet on adipose tissue and adipocytes" D. Krahl, Laboratory study 2008

- study focus was to investigate the changes to the adipose tissue that was treated with different RANGE settings of the water-jet
- effect on the individual adipocytes as well as changes to the blood and lymphatic vessels

body-jet® RANGE	Number of spray jets at one point	Adipose tissue viability achieved (%)
2	3	90
2	5	90
3	3	90
3	5	70
4	3	70
4	5	50

Damaged blood vessels	Damaged lymphatic vessels	Haematoma
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

- Results show, that using the settings in RANGE 1 or 2, 90 % of the adipose tissue remains reliably viable and is thus well suited for aesthetic and/or regenerative applications

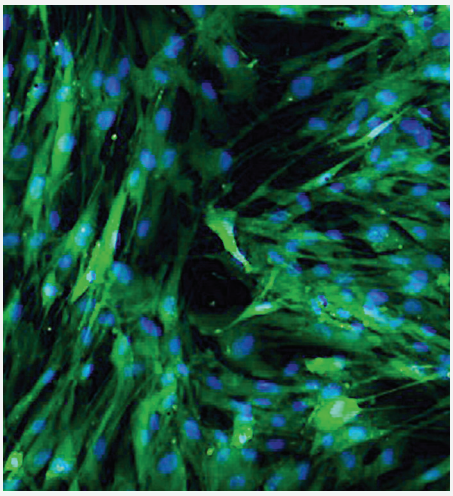
Content of regenerative cells within tissue harvested with WAL

Not only the viability of the adipose tissue is pivotal for its usability for autologous transfer. Another reason why adipose tissue has become a powerful tool for aesthetic and regenerative applications, is its content of regenerative cells.

The population of regenerative cells within adipose tissue is called stromal vascular fraction (SVF).

One cell type contained within this mixed population of cells is the adipose tissue-derived stem/stromal cell (ASC). This cell type possesses stem cell characteristics and contributes to tissue regeneration.

A study of the University Medical Center of Rostock showed, that the SVF isolated from adipose tissue that was harvested with WAL contains a substantial amount of ASC with stem cell properties, that can contribute to tissue retention in aesthetic applications and tissue regeneration in regenerative applications [6].



Adipose tissue-derived stem/stromal cells from tissue harvested with water-jet technology; viability staining, digitally overlaid (source: K. Peters, Cell Biology, Med. University of Rostock)

"Does Water-Jet Force Make a Difference in Fat Grafting? In Vitro and In Vivo Evidence of Improved Lipoaspirate Viability and Fat Graft Survival" Shilu Yin et al. Plastic and Reconstructive Surgery (2015); 127:138 [7]

- study on the effect of WAL on the viability and postoperative fat survival of fresh lipoaspirates
- comparison of manual liposuction to WAL

- The LipoCollector is connected to the liposuction cannula and negative-pressure pump during the harvesting procedure and has a prefilter to eliminate the fibrous materials. Lipoaspirate was separated from fluid in the LipoCollector during the liposuction period.
- Lipoaspirate harvested with WAL contained more intact adipocytes that also displayed a higher viability.
- The SVF from adipose tissue harvested with WAL contained more cells (ASC) with stem cell characteristics.
- Upon grafting, tissue from WAL showed better graft retention and a better grade of revascularization.

Autologous application of adipose tissue harvested with WAL

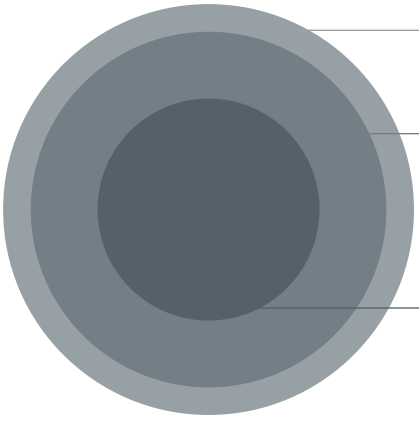
THE INDICATIONS	THE REQUIREMENTS	THE MEANS
Current and new indications for autologous transfer of adipose tissue in plastic and reconstructive surgery:	**Achieving the optimal retention rate of the transferred adipose tissue:**	**Gentle harvesting and processing of the adipose tissue with the body-jet® and LipoCollector® devices**
• Breast augmentation • Breast reconstruction • Correction of soft tissue defects • Treatment of scars • Treatment of chronic wounds • Natural filler for face and hands	• Method used for adipose tissue harvesting, processing and transfer • High viability of the individual adipocytes • optimal size of the adipose tissue clusters • Number of viable regenerative cells obtained (ASC, SVF) • Negative effects due to oxygen, contamination with surrounding air and mechanical stress • Choice of local anaesthetic	• Suction at a vacuum of -500 mbar • Irrigation in RANGE 1 or 2 • body-jet® evo: Use of the 'LipoCollection' function • Gentle filtration and removal of coarse connective tissue, medications and unwanted cell particles with the LipoCollector® or FillerCollector®

As already established, the viability and SVF content of adipose tissue are properties that determine the success of an application of adipose tissue in aesthetic and regenerative treatments. Furthermore, it has been shown, that an appropriate tissue cluster* size is vital for the success of autologous applications of adipose tissue.

**A tissue cluster is a small lobule of adipose tissue, that is generated during the liposuction.*

Optimal cluster size for adipose tissue transfer – Three-zone model

In a recent publication Dr. Yoshimura has defined a three-zone model for the transplanted autologous adipose tissue according to the cluster size [8]:



Surviving zone
Adipocytes survive

Regenerating zone
Adipocytes die, but stem cells survive. Dead adipocytes are replaced with new ones.

Necrotic zone
Both adipocytes and stem cells die.

Surviving zone

The **first zone** closest to the surface is the **surviving zone**, which is less than **300 µm** thick. In the surviving zone both the adipocytes and the regenerative cells (adipose-derived stromal cells, ASCs) can survive.

Regenerating zone

The **second zone** (up to **1200 µm** thick) is the **regenerating zone**, the thickness of which depends on the micro-environmental conditions such as the vascularization and connection to the surrounding tissue. In this zone, the adipocytes die on the first day but the adipose-derived stromal cells (ASCs) survive and generate new adipocytes to replace the dead cells.

Necrotic zone

The **third and central zone** is the **necrotic zone** in which both the adipocytes and the adipose derived stromal cells die. It is **more than 1200 µm** thick and regeneration can no longer be expected here with the necrotic area being absorbed or filled with scar tissue. The figure* below summarizes the three-zone model for transplanted adipocyte formations or cell clusters.

Adipocyte formations (cell clusters) that are harvested with the water-jet assisted method have a size of 650 to 900 µm that is optimal for survival in the recipient tissue! This could be one of the fundamental reasons for the high survival rates of up to 87 % after water-jet assisted autologous fat grafting using the BEAULI™-method [9,10]. Large adipocyte formations with a diameter of 1200–2000 µm (as harvested with other liposuction methods) lead to ischaemic necrosis and fatty cysts. The adipocyte formations (cell clusters) harvested with the body-jet® devices have a diameter of 650 to 900 µm and survive in the recipient tissue after the transplantation.

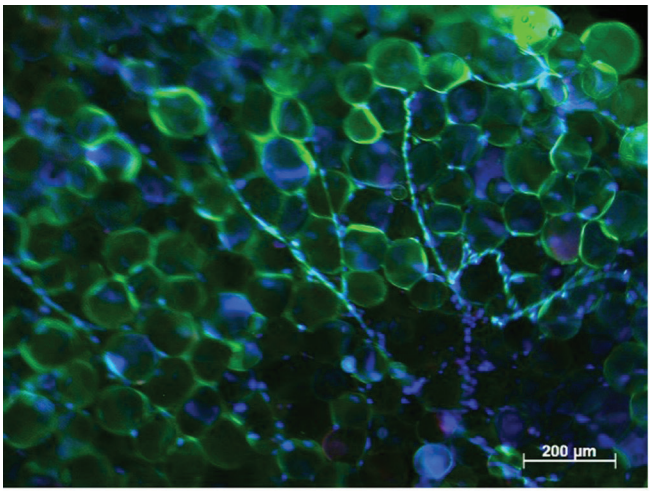


Image: Viable adipocyte formation harvested with the body-jet® device, size approx.700–900 µm. Adipocytes connected by blood vessels (viability staining, electron micro- scope image (source: K. Peters, Cell Biology, Med. University of Rostock)

Conclusions

WAL for the harvest of adipose tissue

Water-jet assisted liposuction is optimal for the harvest of autologous adipose tissue for aesthetic and regenerative treatments as it provides a method of liposuction maximally gentle to the patients and retaining high viability and quality of the aspirated tissue.

High quality of adipose tissue harvested with WAL

Through concise scientific studies it has been proven that the WAL yields adipose tissue aspirate with high viability and a substantial content of regenerative cells with stem cell characteristics that exert regenerative effects.

Autologous application of adipose tissue harvested with WAL

WAL leads to adipose tissue clusters of a size that warrants optimal tissue retention. Adipose tissue harvested with water-jet assistance has been used for successful aesthetic and regenerative treatments.

HUMAN MED®

The leader in water-jet assisted technology

As an innovator in water-jet assited technology, HUMAN MED® is the leader and the world's largest manufacturer of water-jet assisted medical devices for aesthetic and plastic-reconstructive surgery as well as regenerative medicine. Based on many years of success in the areas of general surgery, urology and neurosurgery, in 2004 HUMAN MED® dedicated to aesthetic and plastic-reconstructive surgery as well as regenerative medicine. Since then HUMAN MED® is a leading innovator of water-jet assited technology and the world's largest manufacturer of water-jet assisted medical devices for aesthetic and plastic-reconstructive surgery as well as regenerative medicine.

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