A Device to Preserve Adipose Tissue Grafts for Soft Tissue Reconstruction

J. PETER RUBIN, MD, FACS
University of Pittsburgh

“The ability to easily and inexpensively store tissue on-site will result in significant decrease in patient discomfort and risk, as well as significant decrease in surgeon time spent on the repeat procedure.”

https://plasticsurgery.pitt.edu/research/research-labs/adipose-stem-cell-center-ascc

CLINICAL NEED
Soft tissue deformities and volume/contour deformities from craniofacial trauma, congenital anomalies, and cancer treatment are difficult to correct. Current standard of care includes injectable fillers, implants, and soft tissue flap procedures, which have limitations and often involve operations with significant risk. As such, autologous fat transfer is being explored as a lower risk alternative. However, as optimal results with fat transfer often require at least two treatments, there is a need for an on-site preservation of harvested tissue for subsequent procedures to minimize donor site morbidity and encourage fast recovery.

SOLUTION
A team of researchers at the University of Pittsburgh led by Dr. Peter Rubin has previously validated the use of autologous fat transfer as a minimally invasive therapy for the restoration of craniofacial form. In order to facilitate fat transfer with minimal donor site morbidity, the team has developed a novel device to cryopreserve adipose for storage at the treatment facility, which can directly be used for the subsequent fat transfer(s).

COMPETITIVE ADVANTAGE
With the on-site cryopreservation and storage of the fat tissue, the device is envisioned to reduce patient and clinician burden for tissue harvest. The utilization of the device obviates the need for repeat tissue grafting procedures, and is anticipated to lead to reduction in treatment costs as the fat transfer injections may be performed outside of an operating room in a less acute setting.

ITP SUPPORT
The work supported by the ITP program is focused on the generation of a prototype cryopreservation/storage device that can be used for clinical trials. Towards that end, project plans include prototype development and validation, as well as the development of a regulatory strategy and commercialization plan.

CLINICAL TRANSLATION PATHWAY

|---------------|------------------------|---------------------|-----------------------------|--------------------------|

Michigan-Pittsburgh-Wyss Regenerative Medicine Resource Center is supported in part by the National Institute of Dental & Craniofacial Research of the National Institutes of Health under Award Number U24DE026915. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Contact Information:
Mutsumi Yoshida, PhD | Managing Director, U-M site | yoshidam@umich.edu | www.doctrc.com
A DEVICE TO PRESERVE ADIPOSE TISSUE GRAFTS
Asim Ejaz, Albert D. Donnenberg, Amy Wylie and J. Peter Rubin
Department of Plastic Surgery, University of Pittsburgh

UNMET CLINICAL NEED
Autologous fat transfer (AFT) is a surgical procedure that involves harvesting adipose tissue by liposuction techniques and grafting it to another site on the body to correct deformities from trauma, congenital anomalies, and cancer treatment, as well as make aesthetic improvements. AFT has evolved as a common procedure with over 100,000 cases performed in the US alone (2016 data-up 13% from 2015) and an estimated worldwide market of 250,000 cases per year, with continued growth. The major problem with fat grafting is that only 63% of the graft volume, on average, heals and persists long term, meaning that optimal results are obtained with at least two treatments. Therefore, preserving harvested tissue on-site for the next procedure is a major clinical need. There is no current technology that does this. Our proposed solution is minimizing the number of surgeries and maximizing the use of adipose tissue for better patient outcomes. Thus allowing for reduced cost making it relevant for the entire market of AFT cases.

MARKET ANALYSIS

• Stakeholders
  - Hospitals or private clinics who provide expensive OR resources and personnel
  - 80,000 cosmetic and 30,000 reconstructive patients undergoing fat graft procedures in the USA. Worldwide market excess 200,000 cases/year
  - Physicians spending extra time performing secondary fat grafting procedure

• Customers
  - Plastic surgeons (Market entry)
  - ENT
  - General surgeons
  - Orthopedic surgeons
  - Ophthalmologists
  - Dermatologists
  - Oral and maxillofacial surgeons
  - Hospitals, private clinics, and private practitioners are purchasers

• Channels to market
  - Device sales
    - Through licensed partner
    - Engage sales distributor
  - Marketing/Outreach
    - First adopters (clinical demonstrations at UPMC)
    - Conference proceedings
    - Conference/trade show demonstrations

INTELLECTUAL PROPERTY

<table>
<thead>
<tr>
<th>Patent/ IP information (app/ serial #)</th>
<th>Date filed</th>
<th>Title</th>
<th>Assignee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial no.: 62/553,322</td>
<td>9/01/17</td>
<td>A Device to Preserve Adipose Tissue Grafts</td>
<td>Univ of Pittsburgh</td>
</tr>
</tbody>
</table>

RESULTS

Adipocytes isolated from Fresh tissue

Cryopreserved tissue

Figure 1. Adipocytes isolated from either fresh fat (A) or cryopreserved fat at day 7 post-cryopreservation (B) were stained with Calcein Am and propidium iodide. Percentage viability was analyzed by employing Nexcelom cellometer K2 and plated (C). No significant difference in viability between the two different groups was observed.

MANUFACTURING

Development Process:
- Initial prototype was developed in partnership with Source Design International LLC.
- Contracted Archimedic in Aug 2020 for the design & development per ISO 13485
- Conducted Human Factors Study:
  - 9 participants; both Surgeons and Nurses
- Detailed mechanical design, risk analysis, manufacturing specs in process

REGULATORY PATHWAY

LipoStore: Regulatory Compliance

- 510(k) submission for syringe
- Tissue is minimally manipulated, allowing for FDA approved repeat injections
- Compatible with clinically used cryogenic reagents for safe long-term storage
- Stored on-site in -80°C degree freezer
- FDA and GMP compliant labeling and safety seals
- Storage case logs the temperature for quality control

TIMELINE & FUTURE DIRECTIONS

- Initial Prototype
- Human Factor Study
- Current Prototype