

# Automated Stem Cell Separation

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## Introduction to Stem Cells

Stem Cells are important in today's society due to their regenerative properties, however some of the main ways they are extracted are either painful or controversial. Stem cells are extracted via:

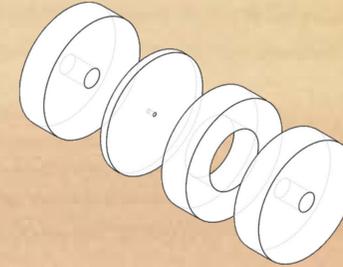
- Bone marrow procedures
- Amniotic fluid procedures
- Adipose tissue (human fat) procedures

### WHAT IS THE SCOPE OF THE PROJECT?

- Our project focus is on the mechanical separation of the stromal vascular fraction (SVF) from adipose tissue in a manner that is non-enzymatic and is not controversial.
- The current enzymatic process using collagenase does not meet FDA standards.
- Our project is a proof of concept that hydrodynamic cavitation can break down the collagen matrix that holds the SVF in adipose tissue.

<http://www.gettyimages.com/detail/photo/fat-tissue-sem-high-res-stock-photography/168835208>, S. GSCHMEISSNER

## Design



Our design is a simple incorporation of hydrodynamic cavitation, the cavitation is caused by a severe pressure drop in the middle of our device. The cavitation causes micro jets to form in the solution breaking the collagen fiber matrix holding the adipose tissue together.

### What makes our device:

- 0.8 mm diameter orifice
- An expansion chamber for visualization
- Acrylic plastic

### What makes our system:

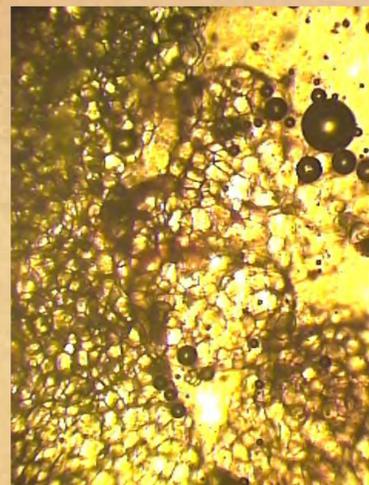
- Peristaltic pump
- Tubing
- Liquid mixture of adipose and water



## Pretreatment



In order to allow the fat to travel through our device without clogging the fat had to be grated (bottom left) and pretreated through a series of needles (top left) to reduce the tissue size (bottom right).



## Process

### System

- Closed loop
- Pulls a solution of 10:1 water to adipose ratio
- Creates hydrodynamic cavitation in the center of the device.



The goal of hydrodynamic cavitation is the following:

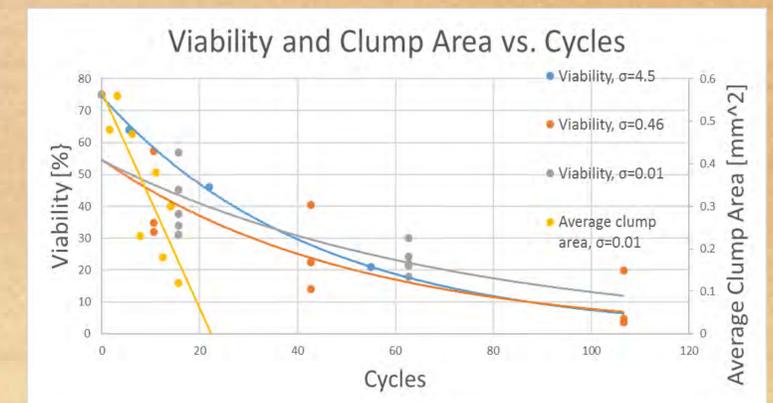
- Breaks up the extracellular matrix made up of collagen fibers.
- Releases the stem cells into the SVF to be extracted.



## Results



Displayed in the far left image is a large adipose structure held together by the collagen matrix in the control sample. The center image displays an adipose structure with the collagen matrix reduced after 6 volumetric cycles. The far right image shows no adipose structures and dark areas hypothesized to be free floating collagen after 28 volumetric cycles.



This plot compares the viability of PC-12 cells and the average clump size of adipose tissue as a function of the number of cycles through the process.

The highest achieved viability was 85%. It should be noted that the viability numbers given in the plot above are absolute while the ideal value and achieved values are relative percentages.

Critical Metrics	Ideal Value	Achieved Value
Reduce Adipose Tissue Matrix	Yes	Yes
Non-Enzymatic Process	Yes	Yes
Cell Viability	≥ 90%	≤ 85%