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Designing a mechanical system for efficient fat processing in regenerative medicine

Who are the patients?
Patients requiring regenerative medical treatments, including those undergoing procedures such as:

- Autologous fat grafting (e.g., for reconstructive surgery after trauma or mastectomy).
- Stem cell therapy derived from fat (adipose tissue is a rich source of mesenchymal stem cells).
- Treatments for soft tissue defects, wound healing, or cosmetic procedures.

What is the problem?
Fat processing for fat grafting involves various techniques to isolate and prepare adipose tissue for transplantation. The goal is to maximize the viability of fat cells while minimizing impurities such as blood, oil, and debris. One commonly used technique in the operating room is tissue emulsification, where fat is mechanically emulsified by passing it back and forth through syringes or a blunt cannula. The advantages of mechanical processing are quick and efficient, and allows to break down large clumps for a smoother graft, but as the main disadvantage of damaging fat cells if performed excessively. Commercial fat processing systems (Puregraft, Revolve, etc.) exist, but face significant challenges related to efficiency, cost, and versatility. Addressing these limitations would enhance their effectiveness and accessibility, especially for regenerative medicine applications.

What is the need?
A mechanical system is needed to process adipose tissue for regenerative medicine applications with the following capabilities:

- A robust mechanical solution (e.g., centrifugation, filtration, or membrane systems) to separate fat from unwanted components like blood, water, and oils, that exceed the performance of the current commercially available solutions
- A user-friendly device for use in operating rooms or clinics.
- A system that maintains sterility, minimizes tissue damage, and produces consistent results at varying scales of use.
- Maximizes the usable fat or stem cell content while maintaining the biological integrity of the processed tissue.

What is the benefit (if problem were solved)?
High-quality fat processing enables safer and more effective regenerative treatments, such as tissue repair, wound healing, and cosmetic enhancements. Ultimately, a novel system would contribute to the broader adoption and innovation of fat-based regenerative therapies, driving progress in personalized medicine and healthcare.