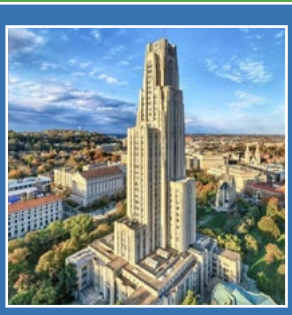
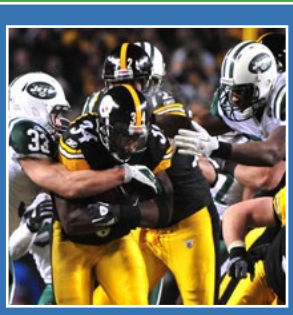
IFATS
International Federation for Adipose Therapeutics and Science

21st Annual IFATS Conference

Adipose Therapeutics: The Next Generation




September 19-22, 2024

University of Pittsburgh, Pittsburgh, PA

THERE'S ONLY ONE IFATS

Presidential Note

Susanna Miettenen, PhD

Frederik Trojahn Kølle, MD, PhD

Warm welcome to the 21st International Conference on Adipose Tissue Therapeutics and Science

This 4-day conference in Pittsburgh, where IFATS has deep roots, aims to explore the latest advancements and future directions in adipose tissue research. Our theme this year is "Adipose Therapeutics: The Next Generation," reflecting the growing understanding of adipose tissue biology and its potential for innovative therapeutic interventions.

Our conference provides a comprehensive platform for researchers, clinicians, students, and industry experts to share knowledge and collaborate on groundbreaking strategies. We aim to foster interdisciplinary collaboration, address current clinical challenges, and inspire future research in adipose tissue science.

We have curated a diverse program featuring keynote lectures from leading experts, interactive panel discussions, and hands-on workshops. Topics will range from the molecular mechanisms of adipose tissue function to cutting-edge approaches in tissue engineering and regenerative medicine. This year, we will also cover emerging fields like single-cell transcriptomics, regenerative engineering, bioprinting, and tissue therapeutics via fat transfer. Panel discussions will delve into fat grafting, musculoskeletal applications, and modeling adipose tissue in health and disease.

To honor past contributions to the field, we will remember Dr. Arnold Caplan, whose pioneering work significantly shaped adipose tissue science and cell-based therapies. Dr. Stephen E. Haynesworth will deliver a tribute to Dr. Caplan's life and legacy.

In our ongoing effort to engage junior researchers, we will continue the IFATS Academy sessions, launched last year, focusing on neurovasculature in adipose tissue and fat grafting. Additionally, IFATS board members will share their expertise through special presentations.

This year, IFATS introduces a hands-on cadaver laboratory, offering a unique opportunity to learn from top plastic surgeons. Clinical experts will demonstrate the latest techniques in endoscopic facelifting and pan facial fat grafting, emphasizing best practices for improved patient outcomes.

We encourage active participation to keep our field vibrant and evolving. As the leading source of information on adipose biology and technology, IFATS relies on your involvement to advance our field. We extend our heartfelt thanks to our sponsors, partners, distinguished speakers, and all attendees. Your support and contributions are vital to the success of this conference and the progress of adipose tissue research.

The next few days promise to be filled with insightful presentations, stimulating discussions, and valuable networking opportunities. We encourage you to actively participate, share your perspectives, and collaborate with your peers. Together, we can push the boundaries of adipose tissue research and therapeutics.

Let us embark on this journey of discovery and innovation, shaping the next generation of adipose tissue therapeutics. We look forward to the fruitful exchanges and groundbreaking ideas that will emerge from this conference.

Susanna Miettenen, PhD
IFATS Co-President

Frederik Trojahn Kølle,MD, PhD
IFATS Co-President

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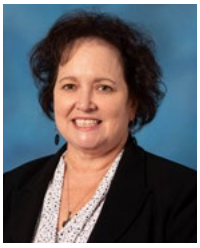

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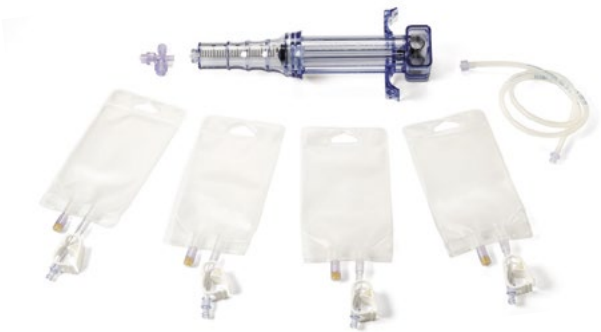

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Summer E. Hanson, MD, PhD
Lauren Kokai, PhD
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J. Peter Rubin, MD, FACS

Invited Speakers & Session Moderators

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Aso, Ejaz, PhD
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Jeffrey M. Gimble, MD, PhD
Martin Halle, MD, PhD
Stephen Haynesworth, PhD
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Jeremy Magalon, PhD
Keith March, MD, PhD
Kacey G. Marra, PhD
John J. McCarthy, PhD
Susanna Miettinen, PhD
Nicholas E. Navin, PhD
Dennis P. Orgill, MD, PhD
Ivona Percec, MD, PhD
Ricardo L. Rodriguez, MD
J. Peter Rubin, MD, MBA
Kristin Stanford, PhD, FAHA
Aris Stermodimas, MD, MSc
Kristy Townsend, PhD
Dharmesh Vyas, MD, PhD
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Kacey Marra, PhD
University of Pittsburgh

Susana Miettinen, PhD
University of Tampere

Shigeki Sugii, PhD
Singapore Bioimaging Consortium / Duke-NUS Graduate Medical School

Dmitry Traktuev, PhD
University of Florida College of Medicine

Free Paper Presenters

Jose Antonio Arellano, MD
Derek Banyard, MD, MBA, MS
Hilton Becker, MD
Julie Fradette, PhD
Miia Juntunen, PhD
Lindsey Kieffer Huff, PhD
Elizabeth Kaleigh Johnston
Hilary Liu, BS
Shawn J. Loder, MD
Fiona Louis, M.Eng., PhD
Jeffrey M. Gimble, MD, PhD
Frederik Mamsen, MD
Sophie Menkes, MD
Walter L. Murfee, PhD
Alexa Rivera del Río Hernández, MD
Nicolas Serratrice, MD
Francisco Silva
Yoshihiro Sowa, MD
Grace Tolan, MS
Yoshihiro Toyohara, MD
Fangzhou Xie, PhD
Mei Yu, PhD
Daniel Patrick Zaki, MD, MS

THURSDAY - SEPTEMBER 19

12:00 -6:00 pm	**CADAVER LAB Facelifting and Fat Grafting, Endoscopic Session and Pan Facial Fat Grafting Session** Instructors: Martin Halle, MD, PhD, Chia Chi Kao, MD, Frederik Trojan Kølle, MD, PhD, J. Peter Rubin, MD, FACS, Aris Sterodimas, MD, MSc, Kamakshi Zeidler, MD	*Scaife Hall*

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FRIDAY - SEPTEMBER 20

7:30 am	**Executive Board Meeting**
8:30 - 9:00 am	**Continental Breakfast in Exhibit Hall**
9:00 - 9:05 am	**Welcome Remarks and Overview** Susanna Miettinen, PhD & Frederik Trojan Kølle, MD, PhD - IFATS Co-Presidents
9:05 - 9:15 am	**The Origin of IFATS** J. Peter Rubin, MD, MBA
9:15 - 10:00 am	**OPENING KEYNOTE SPEAKER:** **Towards a Single Cell and Spatially Resolved Atlas of Normal Breast Tissues and Premalignant Cancer** Nicholas E. Navin, PhD *Professor & Chair Department of Systems Biology, Grady Saunders Distinguished Professor, Director, CPRIT Single Cell Genomics Center, MD Anderson Cancer Center* Introduced by Summer Hanson, MD, PhD
10:00 - 10:30 am	**Coffee Break in Exhibit Hall**
10:30 - 11:00 am	**SPECIAL PRESENTATION:** **Nonfat and PRP Stamping into the Aesthetic Zone of the Skin** Kamakshi Zeidler, MD *Founder & Managing Partner, Medical Director, Head of Aesthetic Surgery AESTHETX*
11:00 - 12:15 pm	**PANEL: Facial Fat Grafting** Moderator: Frederik Trojahn Kølle, MD, PhD **Macro, Micro, Nano Fat for Facial Contouring** Kamakshi Zeidler, MD *Founder & Managing Partner, Medical Director, Head of Aesthetic Surgery, AESTHETX* **Advanced 3D Facial Fat Grafting: The Use of Micro, Milli, Nano Fat for Reversing the Signs of Aging** Aris Sterodimas, MD, MSc *Head Plastic & Reconstructive Surgery Department, Metropolitan General Hospital, Athens, Greece* **Why Fat Transfer is an Essential Part of the Ponytail Lift** Chia Chi Kao, MD *Kao Plastic Surgery, Kao Aesthetics, Kao Regenerative Therapies* **Pan Facial Fat Grafting - A Twelve Point Injection Technique** Frederik Trojahn Kølle, MD, PhD *eriX Private Hospital , Head Surgeon of Plastic Surgery, Department of Plastic Surgery*
12:15 - 12:25 pm	**SPECIAL BOARD PRESENTATION:** **A Decade in Review: Stem Cells and Fat Grafting for Facial Aesthetics - Advances, Limitations and Where Can We Go from Here** Ivona Percec, MD, PhD
12:25 - 1:25 pm	**Lunch**
12:25 - 1:25 pm	**IFATS ACADEMY - The Basics of Fat Grafting** Frederik Trojahn Kølle, MD, PhD and Summer Hanson, MD, PhD

1:25 - 2:40 pm	**PANEL: ISPRES** Moderator: J. Peter Rubin, MD, MBA **Regenerative Remodeling: An Attempt to Bring Plastic Surgery to its Primordial "Plastikos"** Roger K. Khouri, MD *Miami Breast Center* **Xenogenic Scaffolds Induce Adipose Tissue** Dennis P. Orgill, MD, PhD *Division of Plastic Surgery, Medical Director, Wound Care Center, Brigham and Women's Hospital Professor of Surgery, Harvard Medical School* **Setting a New Benchmark in Breast Contouring: Scarless Mastopexy Assisted by Stromal Enriched Lipograft** Aris Sterodimas, MD, MSc *Head Plastic & Reconstructive Surgery Department, Metropolitan General Hospital, Athens, Greece*
2:40 - 3:20 pm	**Free Papers 1 - Fat Grafting** Moderators: J. Peter Rubin, MD, MBA and Alexa Rivera Del Rio Hernandez, MD
2:40	(p.15) - **Advances in Single-Stage Trilaminar Reconstruction of Complex Cutaneous Injury by Composite Skin and Fat Engraftment** Presenter: Shawn Jeffrey Loder, MD - USA Affiliation: University of Pittsburgh Authors: Yadira Villalvazo, MD, MS, Yusuf Surucu, MD, Jose Antonio Arellano, MD, Pooja Humar, BS, Fuat Baris Bengur, MD, Hamid Malekzadeh, MD, Amr Elmeanawy, MD, Alexandra Vagonis, BS, Wayne Nerone, BS, Francesco Egro, MD, Lauren Kokai, PhD, Kacey Marra, PhD, Elof Eriksson, MD, J. Peter Rubin, MD, MBA
2:50	(p.15) - **The Use Of Adipose Tissue Based Therapies On Facial Atrophic Post-Acne Vulgaris Scars: A Systematic Review** Presenter: Jose Antonio Arellano, MD - USA Affiliation: University of Pittsburgh Authors: Mario Alessandri-Bonetti, MD; Giulia Coscarella, MD; Francesco Amendola, MD; Luca Vaienti, MD; Paolo Persichetti, MD, PhD, FEBOPRAS Peter J Rubin, MD, MBA, FACS; Francesco Egro, MD, MSC, MRCS
3:00	(p.16) - **The Effect of Fat Grafting on Scar Hyperpigmentation: A Systematic Review and Meta-Analysis** Presenter: Hilary Liu, BS - USA Affiliation: University of Pittsburgh Authors: Hilary Liu, Mario Alessandri Bonetti, Jose Antonio Arellano, Anna Scarabosio, Ricardo Giorgino, Asim Ejaz, J Peter Rubin, Francesco M. Egro
3:10	(p.16) - **Histological Assessment of Structurally Injected Fat with or without MSC(AT) and ECM** Virtual Presenter: Frederik Penzien Wainer Mamsen, MD - Denmark Authors: MAMSEN, FPW; Kølle FT
3:10 - 3:35 pm	**Coffee Break**
3:35 - 3:45 pm	**SPECIAL BOARD PRESENTATION:** **The Role of Adipose Stem Cells and the Nervous System** Kacey G. Marra, PhD
3:45 - 4:05 pm	**Free Papers 2 - Neural & Muscle Reconstruction** Moderators: Daiki Kitano, PhD and Kacey G. Marra, PhD
3:45	(p.17) - **Nanofat Rescue Following Thermal and Mechanical Injury on Perineural Tissue** Presenter: Grace Tolan, BS - USA Authors: Grace Tolan, BS, Dr. Brannon Claytor, MD
3:55	(p.18) - **Prophylactic Systemic Administration of Adipose-derived Stem Cells in Combination with Irradiation Reduces Late Radiation Tissue Damage** Presenter: Yoshihiro Toyohara, MD - Japan Affiliation: Jichi Medical University Authors: Yoshihiro Toyohara, Yoshihiro Sowa, Natsumi Saito, Takako Shirado, Wu Yunyan, Zhang Bihang, Hyun Sangchul, Shino Higai, Li Bolun, Yuhei Morita and Kotaro Yoshimura
4:05	(p.19) - **The Therapeutic Effect of Adipose-derived Stem Cell Transplantation on Alleviating Muscle Atrophy Using Sarcopenia Model Mouse** Virtual Presenter: Yoshihiro Sowa, MD - Japan Affiliation: Jichi Medical University Authors: Yoshihiro Sowa, Qiannan Zhao, Ko Ogawa, Yoshihiro Toyohara, Shino Higai, Natsumi Saito, Kotaro Yoshimura, Tetsuji Yamaoka, Naoki Morimoto

4:15	(p.20) - **Bovine Adipose Tissue Reconstruction for Cell-based Wagyu Meat** Presenter: Fiona Louis, M.Eng., PhD - Japan Affiliation: Osaka University Authors: Yoshihiro Sowa, Shiro Kitano, and Michiya Matsusaki
4:15 - 4:25 pm	**SPECIAL PRESENTATION:** **Utilizing a Novel Ex Vivo OA Model with Fractionated Fat to Identify Potent Adipose-Derived Therapeutics** Shengyang Jin, MD
4:25 - 4:45 pm	**Transitional Break**
4:45 - 5:30 pm	**SPECIAL PRESENTATION:** **A Tribute to Dr. Arnold Caplan: The Father of Mesenchymal Stem Cells** Stephen E. Haynesworth, PhD *Associate Professor, Department of Biology Director, The Emerging Scholars Program / Case Western Reserve University* Introduced by Jeffrey M. Gimble, MD, PhD
5:30 pm	**Meeting Adjourns for the Day**

SATURDAY - SEPTEMBER 21

8:30 - 9:00 am	**Continental Breakfast in Exhibit Hall**
9:00 - 9:45 am	**OPENING KEYNOTE SPEAKER:** **Regenerative Engineering** Cato Laurencin, MD, PhD *University Professor, University of Connecticut, Chief Executive Officer, The Cato T. Laurencin Institute for Regenerative Engineering, Convergence Institute at the University of Connecticut* Introduced: by Susanna Miettinen, PhD
9:45 - 11:00 am	**PANEL: Musculoskeletal** Moderator: J. Peter Rubin, MD, MBA **Opportunities for Cell-Therapy; Orthobiologics and Regenerative Therapies in Musculoskeletal Injuries and Degenerative Conditions** Dharmesh Vyas, MD, PhD *Associate Professor, Medical Director and Head Team Physician, NHL Pittsburgh Penguins Club, Medical Director, UPMC Lemieux Sports Complex* **Muscle Tissue: Novel Advances in Regenerative Therapies** John J. McCarthy, PhD *Professor of Physiology, College of Medicine, University of Kentucky*
11:00- 11:15 am	**SPECIAL VIRTUAL PRESENTATION:** **Long Lasting Benefits of High Volume PRP Injections for Knee Osteoarthritis** Jeremy Magalon, PhD *Medical Biologist in Cell Therapy, Marseille La Conception University Hospital, Aix Marseille*
11:15 - 11:30 am	**Coffee Break**
11:30 - 12:30 pm	**PANEL: Body** Moderator: Frederik Trojahn Kølle, MD, PhD **Fat Grafting to the Breast and Body Contouring** Frederik Trojahn Kølle, MD, PhD *CeriX Private Hospital, Head Surgeon of Plastic Surgery, Department of Plastic Surgery* **When Body Liposuction Goes Wrong; The Role of Stromal Enriched Lipograft and The Emerging Technologies in Dealing with Complications** Aris Sterodimas, MD, MSc *Head Plastic & Reconstructive Surgery Department, Metropolitan General Hospital, Athens, Greece* **Safety in Gluteal Fat Grafting** J. Peter Rubin, MD, MBA *Chair, Department of Plastic Surgery, UPMC Endowed Professor of Plastic Surgery, Professor of Bioengineering and Business Administration, University of Pittsburgh*

12:30 - 1:30 pm	**Lunch**
12:30 - 1:30 pm	**IFATS ACADEMY - The Neurovasculature in Adipose Tissue -** Kristy L. Townsend, PhD
1:30- 2:15 pm	**KEYNOTE SPEAKER:** **Next-Generation Adipose Tissue Engineering: Using Mature Adipocytes and Bioprinting for Drug Screening and Regenerative Medicine Applications** Fiona Louis, M.Eng., PhD *Assistant Professor, Specially Appointed Researcher, Graduate School of Engineering, Osaka University* Introduced by Rosalyn Abbott, PhD
2:15 -3:30 pm	**PANEL: Modeling Adipose Tissue in Health and Disease** Moderator: Rosalyn Abbott, PhD **Brown Fat /Exercise-induced Adaptations to White and Brown Adipose Tissue** Kristin Stanford, PhD *Department of Surgery, General and Gastrointestinal Surgery, Department of Internal Medicine, Endocrinology, Associate Director, Davis Heart and Lung Research Institute, Associate Director, Diabetes and Metabolism Research Center* **Adipose Tissue Modeling for Diseases** Rosalyn Abbott, PhD *Associate Professor - Carnegie Mellon University, Biomedical Engineering - Materials Science and Engineering* **Building Blocks for Adipose Tissue Models** Susanna Miettinen, PhD *Professor of Cell and Tissue Technology, Adult Stem Cells Group, Faculty of Medicine and Health Technology, Tampere University, Tampere, Finland* **Adipose Stem Cells and their role in Lipedema** Bruce Bunnell, PhD *Professor and Chair, Department of Microbiology, Immunology and Genetics, University of North Texas Health Science Center, Fort Worth, TX* **Neurovascular Plasticity in Adipose and Links to Adipose Health** Kristy L. Townsend, PhD *Associate Professor; Department of Neurological Surgery, Director, Women in Medicine and Science (WIMS), The Ohio State University, College of Medicine*
3:30 -4:00 pm	**Free Papers 3 - Adipose Tissue Models** Moderators: Elizabeth Johnston, PhD and Rosalyn Abbott, PhD
3:30	(p.20) - **Weight Gain Alters Adipose Stem/Stomal Cell Functionality and Size in Adipogenic Conditions** Presenter: Miia Juntunen, PhD - Finland Affiliation: Tampere University Authors: Miia Juntunen, PhD, Alma Yrjanainen, MSc, Ella Lampela, MSc, Marika Kuuskeri, MD, PhD, and Susanna Miettinen, PhD
3:40	(p.21) - **Human-Derived Biomaterials to Fully Support Microphysiological Systems for The Adipose Tissue and Beyond** Presenter: Jeffrey M. Gimble, MD, PhD - USA Affiliation: Obatala Sciences Authors: Cecilia G. Sanchez, Haley R. Lassiter, Jordan T. Robinson, Katie M. Hamel, Emma L. Rogers, Trivia P. Frazier.
3:50	(p.21) - **ObaCell® Obesity-on-a-Chip, a Platform for Disease Modeling and Drug Development and Compatible to AI Image Analysis Recognition- A GLP1 Agonist Case Study** Presenter: Jeffrey M. Gimble, MD, PhD - USA Affiliation: Obatala Sciences Authors: Cecilia G. Sanchez, Trivia P. Frazier, Haley R. Lassiter, Jordan T. Robinson, Katie M. Hamel, Emma L. Rogers
4:00 - 4:30 pm	**Coffee Break**
4:30 - 4:40 pm	**SPECIAL PRESENTATION:** **Burn Reconstruction and the Role of Restoring the Hypodermis** Francesco M. Egro, MBChB, MSc, MRCS
4:40 - 4:50 pm	**SPECIAL BOARD PRESENTATION:** **Emerging Interest in Ectodermally Derived Dermal White Adipose Tissue (dWAT) as Recipient or Donor Site for Fat Grafting** Ricardo L. Rodriguez, MD

4:50 - 5:20 pm	**Free Papers 4 - Fat Grafting Devices** Moderators: Asim Ejaz, PhD and Martin Halle, MD, PhD
4:50	(p.22) - **Lipoaspirate Preparation Device Enables Washing and Integrated Mechanical Processing** Presenter: Derek Banyard, MD, MBA, MS - USA Affiliation: Sayenza Biosciences Authors: Jiayi Feng, Derek A. Banyard, MD, MBA, MS, Marzieh Aliaghaei, PhD, Alan D. Widgerow, MBBCh, MMed, and Jered B. Haun, PhD
5:00	(p.23) - **Small Extracellular Vesicles Purified from Lipoaspirate Fluid Promote Hair Regeneration** Presenter: Mei Yu, PhD - China Affiliation: West China School of Stomatology, Sichuan University Authors: Yue Zhang, Yi Zhang
5:10	(p.23) - **Mechanical Stromal Vascular Fraction Concentration** Presenter: Hilton Becker, MD - USA Affiliation: BeckerMD Author: Hilton Becker, MD
5:20 - 6:00 pm	**CLOSING KEYNOTE SPEAKER:** **The Role of Autologous Fat Transfer in Radiation Fibrosis** Martin Halle, MD, PhD *Associate Professor Senior Consultant, Reconstructive Plastic Surgery, Karolinska University Hospita* Introduced by: Frederik Trojahn Kølle, MD, PhD
6:00 pm	**Meeting Adjourns for the Day**
6:30 pm	**Dinner -** University Club, Ballroom A *(Additional Fee applies, registration required)*

SUNDAY - SEPTEMBER 22

7:45 - 8:45 am	**Continental Breakfast in Exhibit Hall**
8:00 - 9:00 am	**IFATS Members Meeting**
9:00 - 9:10 am	**SPECIAL BOARD PRESENTATION:** **Are They Really Stem Cells in Fat/Senescence in Fat** Ramon Llull, PhD
9:10 - 10:00 am	**Free Papers 5 - Adipose Stem Cell Phenotype and Cell-Based Therapies** Moderators: Susanna Miettinen, PhD and Miia Juntunen, PhD
9:10	(p.24) - **Understanding the Impact of Cytomegalovirus on Adipose Tissue** Presenter: Elizabeth Kaleigh Johnston - USA Affiliation: Carnegie Mellon University Authors: Elizabeth Kaleigh Johnston, Jiani Chen, Kevin Zwezdaryk, Rosalyn Abbott
9:20	(p.25) - **Spatial Transcriptomic Analysis Deciphers Adipocyte-to-Fibroblast Transformation in Bleomycin-Induced Murine Skin Fibrosis** Presenter: Fangzhou Xie, PhD. - China Affiliation: Shanghai Ninth People's Hospital Authors: Yixiang Zhang, Jiahao He, Fangzhou Xie, Shengzhou Shan1, Jiaqi Qin, Chuandong Wang, Qingfeng Lil, Dejun Cao1, Yun Xie1, Bin Fang
9:30	(p.26) - **From White to Brown: A Polymers-Based Two-Step Strategy for Dedifferentiation of Mature Adipocytes into DFAT and Subsequent Redifferentiation into Brown.** Presenter: : Fiona Louis, M.Eng., PhD. - Japan Affiliation: Osaka University Authors: Aslı Sena Karanfil, Fiona Louis, Yoshihiro Sowa, Michiya Matsusaki
9:40	(p.27) - **Brown Adipose Derived Mesenchymal Stem Cells (BADSCs), a Cell-Based Therapeutic as an Alternative to Glucagon-like Peptide-1 (GLP-1) Agonists to Treat Obesity** Presenter: Francisco Silva - USA Affiliation: BioRestorative Therapies, Inc. Authors: Christian Elabd, Vanessa Silva, Francisco Silva

9:50 - 10:00 am	**SPECIAL BOARD PRESENTATION:** **Evolving the Pre-eminent Role of the Secretome in Cell-based Therapy: 20 Years from First Discovery to Broad Exploration** Keith March, MD, PhD
10:00 - 10:30 am	**Best Clinical Papers** Moderators: Frederik Trojahn Kølle, MD, PhD
10:00	(p.27) - **Clinical-PI** **A Comprehensive Study on the Synergy of Nanofat Grafting with Hybrid Cooperative Complexes of High and Low Molecular Weight Hyaluronans, Energy-Based Devices, and Exosomes** Virtual Presenter: Sophie Menkes, MD - Switzerland Affiliation: NESCENS Clinic Author: Sophie Menkes, MD
10:15	(p.28) - **Clinical - PI** **Clinical Significance of Fat Graft Preparation Technique in Breast Reconstruction Revision with Autologous Fat Transfer** Virtual Presenter: Daniel Patrick Zaki, MD, MS - USA Affiliation: Wake Forest University Authors: Daniel Patrick Zaki, MD, MS, Mario Blondin, MD; Blake Dunson, BS; Mariam Gadjiko, MD; Ivo Pestana, MD.
10:30 - 11:00 am	**Coffee Break Visit Exhibits**
11:00 - 11:40 am	**Best Translational and Basic Science Papers** Moderator: Susanna Miettinen, PhD
11:00	(p.28) - **Translational - Student** **Autologous Stromal Vascular Fraction Derived from Fat, Preliminary Results Obtained in a Model of Spinal Cord Contusion in Piglets** Presenter: Nicolas Serratrice, MD - France Affiliation: Aix-Marseille University Author: Nicolas Serratrice, MD
11:15	(p.29) - **Translational - Student** **Advancing Translational Research: A Novel Ex Vivo Human Skin Perfusion System for Enhanced Clinical Applications** Presenter: Alexa Rivera del Rio Hernandez, MD - USA Affiliation: University of Pittsburgh Authors: Alexa Rivera del Río Hernández, MD; Jose Antonio Arellano, MD; Hamid Malekzadeh, MD; Yusuf Surucu, MD; Fuat Baris Bengur, MD; Shawn Loder, MD; Jeffrey A. Gusenoff, MD; Francesco M. Egro, MBChB, MSc, MRCS; J. Peter Rubin, MD, FACS, MBA; Asim Ejaz, PhD
11:30	(p.29) - **Translational - PI** **ASC-based Biological Dressings Enhance Skin Wound Healing in Diabetic Mice** Presenter: Julie Fradette, PhD - Canada Affiliation: LOEX-Universite Laval Authors: Julie Fradette, PhD, Meryem Safoine, MD, PhD, Caroline Paquette, PhD, Gabrielle-Maude Gingras
11:45	(p.30) - **Basic - Student** **Lymphatic Vessel Structure Formation During Stromal Vascular Fraction Derived Vasculogenesis** Presenter: Walter L Murfee, PhD - USA Affiliation: University of Florida Authors: Hulan Shang, Samuel Kogan, Ramon Lull, Adam J. Katz, Walter L. Murfee
12:00	(p.30) - **Basic - Student** **FRESH 3D Printing Adipose Tissue for Reconstructive Medicine** Presenter: Lindsey Kieffer Huff, PhD - USA Affiliation: Carnegie Mellon University. Authors: Lindsey Kieffer Huff, Theo Mohideen, Daniel Aluko, Giselle Obergfell, Adam Feinberg, Rosalyn Abbott
12:15 -12:35 pm	**SPECIAL PRESENTATION:** **First in Human Adipose Stem Cell Treatment for Bladder Radiation Fibrosis** Roger Klein, MD, PhD *PGY 5 Urology Resident, Department of Urology, University of Pittsburgh Medical Center*
12:35 - 12:45 pm	**AWARD ANNOUNCEMENTS** 2025 President Announcement and Presentation
12:45 pm	**Meeting Adjourns**

Synopsis of Conference Panels

Facial Fat Grafting Panel

Friday, September 20, 2024 Time: 11:00 - 12:15 am
Moderator: Frederik Trojahn Kølle, MD, PhD

This panel focuses on latest techniques for facelifting and fat grafting to the face will be presented and discussed.

Macro, Micro, Nano Fat for Facial Contouring
Kamakshi Zeidler, MD
Founder & Managing Partner, Medical Directo, Head of Aesthetic Surger, AESTHETX

Advanced 3D Facial Fat Grafting: The Use of Micro, Milli, Nano Fat for Reversing the Signs of Aging
Aris Sterodimas, MD, MSc
Head Plastic & Reconstructive Surgery Department, Metropolitan General Hospital, Athens, Greece

Why Fat Transfer is an Essential Part of the Ponytail Lift
Chia Chi Kao, MD
Kao Plastic Surgery, Kao Aesthetics, Kao Regenerative Therapies

Pan Facial Fat Grafting - A Twelve Point Injection Technique
Frederik Trojahn Kølle, MD, PhD
CeriX Private Hospital, Head Surgeon of Plastic Surgery, Department of Plastic Surgery

ISPRES Panel

Friday, September 20, 2024 Time: 1:25 – 2:40 pm
Moderator: J. Peter Rubin, MD, MBA

Description

Regenerative Remodeling: An Attempt to Bring Plastic Surgery to its Primordial "Plastikos"
Roger K. Khouri, MD
Miami Breast Center

Xenogenic Scaffolds Induce Adipose Tissue
Dennis P. Orgill, MD, PhD
Division of Plastic Surgery, Medical Director, Wound Care Center, Brigham and Women's Hospital
Professor of Surgery, Harvard Medical School

Setting a New Benchmark in Breast Contouring: Scarless Mastopexy Assisted by Stromal Enriched Lipograft
Aris Sterodimas, MD, MSc
Head Plastic & Reconstructive Surgery Department, Metropolitan General Hospital, Athens, Greece

Musculoskeletal Panel

Saturday, September 21, 2024 Time: 9:45 - 11:00 am
Moderator: J. Peter Rubin, MD, MBA

Description

Opportunities for Cell-Therapy; Orthobiologics and Regenerative Therapies in Musculoskeletal Injuries and Degenerative Conditions
Dharmesh Vyas, MD, PhD
Associate Professor, Medical Director and Head Team Physician, NHL Pittsburgh Penguins Club,
Medical Director, UPMC Lemieux Sports Complex

Muscle Tissue: Novel Advances in Regenerative Therapies
John J. McCarthy, PhD
Professor of Physiology, College of Medicine, University of Kentucky

Body Panel

Saturday, September 21, 2024 Time: 11:30 - 12:30 pm
Moderator: Frederik Trojahn Kølle, MD, PhD

This panel focuses on golden standards for body contouring both covering various lifting techniques in combination with the latest fat grafting techniques.

Fat Grafting to the Breast and Body Contouring
Frederik Trojahn Kølle, MD, PhD
CeriX Private Hospital, Head Surgeon of Plastic Surgery, Department of Plastic Surgery

When Body Liposuction Goes Wrong; The Role of Stromal Enriched Lipograft and The Emerging Technologies in Dealing with Complications
Aris Sterodimas, MD, MSc
Head Plastic & Reconstructive Surgery Department, Metropolitan General Hospital, Athens, Greece

Safety in Gluteal Fat Grafting
J. Peter Rubin, MD, MBA
Chair, Department of Plastic Surgery, UPMC Endowed Professor of Plastic Surgery, Professor of Bioengineering and Business Administration, University of Pittsburgh

Modeling Adipose Tissue in Health and Disease

Saturday, September 21, 2024 Time: 2:15 - 3:30 pm
Moderator: Rosalyn Abbott, PhD

The 2024 IFATS panel on Modeling Adipose Tissue in Health and Disease is designed to provide an overview on the recent developments in the field of adipose tissue modelling and provide a platform to discuss the special features of adipose tissues and how they should be considered when therapies are planned. The panel will provide an overview of the building blocks for adipose tissue models and current approaches for creating disease models in vitro. Brown adipose tissue and exercise-induced alterations in adipose tissue will be explored. An important, but often overlooked aspect of adipose tissues, the neurovasculature, will be introduced. Finally stem cells derived from lipedema patients will be discussed. Lipedema is a painful adipose tissue disorder that is often confused with obesity and lymphedema. As the adipose tissue is the primary affected tissue in patients, defining the role of adipose stem cells in the disease-associated processes will provide insights into the pathophysiology of lipedema and will help researchers develop potential treatments for the disease.

Brown Fat /Exercise-induced Adaptations to White and Brown Adipose Tissue
Kristin I. Stanford, PhD, F.A.H.A.
Professor , Department of Surgery, General and Gastrointestinal Surgery, Department of Internal Medicine, Endocrinology, Associate Director, Davis Heart and Lung Research Institute, Associate Director, Diabetes and Metabolism Research Center

Adipose Tissue Modeling for Diseases
Rosalyn Abbott, PhD
Associate Professor - Carnegie Mellon University, Biomedical Engineering - Materials Science and Engineering

Building Blocks for Adipose Tissue Models
Susanna Miettinen, PhD
Professor of Cell and Tissue Technology, Adult Stem Cells Group, Faculty of Medicine and Health Technology, Tampere University

Adipose Stem Cells and their role in Lipedema
Bruce Bunnell, PhD
Professor and Chair, Department of Microbiology, Immunology and Genetics, University of North Texas Health Science Center, Fort Worth, TX

Neurovascular Plasticity in Adipose and Links to Adipose Health
Kristy Townsend, PhD
Associate Professor; Department of Neurological Surgery, Director, Women in Medicine and Science (WIMS), The Ohio State University, College of Medicine

REVOLVE™
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CHOOSE REVOLVE™ SYSTEM FOR HIGH-QUALITY FAT

#1
COMMERCIAL DEVICE FOR FAT PROCESSING
in the US for aesthetic and reconstructive procedures[1,*]

*Surgeon survey data, March 2024 (n = 143)

Featuring an **INTEGRATED, CLOSED SYSTEM**

- **Time efficient**[2]
  In a retrospective study, REVOLVE™ System processed more fat per minute than centrifugation.
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- **Predictable**[3]
  In an animal model, REVOLVE™ System yielded significantly higher fat graft retention than decantation and similar results to centrifugation.[†,‡]

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[†]Correlation between these results and results in humans has not been established.

[‡]In this preclinical study, human fat was processed using 3 different methods: REVOLVE™ System, decantation, and centrifugation (processed at 1200 g for 3 minutes). Fat samples from each group were implanted into mice, then explanted after 28 days and evaluated for a head-to-head comparison of volume retention.

INDICATIONS AND IMPORTANT SAFETY INFORMATION

INDICATIONS

The REVOLVE™ Advanced Adipose System (REVOLVE™ System) is used for aspiration, harvesting, filtering, and transferring of autologous adipose tissue for aesthetic body contouring. This system should be used with a legally marketed vacuum or aspirator apparatus as a source of suction. If harvested fat is to be re-implanted, the harvested fat is only to be used without any additional manipulation. REVOLVE™ System is intended for use in the following surgical specialties when the aspiration of soft tissue is desired: plastic and reconstructive surgery, gastrointestinal and affiliated organ surgery, urological surgery, general surgery, orthopedic surgery, gynecological surgery, thoracic surgery, and laparoscopic surgery.

IMPORTANT SAFETY INFORMATION

CONTRAINDICATIONS

Contraindications to autologous fat transfer include the presence of any disease processes that adversely affect wound healing, and poor overall health status of the individual.

WARNINGS

REVOLVE™ System must be used within the same surgical procedure. Reuse of this device in the same patient in a subsequent surgical procedure, or for more than one patient, may result in infection and/or transmission of communicable diseases. Do not use the product if sterile packaging is damaged.

This device will not, in and of itself, produce significant weight reduction. This device should be used with extreme caution in patients with chronic medical conditions such as diabetes, heart, lung, or circulatory system disease or obesity. The volume of blood loss and endogenous body fluid loss may adversely affect intra and/or postoperative hemodynamic stability and patient safety. The capability of providing adequate, timely replacement is essential for patient safety.

PRECAUTIONS

REVOLVE™ System is designed to remove localized deposits of excess fat through small incision and subsequently transfer the tissue back to the patient. Use of this device is limited to those physicians who, by means of formal professional training or sanctioned continuing medical education (including supervised operative experience), have attained proficiency in suction lipoplasty and tissue transfer. Results of this procedure will vary depending upon patient age, surgical site, and experience of the physician. Results of this procedure may or may not be permanent. The amount of fat removed should be limited to that necessary to achieve a desired cosmetic effect. Filling the device with adipose tissue over the maximum fill volume line can lead to occlusion of the mesh resulting in mesh tear.

ADVERSE EFFECTS

Some common adverse effects associated with autologous fat transfer are asymmetry, over- and/or under-correction of the treatment site, tissue lumps, bleeding, and scarring. Potential adverse effects associated with REVOLVE™ System include fat necrosis, cyst formation, infection, chronic foreign body response, allergic reaction, and inflammation.

REVOLVE™ System is available by prescription only.

For more information, please see the Instructions for Use (IFU) and User Manual for REVOLVE™ System available at www.allergan.com/RevolveIFU or call 1.800.678.1605.

To report an adverse reaction, please call Allergan at 1.800.367.5737.

References: 1. Data on file, Allergan Aesthetics, March 2024; Aesthetic Monthly Tracker. 2. Gabriel A, Maxwell GP, Griffin L, Champaneria MC, Parekh M, Macarios D. A comparison of two fat grafting methods on operating room efficiency and costs. *Aesthet Surg J.* 2017;37(2):161-168. 3. Ansorge H, Garza JR, McCormack MC, et al. Autologous fat processing via the Revolve system: quality and quantity of fat retention evaluated in an animal model. *Aesthet Surg J.* 2014;34(3):438-447. 4. Data on file, Allergan Aesthetics, June 2022; Fat Grafting Final Report.

Allergan Aesthetics
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US-PRM-00463 06/24

Abstracts

FRIDAY, SEPTEMBER 20, 2024
FREE PAPER SESSION #1: Fat Grafting

Advances in Single-Stage Trilaminar Reconstruction of Complex Cutaneous Injury by Composite Skin and Fat Engraftment

Presenter: Shawn Loder, MD (USA)
Affiliation: Department of Plastic Surgery, University of Pittsburgh, Pittsburgh, PA
Authors: Yadira Villalvazo, MD, Yusuf Surucu, MD, Jose Antonio Arellano, MD, Pooja Humar, MD, Fuat Baris Bengur, MD, Shawn Loder, MD, Hamid Malekzadeh, MD, Amr Elmeanawy, MD, Alexandra Vagonis, MD, Wayne Nerone, BS, Francesco Egro, MD, Lauren Kokai, PhD, Kacey Marra, PhD, Elof Eriksson, MD, J. Peter Rubin, MD, MBA

INTRODUCTION: Management of large, complex, and unfavorably localized burns remains a significant challenge with morbidity arising from not only injury but also from the techniques used for reconstruction. We have previously presented on the viability of a fat-first approach to burn reconstruction utilizing pixel-grafted skin for purpose of mitigating adhesions and enhancing pliability. The purpose of this study is to assess the viability and efficacy of a single-stage technique, utilizing split-thickness skin graft (STSG) as a sheet graft over a layer of morselized autologous fat. We hypothesized that not only would this construct remain viable but results in a closed, contracture resistant reconstruction with the mobility and pliability benefits we found with a fat-first approach.

METHODS: This experimental study involved three female Yorkshire swine, each sustaining four full-thickness burns of 64cm^2 (total n=14). Surgical debridement to fascia followed by reconstruction was performed 48 hours post-injury. Control wounds were treated with STSG directly over the fascia. Experimental wounds were treated with variations: 1) a base layer of morselized autologous fat under an STSG, and 2) a fat graft layer under skin pixels. Additional thicknesses of fat layers and use of fibrin adhesive were evaluated. Biomechanical properties and histologic features of the reconstructed tissues were assessed at six weeks post-operatively.

RESULTS: Comparisons between wounds treated with STSG over fat grafts and STSG alone demonstrated that the former exhibited a regenerated subcutaneous layer that closely resembled uninjured tissue, as evidenced by ultrasound findings (ANOVA; $p<0.05$). Biomechanical testing indicated significantly improved mobility and flexibility of the epidermis in the adipose-treated groups (ANOVA; $p<0.05$). Histological and immunofluorescent staining confirmed the regeneration of epidermis, dermis, and a viable adipose layer beneath the grafts.

CONCLUSION: The immediate, single-stage application of adipose grafts with STSG in full-thickness burns substantially restores normal soft tissue thickness and enhances skin graft mobility and flexibility in a swine model. These promising preclinical results support the potential translation of this technique to human burn patients, aiming for improved functional and aesthetic outcomes

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The Use Of Adipose Tissue Based Therapies On Facial Atrophic Post-Acne Vulgaris Scars: A Systematic Review

Presenter: Jose Antonio Arellano, MD (USA)
Affiliation: Department of Plastic Surgery, University of Pittsburgh Medical Center, Pennsylvania, USA.
Authors: Jose Antonio Arellano, MD, Mario Alessandri-Bonetti, MD, Giulia Coscarella, MD, Francesco Amendola, MD, Luca Vaienti, MD, Paolo Persichetti, MD, PhD, FEBOPRAS, Peter J Rubin, MD, MBA, FACS, Francesco Egro, MD, MSc, MRCS

INTRODUCTION: Acne vulgaris, a common inflammatory skin condition, often results in facial scarring, causing significant psychological distress, particularly among the youth. Despite numerous scar treatments, no established gold standard exists, prompting further investigation. Autologous fat grafting and other adipose tissue-based therapies (ATBTs) have emerged as promising interventions due to their scar modulation and tissue regeneration properties. Adipose tissue, comprising mature adipocytes and the stromal vascular fraction (SVF), notably adipose-derived stem cells (ADSCs), demonstrates potential in promoting neovascularization, immunomodulation, and scarremodeling.

METHODS: A systematic review was conducted using the Prospera database (CRD42022384919) to consolidate evidence on ATBTs in treating facial atrophic acne scars. Ten studies, involving 168 patients, were included after querying PubMed, Scopus, and Embase databases. Various ATBTs were employed, including standard fat grafting, nanofat, ADSC-conditioned medium (ADSC-CM), and ADSC exosomes (ADSC-Exo). SVF, administered subdermally under the scar area, was the most commonly utilized ATBT. Among the included studies, five were randomized controlled trials, five were prospective cohort studies, and four combined fraction carbon laser or platelet-rich plasma with ATBT. Additionally, four studies performed simultaneous needle subcision to break down dermal and subdermal fibrotic tissue before ATBT injection.

RESULTS: Evaluation of patient and physician satisfaction, using subjective outcome measures such as Likert scales or FACE-Q, revealed overall improvement in scar appearance and moderate-to-high satisfaction among patients undergoing ATBT treatment. Biometric assessments, including skin ultrasonography and digital imaging analysis, demonstrated that ATBT effectively reduced scar area, depth, and increased skin thickness. Histological analysis of atrophic facial acne scars before and after treatment confirmed the regenerative properties of ATBTs, with increased dermal collagen and elastin density observed in studies evaluating ATBTs alone or combined with adjuvant treatments compared with controls.

CONCLUSION: Results from a diverse range of adipose tissue-based therapies show promising outcomes, including increased elastin and collagen production, enhanced dermal thickness, and improved skin hydration. However, larger clinical trials with longer follow-up periods are essential before ATBTs can be considered as an effective and standard treatment for facial atrophic post-acne scars.

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The Effect of Fat Grafting on Scars Hyperpigmentation: A Systematic Review and Meta-Analysis

Presenter: Hilary Liu, BS (USA)
Affiliation: University of Pittsburgh
Authors: Hilary Y Liu , Mario Alessandri Bonetti, Jose Antonio Arellano, Anna Scarabosio, Ricardo Giorgino, Asim Ejaz, J Peter Rubin, Francesco M. Egro

INTRODUCTION: Hyperpigmented scars, particularly in exposed body areas, can be difficult to conceal and may evoke psychological distress. While the precise causes of scar dyschromia are not fully understood, alterations in melanogenic activity appear to hold more significance than changes in melanocyte quantity. Current treatments encompass laser interventions. However, it is essential to consider their costs and potential complications in relation to their limited proven effectiveness. Fat grafting has gained interest as a scar modulation technique due to its regenerative properties, and its efficacy in reducing scar hyperpigmentation is currently under investigation.

METHODS: A systematic review and meta-analysis was reported according to PRISMA guidelines. PubMed, Embase, and Cochrane Library databases were accessed. PROSPERO registration number is CRD42023457778. The primary outcome was a change in scar pigmentation after fat grafting. Pigmentation changes after fat grafting were calculated using the standardized mean difference (SMD) between baseline and postoperative scores according to POSAS and VSS scales. Bias assessment was conducted according to the National Institute for Health and Clinical Excellence quality assessment tool.

RESULTS: A total of 8 articles meeting inclusion and exclusion criteria were identified, involving 323 patients with hyperpigmented scars treated with fat grafting. A significant difference in scar pigmentation was noted after treatment with fat grafting according to observers' ratings, with a SMD of −1.09 [95% CI: −1.32; −0.85], $p<0.01$. The SMD for patient-reported scar pigmentation after treatment with fat grafting was −0.99 [96% CI: −1.31; −0.66], $p<0.01$. Four studies provided objective measurements of melanin changes after fat grafting and revealed inconsistent findings compared to subjective observations.

CONCLUSION: Fat grafting shows promise in ameliorating hyperpigmented scars based on subjective assessments, but further corroborating evidence from objective measures is required

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Histological Assessment of Structurally Injected Fat with or without MSC(AT) and ECM.

Presenter: Frederik Penzien Wainer Mamsen, MD (Denmark)
Affiliation: Department of Orthopedic Surgery, Holbaek, Denmark
Authors: MAMSEN, FPW; Kølle FT

INTRODUCTION: The clinical investigation of ex vivo expanded MSC(AT)-enriched fat grafting has been ongoing for more than a decade. Systematic literature reports indicate a significant increase in the retention of fat injected with MSC(AT). Although numerous theories have been proposed to describe the mechanism of action leading to increased fat graft retention, little evidence has been gathered for the histological assessment of MSC(AT)-enriched fat grafts using clinically relevant injection techniques. Extracellular matrix, as a scaffold for MSC(AT)-enriched fat grafting, has also been studied as a method to protect the graft during injection and while residing in the recipient tissue and will be investigated in this study.

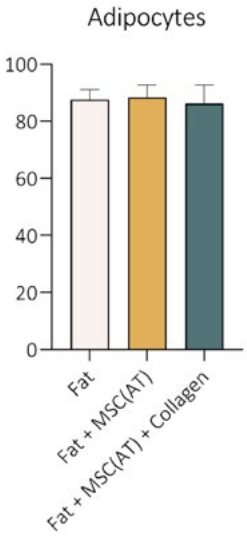
METHODS: Five participants were enrolled in the study. Three squares were tattooed on the abdominal skin of each participant within the later excision area of an abdominoplasty. Inside the tattooed squares, three solutions were structurally injected into the subcutaneous tissue, resembling the gold standard used in fat grafting. The placement of the solutions was randomized and blinded to the surgeon, participant, and data assessor. The solutions included: i) fat, ii) fat with MSC(AT), and iii) fat with MSC(AT) and ECM, with fat serving as the control. The interventions were left in place for six months, after which the entire treated area was removed during an abdominoplasty. The large tissue specimen was fixed, and five whole section samples were stained for analysis. The histological composition of the intervention was evaluated using a deep machine learning tool developed by BioImaging at the University of Copenhagen to identify adipocytes, necrotic tissue, and connective tissue.

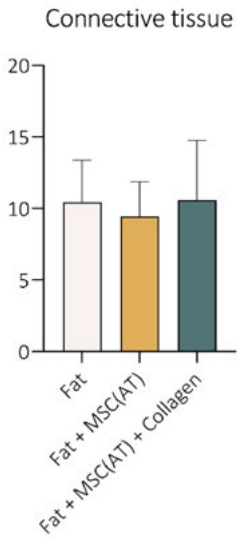
RESULTS:

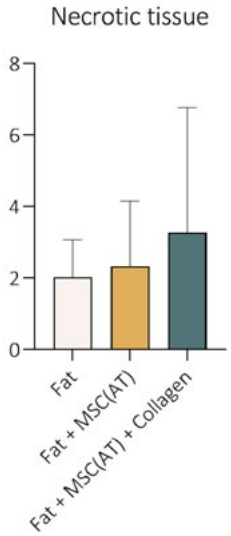
Adipocytes	Fat	88.4% (IQR=84.9-89.9%)	
	Fat and MSC(AT)	88.4% (IQR=84.7-92.7%)	(p=0.84)
	Fat, MSC(AT) and ECM	87.4% (IQR=83.6-90.4%)	(p=0.23)
Connective Tissue	Fat	9.6% (IQR=8.5-12.7%)	
	Fat and MSC(AT)	9.5% (IQR=5.9-11.9%)	(p=0.51)
	Fat, MSC(AT) and ECM	9.5% (IQR=7.9-12.6%)	(p=0.85)
Necrotic Tissue	Fat	1.8% (IQR=1.3-2.3%)	
	Fat and MSC(AT)	1.65%(IQR=1.15-2.95%)	(p=0.36)
	Fat, MSC(AT) and ECM	2.2% (IQR=1.7-3.35%)	(p=0.03)*

CONCLUSION: The structural composition between conventional fat grafts and MSC(AT)-enriched fat grafts did not differ significantly in terms of adipocytes, connective tissue, or necrotic tissue. However, significantly more necrosis was observed in MSC(AT) and ECM-enriched fat grafts compared to conventional fat grafts. This study does not support the notion that enriching fat grafts with MSC(AT) or ECM results in reduced tissue necrosis.

Histology is presented as percentage of total tissue area.







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FRIDAY, SEPTEMBER 20, 2024
FREE PAPER SESSION #2: Neural & Muscle Reconstruction

Nanofat Rescue Following Thermal and Mechanical Injury on Perineural Tissue.

Presenter: Grace Tolan BS (USA)
Affiliation: Claytor Noone Plastic Surgery, Main Line Health, Philadelphia, PA
Authors: Grace Tolan, BS, Dr. Brannon Claytor, MD

INTRODUCTION: Combination of thermal and mechanical trauma to aged skin has a very deleterious effect. The nonspecific immune system response to injury is to flood the tissue with immunomodulating mediators. These frequently lead to swelling around peripheral nerves as well as leaky capillaries. The inflammatory response is often responsible for delayed wound healing and prolonged pain.

METHODS: Patients treated with thermal and mechanical injury were simultaneously treated with applications of nanofat. Tissue biopsies at the time of application show minimal changes at the subepidermal level. Tissue biopsies taken at post procedure day four demonstrate significant perineural inflammation with significant amount of extravasation of monocytes, macrophages and immune mediators in and around the nerves. Patients treated with immediate nanofat application demonstrate increased mitosis with decreased perineural inflammation and decreased capillary leaking.

RESULTS: Patients treated with nanofat showed tremendous reduction of tissue inflammation at the site of subepidermal nerves and a dramatic reduction in extravasation of monophages and natural killer cells.

CONCLUSION: Thermal and mechanical injury to the tissue dramatically increases inflammatory mediators with a significant increase in swelling as well as extravasation of cells through the capillary walls. This perineural inflammation dramatically correlates with pain in patients who are treated with these thermal and mechanical events. However, patients treated with immediate application of nanofat have virtually no discomfort as well as dramatically reduced edema and swelling and dramatically accelerated recovery. The application of elements of nanofat deliver mediators which abrogate nerve inflammation at the site of injury.

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Prophylactic Systemic Administration of Adipose-Derived Stem Cells in Combination with Irradiation Reduces Late Radiation Tissue Damage

Presenter: Yoshihiro Toyohara, MD (Japan)
Affiliation: Department of Plastic Surgery, Jichi Medical University
Authors: Yoshihiro Toyohara, Yoshihiro Sowa, Natsumi Saito, Takako Shirado, Wu Yunyan, Zhang Bihang, Hyun Sangchul, Shino Higai, Li Bolun, Yuhei Morita and Kotaro Yoshimura

INTRODUCTION: Radiation therapy is one of the mainstream treatments in recent cancer treatment, but it has harmful deterministic effects on normal tissues. Late radiation tissue damage cause delayed wound healing and intractable skin ulcers, which have negative impacts on prognosis and quality of life of radiation-treated cancer survivors. Our previous studies have shown that prophylactic local administration of adipose-derived stem cells (ASC) in combination with irradiation prevents late radiation disorders. For future clinical applications, this study investigated the effects of prophylactic systemic administration of ASC on late radiation tissue damage. The objective is to make radiation therapy safer and better.

METHODS: A total of 40 Gy (2 Gy, 20 times (5 times per week for four weeks)) was irradiated to the dorsal skin of nude mice (BALB/cAJcl-nu/nu), and human ASC were injected into the mice systemically (intravenous or intraperitoneal injection, once or twice). As control groups, a non-irradiated group and vehicle-treated irradiated groups were prepared. After 6 months, 6 mm diameter wounds were created on the dorsal skin of the mice and observed for 28 days. Comparison of the wound healing process and immunohistological assessments of the tissues were performed.

RESULTS: ASC-treated groups epithelialized faster than Vehicle-treated groups, although not as fast as Non-irradiated group (Fig.1). ASC-treated groups had less fat layer atrophy and fibrosis than Vehicle-treated groups (Fig.2 and 3). Engraftment of the injected ASC was confirmed in the fat layer of some samples.

CONCLUSION: Prophylactic systemic administration of ASC in combination with irradiation can reduce delayed wound healing and histological damage. We will continue further studies for clinical applications.

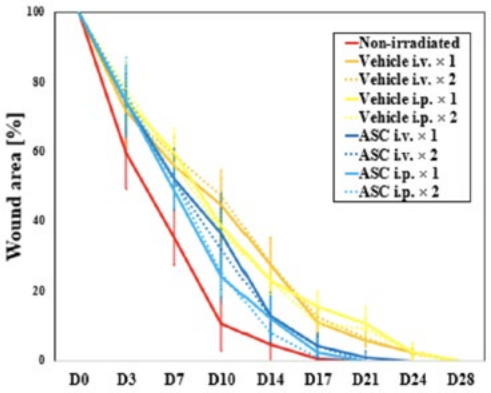

Fig.1 Wound healing

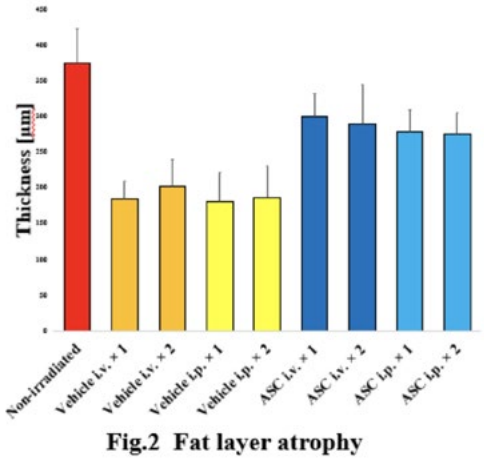

Fig.2 Fat layer atrophy

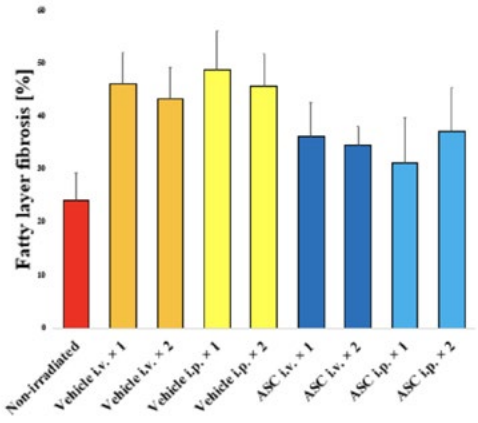

Fig.3 Fat layer fibrosis

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The Therapeutic Effect of Adipose-Derived Stem Cell Transplantation on Alleviating Muscle Atrophy using Sarcopenia Model Mouse

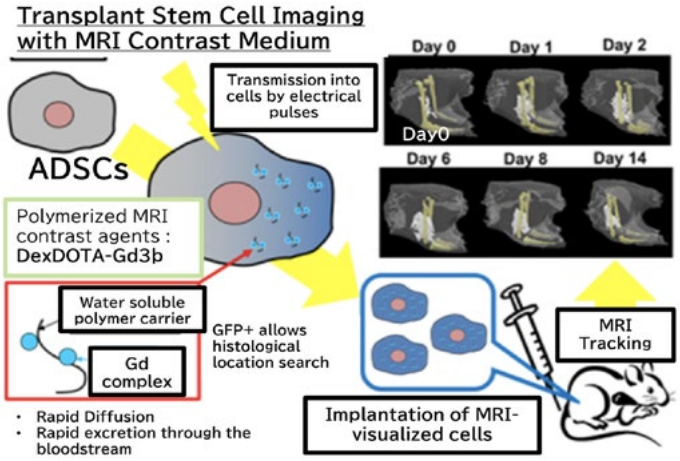
Presenter: Yoshihiro Sowa, MD (Japan)
Affiliation: Department of Plastic Surgery, Jichi Medical University
Authors: Qiannan Zhao, Ko Ogawa, Yoshihiro Toyohara, Shino Higai, Natsumi Saito, Kotaro Yoshimura, Tetsuji Yamaoka, Naoki Morimoto

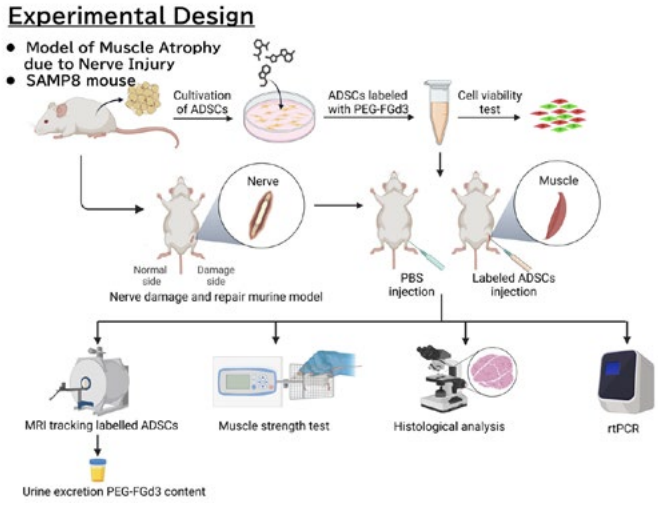
INTRODUCTION: In contemporary society, facing an aging population, a rapid increase in elderly individuals requiring care is anticipated. Establishing prevention and treatment methods for frailty, particularly sarcopenia, characterized by muscle weakness and physical decline, which precedes care dependency, is an urgent challenge. Adipose-derived stem cells (ADSCs), which can be minimally invasively harvested from adipose tissue, are expected to have preventive effects on muscle mass reduction in sarcopenia. Our objective is to demonstrate the therapeutic and preventive effects of administration of ADSCs in a mouse model of muscle atrophy.

METHODS: Using a sciatic nerve injury mouse model and senescence-accelerated mouse prone 8 (SAMP8) as sarcopenia model mice, ADSCs were locally injected into the gastrocnemius muscle from the inguinal fat pad of mice. At the same time, the transplanted cells were marked with a specific contrast agent (PEG-FGd3) and their dynamics after transplantation were tracked by MRI. Additionally, wet weight of the gastrocnemius muscle, muscle strength (ankle dorsiflexion exercise), and histological examination (HE, Masson's trichrome, MyoD staining) were performed. Furthermore, expression analysis of inflammatory cytokines and macrophage polarization was conducted to elucidate the mechanism of action.

RESULTS: The contrast effect of PEG-FGd3 in ADSCs transplanted into the gastrocnemius muscle decreased rapidly within 1-3 days after transplantation, but a faint contrast remained for approximately one week. Two weeks after transplantation, the wet weight and muscle strength of the gastrocnemius muscle showed a significant preventive effect against muscle atrophy in the treated group. Histological examination also revealed consistent results in terms of muscle fiber diameter and expression of muscle progenitor cell markers. An increase in M2 macrophage-related substances and anti-inflammatory markers was observed. Similar results were obtained for the senescence-accelerated mouse, although three or more consecutive ASC administrations were required.

CONCLUSION: Local administration of ASCs to the gastrocnemius muscle of sarcopenia model mice suggested a reduction in muscle atrophy. It was speculated that the anti-inflammatory effect against abnormal inflammation in the muscle, which is the cause of muscle atrophy, was induced by early administration of ADSCs.





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Bovine Adipose Tissue Reconstruction for Cell-based Wagyu Meat

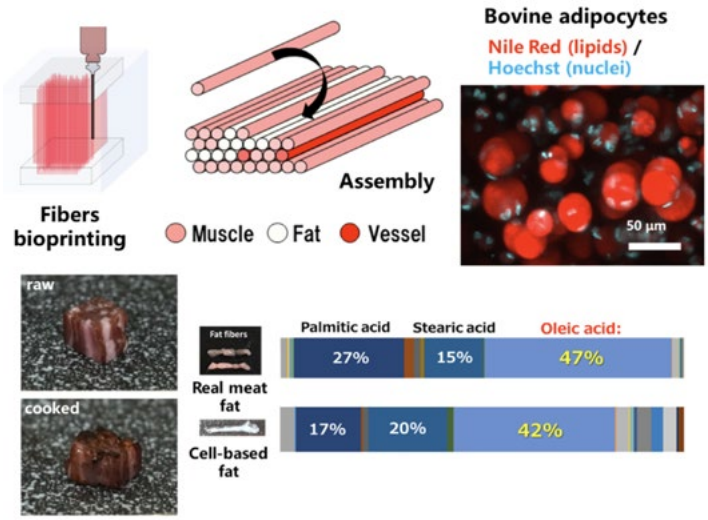
Presenter: Fiona Louis, M.Eng., PhD (Japan)
Affiliation: Osaka University
Authors: Yoshihiro Sowa, Shiro Kitano, and Michiya Matsusaki

INTRODUCTION: Given the significant impacts of traditional livestock meat production, cultured meat has gained substantial attention due to its ethical, economic, environmental, and health benefits. While plant-based meat alternatives are already on the market, cultured meat has the potential to more accurately replicate the flavor, texture, and composition of real meat. Despite recent advancements, producing cultured steak with a composition and structure similar to real steak remains a challenge. Additionally, most studies have predominantly focused on muscle tissue, while recent research emphasized the importance of fat in enhancing meat's flavor, taste, juiciness, and texture.

METHODS: Freshly extracted ASC from liposuction of 6 young (< 30yo) and 6 old (>50yo) female donors were assessed for differentiation potential, colonies forming efficiency and pro-angiogenic activity. In the Cytodex beads based pro-angiogenic assay, ASC were cultured on top of the fibrin gel containing human dermal endothelial cells until sprouting. Sprouts were imaged using confocal microscope and analyzed using Sprout Morphology plugin of ImageJ. Total network length of each condition was quantified.

RESULTS: Proportion of ASC colonies forming efficiency between young and old ASC show no statistical difference. Neutral lipid content and mineralization concentration show no statistical difference between young and old ASC, indicating that ASC differentiation potential does not change with age. ASC induced significantly longer total network length compared to fibroblasts, however, total network length between young and old ASC donor exhibits no statistical difference

CONCLUSION: Overall, age does not alter ASC differentiation, CFE and pro-angiogenic potential. The result of our study indicates that further studies are warranted to understand whether fat graft retention and its skin rejuvenation efficacy are linked to the ASC quantity at the recipient sites or are related to its interaction with other components of the fat graft or local microenvironment



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ABSTRACTS - SATURDAY, SEPTEMBER 21, 2024
FREE PAPER SESSION #3: Adipose Tissue Model

Weight Gain Alters Adipose Stem/Stomal Cell Functionality and Size in Adipogenic Conditions

Presenter: Miia Juntunen, PhD (Finland)
Affiliation: Tampere University
Authors: Miia Juntunen, PhD, Alma Yrjanainen, MSc, Ella Lampela, MSc, Marika Kuuskeri, MD, PhD, and Susanna Miettinen, PhD

INTRODUCTION: The increasing prevalence of obesity has generated a surge for novel methods examining human weight gain in cellular level. In adipose tissue, the excessive energy intake induces adipogenesis, i.e. expansion and differentiation of adipose stem/stromal cells (hASCs) to mature adipocytes. Though the process has been widely studied in traditional 2D monocultures, recent progress with spheroid cultures has shown its potential in recreating in vivo-like unilocular adipocytes with obesity-related cellular dysfunction[1]. Here, we aim to generate unilocular adipocyte spheroids from hASCs and study the effect of weight gain in adipose stem/stromal cell size, morphology and examine the changes in metabolic functionality and gene expression.

METHODS: hASCs were isolated from obese human adipose tissue samples (n=3). 5000 hASCs were plated on low attachment 96-well plate in two adipogenic culture conditions: adipogenic medium (AM) and AM supplemented with lipid emulsion to mimic the effect of excessive energy intake. Spheroid size and secretion levels of adiponectin and leptin were measured through the 21-day culture period. Quantification of lipid droplet volume and size within spheroids are being computed. Also, differences in adipogenic gene expression between the conditions are being studied.

RESULTS: We showed the formation of hASC spheroids with unilocular lipid droplets enclosed by lipid-droplet specific- coating protein perilipin-1. Currently, we are performing statistical analyses for determining differences of adiponectin and leptin secretion for further comparison of adiponectin/leptin ratio to determine the metabolic state in both conditions. Also, we are quantifying the lipid droplet volumes for further statistical analyses to study differences in adipocyte hypertrophy and/or hyperplasia between the conditions. In addition, we are comparing the gene expression changes of adipogenic genes, PPARg, FABP4, leptin and adipoq, in response to increased lipid concentration.

CONSLUSION: To summarize, we generated spheroids consisting of mature adipocytes with large lipid droplets. Based on preliminary data in adiponectin and leptin secretion, we observed altered secretion in both adipokines demonstrating hASC responsiveness to increased lipid concentration. The systematic characterization of spheroid adipogenesis will elucidate the hASC capacity in lipid accumulation and metabolic alterations providing insights in weight gain in vitro.

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Human-Derived Biomaterials to Fully Support Microphysiological Systems for The Adipose Tissue and Beyond

Presenter: Jeffrey M. Gimble, MD, PhD (USA)
Affiliation: Obatala Sciences
Authors: Cecilia G. Sanchez, Haley R. Lassiter, Jordan T. Robinson, Katie M. Hamel, Emma L. Rogers, Trivia P. Frazier

INTRODUCTION: Human-derived hydrogels and xenofree culture media products are suitable alternatives to current animal derived materials used in vitro and in vivo models for the understanding of human disease. Here we are presenting three human-derived hydrogels, ObaGel®, ObaGel®ECM, ObaGel®-Coating, in conjunction with xenofree free culture medium, as alternatives to current murine-derived and synthetic recombinant hydrogels and serum-based media products that show unique physiochemical, biochemical, and biological properties to support organ on chip.

METHODS: Three thermoregulated hydrogels were developed from human decellularized tissues through a series of processes refined by Obatala Sciences. The human scaffolds were characterized for mechanical and biological properties using rheology, electron microscopy, and cellular proliferation and differentiation studies to be used as 2D basement membranes and as 3D systems. Xenofree media performance was compared to Obatala Sciences' serum-based media products via the evaluation of stem cell proliferation and differentiation and impact of long-term storage on culture media performance.

RESULTS: The manufacturing process was designed to reduce lot-to-lot variability. Results from biochemical characterization for glycosaminoglycans and protein content between lots are presented. Biomaterial characteristics are compatible with diverse MPS (Microphysiological Systems). Biocompatibility studies show a significant rate of proliferation and differentiation of the Stromal Vascular Fractions (SVF) and Adipose Stem Cells (ASC). Furthermore, the use of matrices for the culture of other cell types was confirmed. Moreover, our studies prove the potential of hydrogels for drug screening against metabolic disorders.

CONCLUSION: This study provides the characterization of human derived biomaterials for MPS systems, coating surfaces, bioprinting, and regenerative medicine.

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ObaCell® Obesity-on-a-Chip, a Platform for Disease Modeling and Drug Development and compatible to AI Image analysis recognition- A GLP1 agonist case study

Presenter: Jeffrey M. Gimble, MD, PhD (USA)
Affiliation: Obatala Sciences
Authors: Cecilia G. Sanchez, Trivia P. Frazier, Haley R. Lassiter, Jordan T. Robinson, Katie M. Hamel, Emma L. Rogers

INTRODUCTION: Obesity has become a major public health crisis in the United States, with an estimated economic burden of $100 billion annually, and growing. There are strong racial/ethnic and age-related disparities in the prevalence of metabolic syndrome associated with Obesity and fat distribution. Significant progress has been made in the last half-century in the management of metabolic diseases. Recently, Glucagon-like peptide-1 analogs (GLP1) are being developed to target metabolic disorders. Nevertheless, there is a need to develop platforms that provide earlier indicators of toxicity and drug efficacy using human-based systems to accelerate drug development and reduce the need for drug testing in animal models, which are time consuming, costly, and often don't predict the potentially adverse effects in humans. We previously defined the molecular, functional/physiological, and cellular characterization of our "Fat-on-a-chip" system, a tissue model that can recapitulate the cellular heterogeneity associated with donor-specific and anatomical depot-specific features and produces a scalable screening tool for modeling white and brown adipose. More recently, we developed a proprietary 3-D adipose tissue system called ObaCell® Obesity-on-a Chip," for disease modeling and drug discovery. This matrix mimicry system can incorporate the pathophysiological features associated with adipocyte hypertrophy (ObaCell® Obesity-on-a-Chip). Here we used Glucagon-like peptide-1 (GLP1) agonists to prove system screening feasibility.

METHODS: Proprietary Obesity on a Chip model, Lipolysis and glucose uptake; GLP1 agonists (Tirzetapide; Semaglutide; Retatrutide), AI analysis and optimization for lipid droplets analysis.

RESULTS: Obesity on a Chip model has unilocular lipid droplets (often over 30 microns in size), using a combination of fiber networks and our proprietary human derived hydrogel, Obagel® ECM. These self-assembling adipose depots, supported for extended culture periods with minimal effort, can be used to model human adipose tissue that is representative of individual donor demographics (body mass index, age, gender, ethnicity, depot/adipose location, and metabolic disease status). The system is compatible with AI bioanalysis for lipids detection for quality control and drug screening.

CONSLUSIONS: The Obesity on a Chip model is metabolically active and AI image analysis compatible, a robust system for the screening of compounds, and an ideal preclinical test for drug development.

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ABSTRACTS - SATURDAY, SEPTEMBER 21, 2024
FREE PAPER SESSION #4: Fat Grafting Devices

Lipoaspirate Preparation Device Enables Washing and Integrated Mechanical Processing

Presenter: Derek Banyard, MD, MBA, MS (USA)
Affiliation: Sayenza Biosciences
Authors: Jiayi Feng, Derek A. Banyard, MD, MBA, MS, Marzieh Aliaghaei, PhD, Alan D. Widgerow, MBBCh, MMed, and Jered B. Haun, PhD

INTRODUCTION: Autologous fat grafting of human lipoaspirate (LA) is gaining popularity within reconstructive and cosmetic surgery. LA requires multiple saline washes before reinjection, traditionally performed manually (i.e., Cotton gauze rolling, decantation) or with commercialized processing devices (i.e., REVOLVE, Puregraft). However, surgeons often find these devices time-inefficient, with minimal graft retention improvement compared to manual techniques. We hypothesize that a closed-loop, peristaltic-driven fluidic platform could enhance LA washing, resulting in minimal adipose tissue manipulation and standardization within the operating room for improved graft retention.

METHODS: The Preparation Device (PD) was designed and manufactured using stereolithography to enable closed-loop operation of the system. Using human LA samples, the PD was optimized first in a batch and then a dynamic wash protocol and was compared to a traditional washing approach. Resultant adipose tissue samples underwent a visual colorimetric comparison and were enzymatically digested for ex vivo measurement of cell counts, cell viability, and Mesenchymal Stem Cells (MSCs) and Endothelial Progenitor Cells (EPCs). LA samples were mechanically processed using an Emulsification and Micronization Device (EMD) for downstream stem/progenitor cell analysis.

RESULTS: Both batch and dynamic wash protocols produced LA with equivalent color and quality as traditional manual washing. Internal baffles within the PD helped increase agitation within the PD's internal cavity. An updated cap with three separate saline jets enhanced LA mixing and decreased wash times using a dynamic wash protocol. There were no significant changes in cell counts or viability. Both MSC and EPC populations increased with PD preparation. Integration of the EMD within the PD platform enabled closed-loop mechanical processing and significantly improved EPC numbers (5-fold) compared to manual washed/syringe pump EMD processing.

CONSLUSION: Our new fluidic platform demonstrates effective washing of LA within a closed-loop system and demonstrates minimal manipulation and purity of final adipose tissue. Additionally, this platform enables the simple integration of mechanical processing while enriching for EPCs. Automation of this platform will enable improved reproducibility within clinical settings and save time within the operating room. Future directions will explore in vitro wound healing response and fat graft retention within an in vivo murine model.

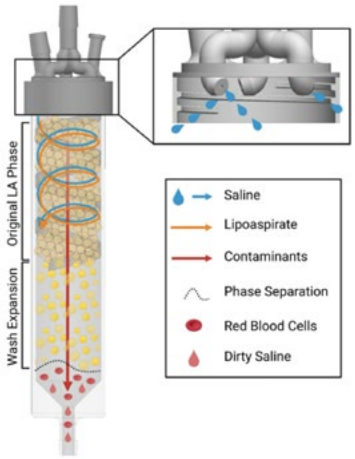

Fig. 1. Dynamic wash protocol creates counter-rotational mixing for enhanced lipoaspirate purity. After loading, LA and saline are allowed to phase separate for 1 minute. Utilizing three angled nozzles at the base of the PD cap, saline is sprayed towards the wall of the PD in a direction opposite to the internal baffles (cross-section view). Using a 5 mL/sec flow rate, the lipoaspirate then begins to rotate counter-clockwise and expand towards the bottom of the PD. Using 25 mL saline wash rounds, the LA expands until the phase separation line, then compresses back to its original location upon stopping the flow rate. Contaminants leave the outlet of the PD as saline is replaced from the top.

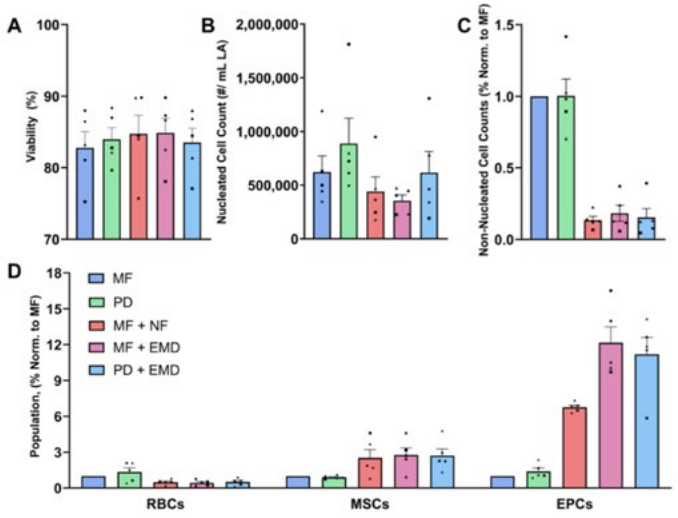

Fig. 2. Preparation device enables equivalent LA purity using a dynamic wash protocol. Human LA (n=5) was washed in the preparation device using a 5:1, saline to LA, wash ratio. MF was washed using a 3:1 wash ratio. All wash conditions underwent EMD processing using a syringe pump. (A) Cell viability remained >80% viability for all conditions. (B) Nucleated cell counts saw a slight increase after washing with the PD. Nucleated cell counts remained higher per mL LA upon EDM processing compared to MF and NF controls. (C) Non-nucleated cell counts of PD washed LA was equivalent to MF. No significant changers were evident after EDM processing. (D) Flow cytometry revealed similar RBC content for the PD before and after EMD processing. MSC populations were not significantly affected when compared to control conditions. EPCs saw a significant increase upon NF and EMD processing for MF and PD wash conditions.

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Small Extracellular Vesicles Purified from Lipoaspirate Fluid Promote Hair Regeneration

Presenter: Mei Yu, MD (China)
Affiliation: West China School of Stomatology, Sichuan University
Authors: Yue Zhang, Yi Zhang

INTRODUCTION: Diverse adipose tissue-derivatives have shown the therapeutic potential to treat hair loss, however, the small extracellular vesicle derived from lipoaspirate fluid (sEV-LF) have not been investigated on hair regeneration yet. The objective of this study was to determine whether pure sEV could been purified from the large volume of lipoaspirate fluid, and then evaluate the potential therapeutic efficacy of sEV-LF on hair loss.

METHODS: A novel method which combine the tangential flow filtration (TFF) and ultracentrifugation with sucrose cushion was established to isolate sEV-LF, this method has the advantages including high yield, high purity, and reproducibility, with minimal expertise required. Then the effect sEV-LF on hair growth-promoting were investigated in a mouse model. Different concentration of sEV-LF were injected Intradermally in the back of depilated mice, anagen entry rate and hair coverage percentage were analyzed through continuously taken gross photographs. The distribution of PKH26 label sEV-LF were visualized at different time point after injection. The depth of dermal white adipose tissue and presence of melanin cell were evaluated by hematoxylin-eosin and Masson Fontana stainin

RESULTS: The results showed that over 99% sEV-LF were internalized in 48h post injection. sEV-LF is widely distributed in epidermis, dermis and outer root sheath of hair follicles, which indicated that sEV-LF might play the roles in multiple pathways. In sEV-LF-treated mice, an increase in the anagen entry rate, hair coverage percentage, dermal thickness and deposition rate of melanin was observed.

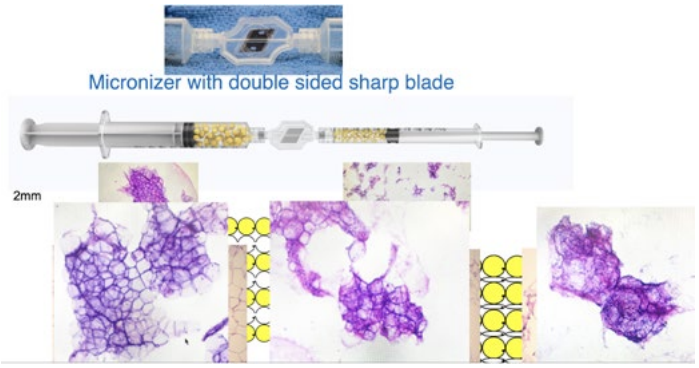
CONSLUSION: Our findings indicated that sEV-LF could an effective treatment option for hair loss through accelerating the hair regrowth.

Mechanical Stromal Vascular Fraction concentration

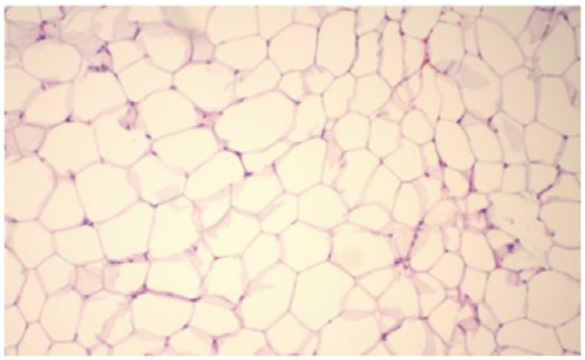
Presenter: Hilton Becker, MD (USA)
Author: Hilton Becker, MD

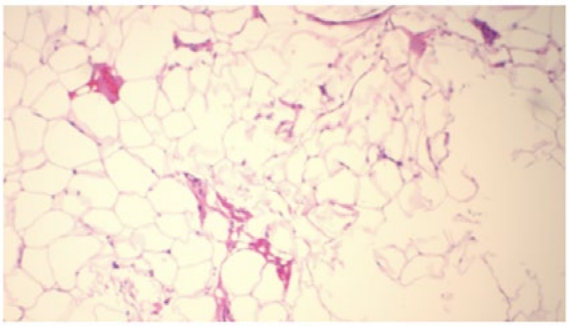
INTRODUCTION: Adipose tissue is a great source of regenerative cells. Fat is composed of Stromal cells which provide support to the parenchymal cell or lipocytes .Stromal cell are made up of a structure of fibroblasts, collagen and angiocytes containing the stem cells. Stromal cells provide tissue repair and renewal, collectively known as Stromal Vascular Fraction (SVF) SVF can be isolated by enzymatic or mechanical means. Enzymatic separation is considered a biological drug by the regulatory authorities and requires that current good manufacturing practice (GMP) are implemented. Enzymatic separation destroys not only bonds between cells, but also extracellular matrix (ECM) and the stromal regenerative cells. For these reasons, mechanical stromal cell production has become increasingly popular.

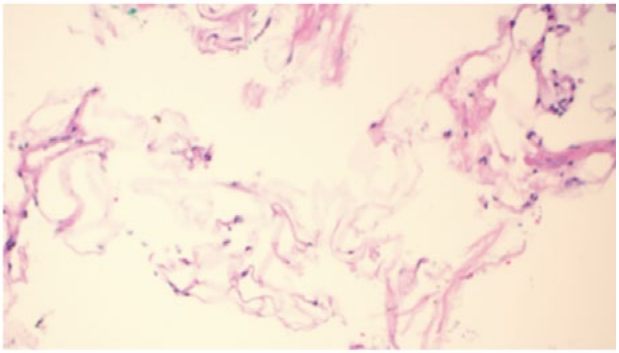
METHODS: Mechanical separation is commonly done with devices that crush or partially cut the fat cells with blunt pressure . A technique of concentrating the stromal vascular fraction of fat grafts using a micronizer housing a double edged ultra sharp blade is described . The micronizer is available in a 2.4 and a 1.2 diameter
Fat cells are sequentially lysed with the blade, releasing the oil which is removed by centrifugation or straining, resulting in increased SVF content. The adipose-derived stem cells (ASCs) are preserved ,without stromal cellular damage . The Micronizer is used to cut the fat particles to the desired sizes for injection. By passing the fat particles through the 2.4mm micronizer ,particles are reduced to 1mm, When passed through the 1.2 mm micronizer the fat particles are reduced to 0.5mm 1mm fat particles are used for injection above the periosteum for malar chin and mandibular volume enhancement 0.5mm for cheek , circumoral and lip volume correction . 0.25mm for intra -dermal injection for skin rejuvenation. Particle size can be further reduced by selective straining creating Nannofat for injection intradermally into the lower eyelid skin.



RESULTS: Histology shows stromal vascular content concentrated following passage through the micronizer







CONCLUSION: As fat is passed through the micronizer the fat cells are lysed reducing particle size and resulting in SVF concentration.

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ABSTRACTS - SUNDAY, SEPTEMBER 22, 2024
FREE PAPER SESSION #5: Adipose Stem Cell Phenotype & Cell-Based Therapies

Understanding the Impact of Cytomegalovirus on Adipose Tissue

Presenter: Elizabeth Kaleigh Johnston (USA)
Affiliation: Carnegie Mellon University
Authors: Jiani Chen, Kevin Zwezdaryk, Rosalyn Abbott

INTRODUCTION: Cytomegalovirus (CMV), a herpesvirus infecting over half of adults by age 40, is typically asymptomatic, but can be deadly in immunosuppressed individuals. Infection results in latency and lifelong persistence in subsets of cells, notably endothelial, fibroblast, and immune cells with the potential for reactivation. CMV has been shown to reside in adipose tissue (AT) after infection, but its impact on AT behavior have yet to be fully elucidated. This study aims to determine CMV's effects on AT in both mouse and human models.

METHODS: qPCR analysis, focused on adipose-specific, inflammatory, and metabolic genes (shown in Figure 1), was performed on AT from mock-infected and mCMV-infected mice. To validate murine findings in human AT, two-dimensional human adipose stem cells (hASCs) and AT-seeded silk scaffold models were used for further experimentation. To determine if CMV impacted hASC differentiation, hASCs were grown to confluency, inoculated with CMV (MOI=2), and induced with adipogenic media for 14 days before analysis. In the whole AT model, scaffolds seeded with subcutaneous AT were inoculated with CMV (MOI=2) for 24-hours and cultured for 72-hours before analysis.

RESULTS: Inguinal AT from mCMV-infected mice showed downregulation of adipose-specific genes (Leptin, Adiponectin, and PPAR-y) and an upregulation of UCP-1 and PGC1-a, genes associated with thermogenesis and brown AT (Figure 1A). Similar changes were seen in CMV-infected human models. Notably, CMV-infected hASCs failed to differentiate, unlike controls (Figure 1B), suggesting that CMV hinders adipogenic differentiation, potentially contributing to adipose dysfunction. In the human whole AT model, staining revealed prominent CMV infection (IE1-expression) in both stromal cells and some mature adipocytes after inoculation (Figure 1C). Interestingly, UCP-1 was expressed in our control and slightly more so in our CMV-infected group (Figure 1C). Since UCP-1 is traditionally considered a marker for brown fat, further research is needed to ascertain its involvement in obese, human AT and the purpose of its activation upon CMV infection.

CONCLUSION: CMV affects both the adipogenic and metabolic behavior of murine and human AT with perturbations in both adipogenesis and UCP-1 expression. However, the implication of this dysfunction in long-term AT behavior warrants further investigation.

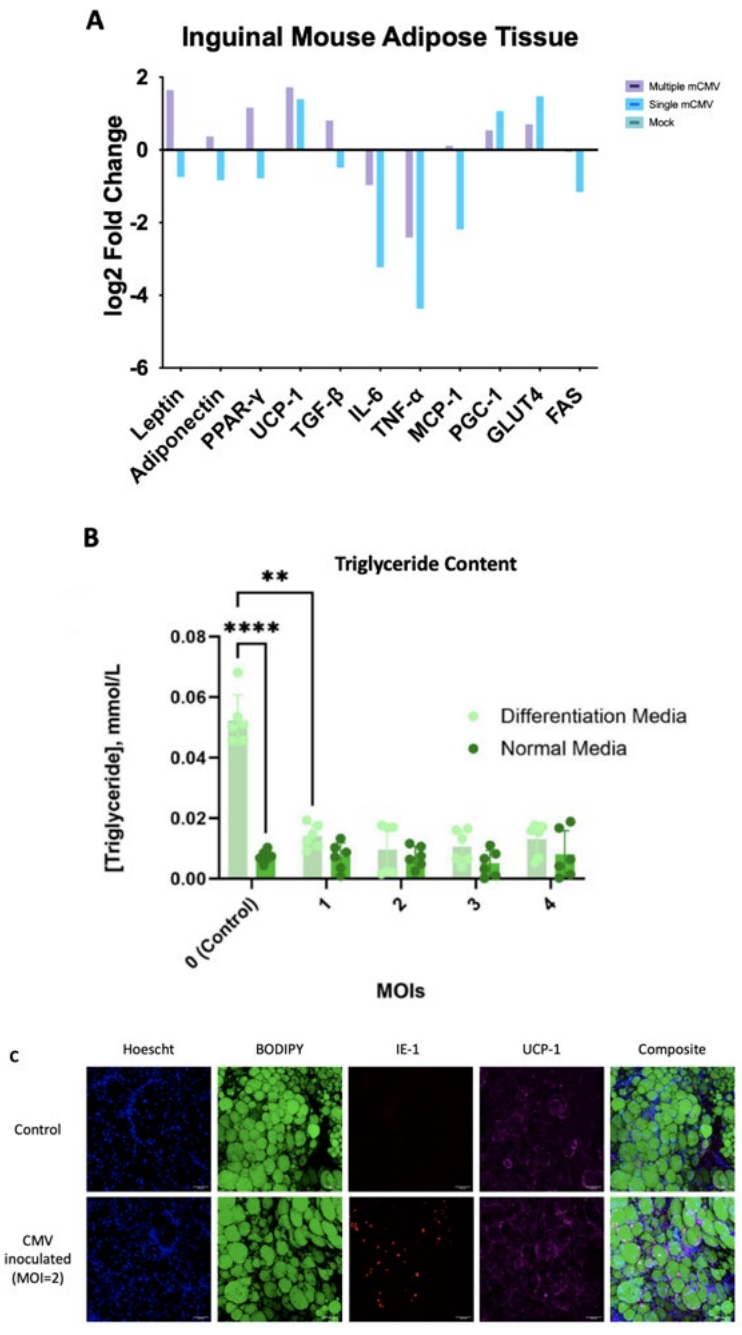

Figure 1. Impact of cytomegalovirus on adipose tissue. (A) Fold change, qPCR results of adipose tissue from mock-infected (green-normalized so it is at 0) and mCMV-infected mice (blue). Adipose-specific genes (Leptin, Adiponectin, and PPAR-y) and inflammation-related genes (IL-6, TNF-a, and MCP-1) were downregulated upon infection. Metabolism-related genes (UCP-1, PGC-1, and GLUT4) were all upregulated upon infection. (B) CMV-infected and mock-infected hASCs underwent differentiation for 14 days before being analyzed with a triglyceride assay which demonstrated that CMV-infected hASCs (regardless of MOI) did not acquire lipids. (C) Human adipose tissue was seeded onto silk scaffolds and either CMV-infected or mock-infected before being cultured for 72-hours. Immunofluorescent staining for Hoescht (nuclei-blue), BODIPY (lipids-green), IE-1 (CMV marker-red), and UCP-1 (thermogenic protein-magenta) showed a presence of CMV after 3 days that may have also slightly increased the quantity of UCP-1 in the CMV-infected group. Scale bar=100 µm.

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Spatial Transcriptomic Analysis Deciphers Adipocyte-to-Fibroblast Transformation in Bleomycin-Induced Murine Skin Fibrosis

Presenter: Fangzhou Xie, PhD (China)
Affiliation: Shanghai Ninth People's Hospital
Authors: Yixiang Zhang, Jiahao He, Fangzhou Xie, Shengzhou Shan, Jiaqi Qin, Chuandong Wang, Qingfeng Lil, Dejun Cao, Yun Xie, Bin Fang

INTRODUCTION: Scleroderma, as an autoimmune disorder, is characterized by inflammation and fibrosis, predominantly occur in the skin and extending to various body parts. The disease is associated with a high mortality rate, imposing substantial burdens to the society. The pathophysiology of scleroderma is multifaceted, with the current understanding including endothelial damage, inflammatory cell infiltration, and fibroblast activation in its progression. Nonetheless, the mechanism of cellular interactions and the precise spatial distribution of these cellular events within the fibrotic tissues remain elusive, highlighting a critical gap in our comprehensive understanding of scleroderma's pathogenesis.

METHODS: In this study, we administered bleomycin intradermally to the dorsal skin of four individual murine models. Subsequently, skin tissues were harvested at predetermined intervals (0 day, 7 days, 14 days, 28 days) for comprehensive spatial transcriptomic analysis to determine the spatial dynamics influencing scleroderma pathogenesis. To validate the possible results from bioinformatic analysis, further in vitro and in vivo experiments were conducted.

RESULTS: Analysis of the spatial transcriptome across four distinct murine models has elucidated considerable alterations in cell clusters along with scleroderma progression. Gene Ontology (GO) analysis unveiled disruptions in lipid metabolism as the disease advances. Pseudotime analysis has further showed evidence for a phenotypic transition from adipocytes to fibroblasts. These transformed fibroblasts are identified as pivotal contributors to escalating inflammation. In vitro and in vivo experiments validate the adipocyte loss and fibroblast formation, with the transformed fibroblasts demonstrating pronounced pro-inflammatory characteristics, underscoring their substantial role in the disease mechanism.

CONCLUSION: Through spatial transcriptome analysis, our study showed the spatial distribution and dynamic alterations of various cell types during scleroderma progression. Crucially, we identified the transformation of adipocytes into fibroblasts as a key factor promoting disease advancement. These emergent fibroblasts possess the capacity to intensify inflammation, suggesting that focused research on these specific cell clusters could yield profound insights into the underlying mechanisms of scleroderma, potentially guiding future therapeutic strategies.

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From White to Brown: A Polymers-Based Two-Step Strategy for Dedifferentiation of Mature Adipocytes into DFAT and Subsequent Redifferentiation into Brown Adipocytes

Presenter: Fiona Louis, M.Eng., PhD (Japan)
Affiliation: Osaka University
Authors: Aslı Sena Karanfil, Fiona Louis, Yoshihiro Sowa, Michiya Matsusaki

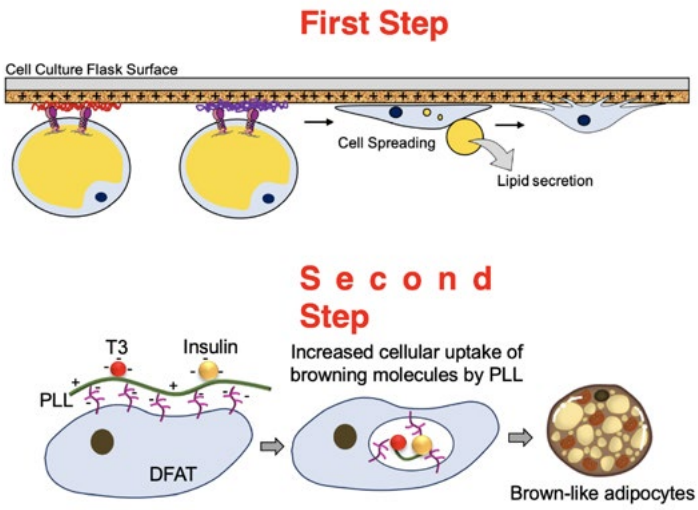
INTRODUCTION: Brown adipose tissue (BAT) plays a crucial role in thermoregulation and has significant potential for treating obesity and related metabolic disorders due to its high mitochondrial activity and expression of UCP1 (thermogenin). However, BAT exists in limited quantities. This research aimed to generate BAT from white adipose tissue in vitro.
White adipocytes can be transformed into dedifferentiated fat cells (DFATs), a novel source of stem cells capable of redifferentiation, making them valuable for cell therapy. While the current DFAT generation processes have limited efficiency, our initial objective was to enhance the dedifferentiation ratio of white adipocytes into DFATs using cationic (PLL, PDDA, PAH) and anionic (gelatin, gellan gum) polymers, as well as extracellular matrix and basal membrane proteins (Collagen I, Collagen IV, Fibronectin, Laminin).

METHODS: The subsequent goal was to fabricate BAT from DFATs in a 3D in vitro model. DFATs were encapsulated in a fibrin gel enriched with these proteins and polymers. The impact of added polymers on the browning process, characterized by increased UCP1 expression and mitochondrial activity, was then assessed.

RESULTS: Proteins and cationic polymers promoted cell adhesion and increased the DFAT ratio compared to anionic polymers and uncoated flasks, likely due to integrin interactions and electrostatic interactions promoting cellular adhesion. For the browning of DFATs in fibrin gel, gelatin and laminin-enriched fibrin gels showed increased UCP1 expression and mitochondrial staining and PLL particularly demonstrated a significant browning-inducing effect. Compared to fibrin-only samples, PLL increased UCP1 gene expression by 6 (±3) times, UCP1 concentration by 5 (±2) times (ELISA), and mitochondrial content by 2 (±1) times after two weeks in brown adipogenic medium. This effect can be attributed to PLL's electrostatic properties facilitating the cellular uptake of critical brown adipogenic inducers such as thyroid hormone (T3) and insulin.

CONCLUSION: These findings underscore the potential of using specific polymers to enhance the differentiation of DFATs into BAT, offering a promising strategy for developing cell-based therapies for obesity and metabolic disorders.

References: Karanfil, Aslı Sena, et al. "ECM proteins and cationic polymers coating promote dedifferentiation of patient-derived mature adipocytes to stem cells." Biomaterials Science 11.23 (2023): 7623-7638 ; Karanfil, Aslı Sena, et al. "Cationic Polymer Effect on Brown Adipogenic Induction of Dedifferentiated Fat Cells." (In revision in Materials Today Bio, available at SSRN 4795112).



Brown Adipose Derived Mesenchymal Stem

Derived Mesenchymal Stem Cells (BADSCs), a

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Brown Adipose Derived Mesenchymal Stem Cells (BADSCs), a Cell-Based Therapeutic as an Alternative to Glucagon-like Peptide-1 (GLP-1) Agonists to Treat Obesity

Presenter: Francisco Silva (USA)
Affiliation: BioRestorative Therapies, Inc.
Authors: Christian Elabd, Vanessa Silva, Francisco Silva

INTRODUCTION: Glucagon-like peptide-1 (GLP-1) agonists are a class of medications utilized to treat type 2 diabetes mellitus (T2DM) and obesity. As a class of medications, they are among several pharmacological options for these endocrine diseases. The function of GLP-1 agonists is to lower serum glucose levels and thereby manage metabolism in affected patients. Recent clinical data has demonstrated that pharmaceuticals like Ozempic or Wegovy (semaglutide) and Mounjaro (tirzepatide) can induce rapid weight loss and although this weight loss can bring about health benefits, losing weight rapidly can also cause a decrease in muscle mass, lessen bone density, and lower your resting metabolic rate, leading to sarcopenia — the gradual loss of muscle mass, strength, and function.

Targeting brown adipose tissue (BAT) in humans, by increasing BAT mass/activity, has emerged as a potential way to increase energy expenditure. Transplantation of brown fat in obese mice models has demonstrated beneficial metabolic outcomes including regulating glucose, insulin sensitivity and even reversing obesity. These findings provide a rationale for the use of BAT for the treatment of obesity in humans. Due to the lack of transplantable BAT, tissue engineering of metabolically active transplantable BAT has recently emerged.

METHODS: We describe the isolation of human brown adipose derived mesenchymal stem cells (BADSCs) from brown adipose tissue and demonstrated that these cells can be expanded and differentiated into functional UCP1 expressing brown adipocytes in vitro. Additionally, we demonstrated that in vivo transplantation of BADSCs on biological scaffolds significantly reduced blood glucose levels and body weight in obese mice.

RESULTS: In the present study, we have characterized multiple BADSCs populations isolated from brown adipose depots and developed a xenofree chemically defined differentiation medium and protocol for efficient BAT generation and clinical transplantation. We have also evaluated the use of an immune protecting encapsulation medical device as a delivery system for bioengineered BAT transplantation.

CONCLUSION: This work may provide a safer cell-based alternative to treat obesity without the secondary effects seen in GLP-1 pharmaceuticals such as muscle mass loss, decreased bone density and negative impact on cardiovascular function

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ABSTRACTS - SUNDAY, SEPTEMBER 22, 2024
FREE PAPER SESSION: Best Clinical Papers

A Comprehensive Study on the Synergy of Nanofat Grafting with Hybrid Cooperative Complexes of High and Low Molecular Weight Hyaluronans, Energy-Based Devices, and Exosomes

Presenter: Sophie Menkes, MD (Switzerland)
Affiliation: Nescens Clinic
Authors: Sophie Menkes, MD

INTRODUCTION: The advent of regenerative medicine has propelled the quest for effective synergistic combinations to achieve optimal results in tissue regeneration and aesthetic medicine. This study aimed to investigate the interest and efficacy of combining nanofat grafting with hybrid cooperative complexes of high and low molecular weight hyaluronans, energy-based devices, and exosomes.

METHODS: A total of 20 participants, aged 30-60 years, with signs of skin aging and soft tissue atrophy, underwent a single treatment session. Participants were evenly divided into five groups: nanofat grafting alone, nanofat with hyaluronans, nanofat with energy-based devices, nanofat with exosomes, and a combined treatment of all modalities. Assessments were made pre-treatment, one month, three months, and six months post-treatment, using clinical photography, patient satisfaction scores, Quantificare analysis.

RESULTS: The combined treatment group exhibited the most significant improvement in skin texture, pigmentation, and overall rejuvenation. The nanofat with exosomes group demonstrated notable efficacy in collagen production and skin hydration, while the energy-based devices showed accelerated recovery and skin tightening effects. The hybrid cooperative complexes of high and low molecular weight hyaluronans enhanced the proliferation and differentiation of the grafted cells.

CONCLUSION: The smart combination of nanofat grafting, hybrid cooperative complexes of high and low molecular weight hyaluronans, energy-based devices, and exosomes offers a robust and synergistic approach to tissue regeneration and aesthetic enhancement. This innovative combination warrants further exploration to fine-tune its potential in regenerative medicine.

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Clinical Significance of Fat Graft Preparation Technique in Breast Reconstruction Revision with Autologous Fat Transfer

Presenter: Daniel Patrick Zaki, MD, MS (USA) (Virtual)
Affiliation: Wake Forest University
Authors: Daniel Patrick Zaki, MD, MS, Mario Blondin, MD, Blake Dunson, BS, Mariam Gadjiko, MD, Ivo Pestana, MD

INTRODUCTION: Autologous fat transfer is an accepted technique for filling volume deficits and adjusting contour irregularities after breast reconstruction. Despite this, factors affecting the clinical outcome of this technique in post-reconstruction breast revision surgery are incompletely understood. Particularly, the assessment of needed fat graft volume for contour improvements and the occurrence of post-fat grafting complications remains variable. In addition, there are several fat graft harvest and processing options commonly employed. Still, there remains no standardized protocol, making variation in processing techniques a potential factor in the inconsistent nature of liposculpting results. This study aims to clarify the above factors and determine if fat graft processing technique affects the incidence of postoperative complications in patients undergoing breast reconstruction revision surgery with fat grafting.

METHODS: A retrospective chart review was conducted on 44 patients who underwent fat grafting by a single surgeon over a three-year period. Patient demographics, complications, and operative specifics (e.g., fat graft processing technique) were collected. Participants underwent fat graft harvest using suction-assisted lipectomy and subsequent processing via LipoGrafter, Revolve system, or Coleman technique (centrifugation).

RESULTS: The average time for post-operative follow-up was 5.8 months, with no significant difference noted between groups ($p = 0.78$). Complication rates (e.g. fat necrosis, seroma, infection) were statistically insignificant across techniques ($p = 0.37$). The average operative duration reported in minutes for cases that solely involved fat grafting without concomitant procedures between the three groups was also statistically insignificant ($p = 0.11$). The average volume of usable fat for transfer as a percentage of total lipoaspirate harvested by LipoGrafter, Revolve, and Coleman technique was 39.5, 24.5, and 24.7 percent, respectively, with LipoGrafter yielding a significantly higher percentage of usable fat ($p = 0.003$).

CONCLUSION: This study offers insights for plastic surgeons deliberating over the choice of fat graft processing techniques, particularly in settings with varying access to different processing resources. We found no significant differences in postoperative complications among the three techniques. This finding is particularly relevant for clinical practice, as it suggests that the choice of technique may not significantly impact clinical outcomes, allowing surgeons to select based on availability, familiarity, or other logistical considerations without compromising patient safety.

Procedure Characteristic	LipoGrafter	REVOLVE	Coleman Technique	P-value
Operative duration, minutes (SD)	94.5 (6.36)	76.6 (11.0)	101 (21.5)	0.11
Complication, N (%)				
Fat necrosis	0	0	2	0.37
Seroma	0	0	0	-
Abscess	0	0	0	-
Average Additional Fat Grafting Procedures, number	1.83	1.2105	1.2105	**0.054**
Percent of usable fat, mean (SD)	39.5 (9.10)	24.5 (9.85)	24.7 (6.36)	**0.003**
Follow-up duration, months (SD)	5.2 (3.2)	6.1 (3.4)	6.2 (3.2)	0.78

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ABSTRACTS - SUNDAY, SEPTEMBER 22, 2024
FREE PAPER SESSION: Best Translational & Basic Science Papers

Autologous Stromal Vascular Fraction Derived from Fat, Preliminary Results Obtained in a Model of Spinal Cord Contusion in Piglets.

Presenter: Nicolas Serratrice, MD (France)
Affiliation: Aix-Marseille University
Author: Nicolas Serratrice, MD

INTRODUCTION: The stromal vascular fraction (SVF) derived from adipose tissue is composed of a true "cocktail" of mesenchymal and hematopoietic stem cells with trophic, pro-angiogenic and immunomodulatory effects. Our previous work in rats established the neuroprotective and neuroregenerative properties of autologous SVF when administered in the first hours after spinal cord contusion. Here we have crossed the big animal model.

METHODS: A new model of spinal cord injury (SCI) was established in piglets (2 months, 20 kg) at the Surgical Teaching and Research Center (CERC) on the university campus of the North Hospital (AP-HM/AMU). Spinal contusion at L3 level (the pig has 7 lumbar vertebrae) is carried out using a weight system, which makes the animals paraplegic and incontinent, greatly facilitating their housing. The autologous SVF is then prepared using Celution system (Cytori) directly in the operating room from cervical fat, under the same GMP conditions used in humans. The final autologous product is thus directly injected intralesionally with specific cannulas within 4 hours after the spinal cord contusion; another part of the cell therapy product being used for quality control (viability of cells, flow cytometry studies, CFU determination) carried out at the Cellular Therapy Unit (CTU) of La Conception Hospital (AP-HM). The animals are then evaluated for 3 weeks using functional tests (Porcine Thoracic Injury Behavioral Scale) and by goniometric measurements and telemetric EMG recordings at the hips. The animals' walking was also filmed in a dedicated corridor with a video recording system. The piglets were sacrificed at 3 weeks, the spinal cords were fixed in a formalin solution and were imaged in a 7T MRI before performing immuno-histological studies.

RESULTS: The implantation of the autologous SVF cells at the level of the SCI promotes: 1) early locomotor recovery, the piglet stands on its hind legs on D4 and walks again on D7, while the injured control animal is still para/incontinent on D21, 2) restoration of goniometric and electrophysiological measurements in 3 weeks, 3) also improvement of sensitivity in the hind legs and continence; 4) the data obtained with 7T MRI are being correlated with histological studies.

CONCLUSION: These very promising results point to an immediate neuroprotective effect of autologous SVF after SCI. The experiments are being repeated on a larger cohort of animals. If the results are confirmed, a transition to humans could be considered very soon.

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Advancing Translational Research: A Novel Ex Vivo Human Skin Perfusion System for Enhanced Clinical Applications

Presenter: Alexa Rivera del Rio Hernandez, MD (USA)
Affiliation: Department of Plastic Surgery, University of Pittsburgh
Authors: Alexa Rivera del Río Hernández, MD, Jose Antonio Arellano, MD, Hamid Malekzadeh, MD, Yusuf Surucu, MD, Fuat Baris Bengur, MD, Shawn Loder, MD, Jeffrey A. Gusenoff, MD, Francesco M. Egro, MBChB, MSc, MRCS, J. Peter Rubin, MD, FACS, MBA, Asim Ejaz, PhD

INTRODUCTION: Translating preclinical research to clinical application is a challenge due to the metabolic and anatomical differences between traditional animal models and human systems. While the organ-on-a-chip model can offer a promising alternative by replicating human cell-based organization, these models usually lack the true complexity of a human's native microenvironment and its anatomical fidelity, all necessary for accurate translational outcomes. To address this challenge, we established an innovative ex vivo perfused fasciocutaneous flap model, utilizing human surgical waste tissue and offering an alternative platform that has an extended viability for up to three weeks for several applications on understanding skin physiology and therapeutic developments.

METHODS: Key aspects of our methodology include the refinement of surgical procedures, angiosome exploration, engineering of a bioreactor system, and optimization of perfusion media to keep the tissue viability and functionality. These parameters were assessed through various methods. Through thermal and fluorescent techniques, we confirmed perfusion success; continuous monitoring of metabolic activity was carried out by measuring glucose consumption and lactate production, thereby providing feedback on tissue health. Furthermore, tissue integrity and cellular responses were assessed with histological analysis, TUNEL staining, and gene expression profiling. Moreover, vascular reactivity was evaluated through the tissue's physiological response to vasoactive agents.

RESULTS: Beyond these viability and functionality assessments, our model demonstrated versatility across a series of applications. We investigated the dynamics of radiation and chemical-induced injuries, showcasing the model's utility in studying tissue responses to these insults. We explored its potential in elucidating adipose tissue metabolism and establishing tumor models for melanoma and breast cancer. Our model also exhibited compatibility with circulating allogenic immune cells, opening doors for studying immune-mediated responses and interventions in skin pathologies. Additionally, enhanced wound healing kinetics were observed in our interventions, which reinforced the clinical relevance and therapeutic potential of this model.

CONCLUSION: Overall, we present a novel approach to bridge the gap between preclinical research and clinical translation. By providing a platform with greater physiological and anatomical relevance to human skin, our ex vivo human skin perfusion system holds promise in enhancing translational success, as well as reducing reliance on animal experimentation.

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ASC-based Biological Dressings Enhance Skin Wound Healing in Diabetic Mice

Presenter: Julie Fradette, PhD (Canada)
Affiliation: LOEX-Universite Laval
Authors: Julie Fradette, PhD, Meryem Safoine, MD, PhD, Caroline Paquette, PhD, Gabrielle-Maude Gingras

INTRODUCTION: Long term diabetes often leads to chronic wounds refractory to treatment. Cell-based therapies are actively investigated to enhance cutaneous healing. Adipose-derived stem/stromal cells (ASCs) are attractive considering their therapeutic secretome and performance in tissue engineering. Our team recently described a production system entirely devoid of FBS (fetal bovine serum) from human ASCs extraction to engineering of ASC-derived dressings displaying superior characteristics compared to their FBS-based counterparts. These dressings indeed showed sustained pro-angiogenic molecules secretion, increased tissue thickness allowing easier manipulability and a 50% reduction in production time. We thus hypothesize that repeated application of these ASC-based dressings would enhance skin repair in a preclinical murine model of diabetes.

METHODS: The biological dressings were repeatedly applied every four days on full thickness 8-mm splinted skin wounds created on the back of polygenic diabetic NONcNZO10/LtJ mice (modeling type 2 diabetes, n=10 wounds per group). The wound closure rate and quality of the healed skin were evaluated compared to untreated wounds (inert gel formulation).

RESULTS: Global wound closure kinetics evaluated macroscopically showed that ASC-based dressings accelerated wound closure by a week, the treated group reaching 98.7 ± 2.3 % global closure compared to 76.4 ± 11.8 % for the untreated group at day 20 ($p=0.0002$). Histological analyses revealed that treated wounds exhibited healed skin of better quality with a well-differentiated epidermis. Among the treated group, 100% of the wounds displayed a complete reepithelialization. For the untreated group, only 43% of the wounds (3 out of 7 wounds) displayed complete reepithelialization, with the remaining wounds showing partial reepithelialization in the wound edge areas (2 wounds) or no reepithelialization at all (2 wounds).
The neodermis featured a more organized, homogeneous and 1.6-fold thicker granulation tissue for the treated animals. Skin vascular index, assessed by CD31 labeling, was 2.5-fold higher for the NONcNZO10/LtJ treated wounds.

CONCLUSION: We described an entirely serum-free production system of naturally derived scaffold-free ASC-based biological dressings. These dressings acted in vivo on multiple processes of wound healing including reepithelization, granulation tissue formation and neovascularization, and represent a promising therapy for difficult to heal diabetic wounds.

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Lymphatic Vessel Structure Formation During Stromal Vascular Fraction Derived Vasculogenesis

Presenter: Walter L. Murfee, PhD (USA)
Affiliation: University of Florida
Authors: Nien-Wen Hu, Hulan Shang, Samuel Kogan, Ramon Llull, Adam J. Katz, Walter L. Murfee

INTRODUCTION: Therapies aimed at manipulating microvascular function require the ability to generate both blood and lymphatic vessels. Adipose-derived stromal vascular fraction (SVF), consisting of endothelial cells, stem cells, pericytes, smooth muscle cells, fibroblasts, and immune cells, has emerged as a potential heterogeneous cell population for de novo blood vessel growth, but the potential for SVF to form lymphatic vessels remains unknown. The objectives of this study were to characterize the presence of lymphatic endothelial cells in mouse SVF and evaluate lymphatic vessel structure formation over time..

METHODS: SVF was isolated from the C57BL/6 mouse inguinal adipose tissue and analyzed via flow cytometry using antibodies against PECAM and lymphatic markers (Prox1, Podoplanin, Lyve-1). For vessel formation studies, SVF was seeded onto avascular mouse mesentery tissues and cultured in MEM + 10% FBS for up to 9 days (0.5 x 10^6 SVF cells/tissue). Tissues were labeled for PECAM plus Lyve-1 or Prox1. To probe non-endothelial cell specific contributions, SVF was harvested from neuron-glial antigen 2 (NG2) -/- mice and seeded onto tissues from WT C57BL/6 mice.

RESULTS: The presence of lymphatic endothelial cells in SVF is supported by the percentages of PECAM positive cells that are also lymphatic marker positive (Prox1: 4 - 11 %; Podoplanin: 15 – 41 %; Lyve-1: 1.2 – 1.3 %). By day 1 after cell seeding on tissues, SVF cells formed PECAM positive segments. Day 3 tissues displayed cell clusters with segment extensions. At later time points, segments were connected in a network pattern. A subset of structures, termed "blebs," were lymphatic marker positive. The "blebs" were characterized by large and irregular diameters, observed to connect with nearby SVF derived PECAM positive vessel segments, and changed shape over time. By day 9, structures with typical lymphatic vessel morphology were observed. NG2 -/- SVF displayed fewer lymphatic structures indicating the importance of non-endothelial cells. .

CONCLUSION: Our characterization of lymphatic endothelial cell presence and the discovery of lymphatic-like structures provoke a new research area focused on the ability for SVF to form lymphatic vessels. Our results also suggest that lymphatic vessel formation is dependent on the heterogenous SVF cell milieu.

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FRESH 3D Printing Adipose Tissue for Reconstructive Medicine

Presenter: Lindsey Kieffer Huff, PhD (USA)
Affiliation: Carnegie Mellon University
Authors: Lindsey Kieffer Huff, PhD, Theo Mohideen, Daniel Aluko, Giselle Obergfell, Adam Feinberg, Rosalyn Abbott

INTRODUCTION: Adipose tissue is frequently damaged due to disease, trauma, or congenital defects, requiring reconstructive procedures. Current treatments fail to recreate the desired macro/microstructure of the damaged adipose tissue. 3D printing adipose tissue can address these shortcomings by fabricating patient-specific grafts with controlled microstructure. Bioprinting mature adipocytes has not been previously achieved due to their significant size, buoyancy, and fragility. Freeform reversible embedding of suspended hydrogels (FRESH) bioprinting is an ideal fabrication method as the cell-laden alginate bioink is crosslinked directly upon extrusion into a CaCl2 gelatin support bath. Here we demonstrate a novel use of FRESH to generate adipose tissue with high precision and reproducibility for reconstructive applications.

METHODS: Mature adipocytes were isolated from primary human tissue, incorporated into an alginate bioink, and FRESH bioprinted into a CaCl2 gelatin support bath. The alginate concentration of the hydrogel, printing speed, and printing needle gauge were varied to evaluate the impact of shear stress on the printed adipocytes. To control experiments, the bioink was extruded into the support with a pipette to evaluate the sole impact of printing.

RESULTS: The 10x10x5mm tissue printed demonstrates the precision of FRESH with dimensional errors <0.6% (Figure 1). Increasing alginate concentration (viscosity) of the adipocyte-laden hydrogel led to decreased cellular diameters (Figure 2), demonstrating that cytoskeletal remodeling is rapid (within hours) and highly dependent on the ECM stiffness. Additionally, printing decreased the cellular diameter relative to the same unprinted alginate concentration. Increasing the needle gauge also resulted in a decreased diameter of printed adipocytes (data not shown), and varying printing speed did not have a significant effect on cell diameter (data not shown).

CONCLUSION: We demonstrate high accuracy (<0.6% error) bioprinting of mature adipocytes with FRESH. Printing parameters can be modulated to yield varying impacts on the adipocyte diameters, attributed to the influence of these parameters on the shear stress experienced by cells during printing. Future work includes printing an anatomical breast implant using an MRI from a patient post mastectomy.

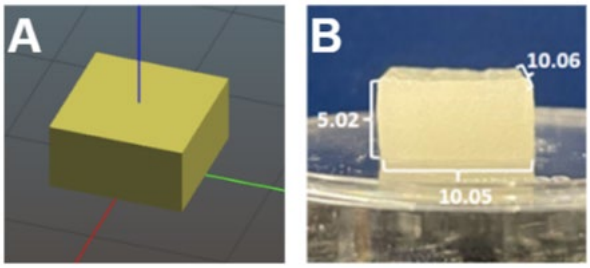

Figure 1. (A) 10x10x5mm CAD model and **(B)** 3D printed construct after post processing with <0.6% error in printing dimensions.

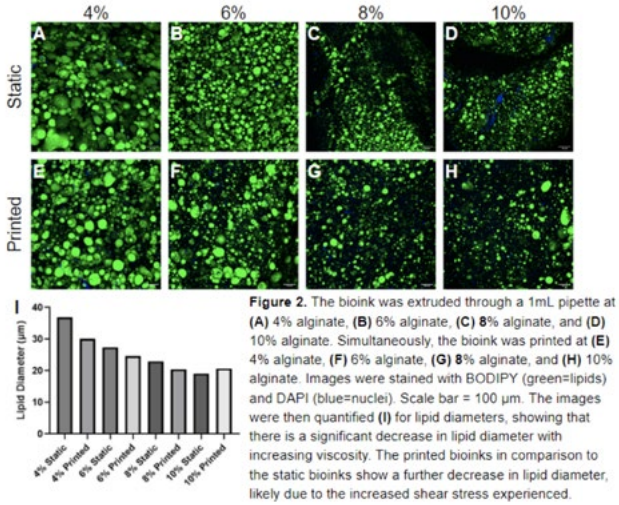

Figure 2. The bioink was extruded through a 1mL pipette at **(A)** 4% alginate, **(B)** 6% alginate, **(C)** 8% alginate, and **(D)** 10% alginate. Simultaneously, the bioink was printed at **(E)** 4% alginate, **(F)** 6% alginate, **(G)** 8% alginate, and **(H)** 10% alginate. Images were stained with BODIPY (green=lipids) and DAPI (blue=nuclei). Scale bar = 100 µm. The images were then quantified **(I)** for lipid diameters, showing that there is a significant decrease in lipid diameter with increasing viscosity. The printed bioinks in comparison to the static bioinks show a further decrease in lipid diameter, likely due to the increased shear stress experienced.

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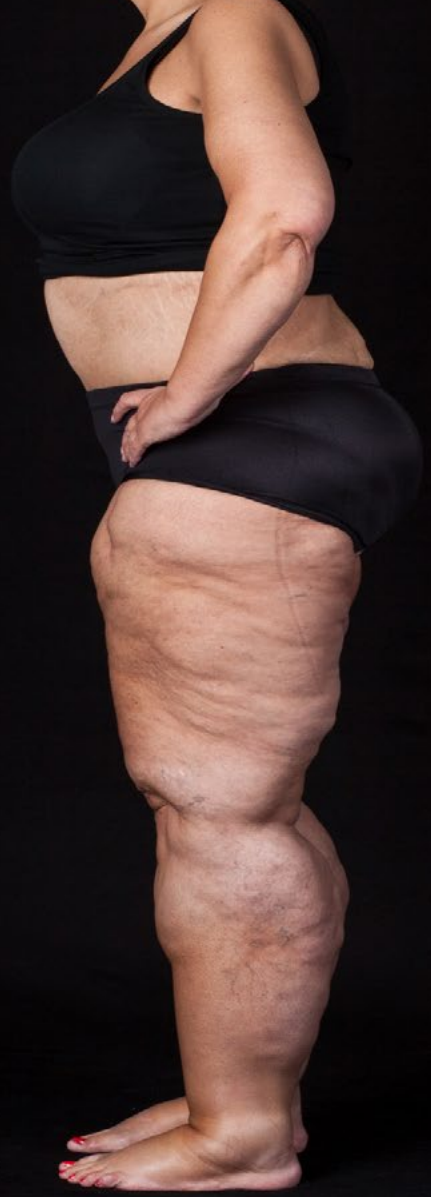

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