

Life Enhancing Solutions Addressing Unmet Medical Needs

2018 SENIOR DESIGN SHOWCASE

Friday, June 1, 2018 – 5:00 PM

George D. Behrakis Grand Hall, 3210 Chestnut St. Philadelphia, PA 19104

(Inside Creese Student Center, on Chestnut Street, between 32nd and 33rd Streets.)

Program of Events

5:00 PM – 5:15 PM	Showcase Event Registration
5:15 PM – 5:25 PM	Welcoming Remarks Paul W. Brandt-Rauf, Dean and Distinguished University Professor
5:25 PM – 7:00 PM	Poster Presentations, Judging, and Networking
7:00 PM – 7:15 PM	Awards Ceremony Wan Shih, Professor
7:15 PM – 7:30 PM	Concluding Remarks Paul W. Brandt-Rauf, Dean and Distinguished University Professor



Quad Charts

Available online at drexel.edu/biomed/seniordesignshowcase

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^{TEAM} Shoulder Torque and Range of Motion Device (STROM)

Kristina Harper, Ife Miller, Alex Molchansky

Dr. Joseph Sarver



Assistive Communication Technology for Amyotrophic Lateral Sclerosis (ALS)

Avi Bash, Jacob Fischer, Kelly McGuigan, Jane Roberts

Dr. Joseph Sarver



TEAM Surgical Guide for Foot and Ankle Subchondroplasty

Patrick Bowlin, Rachel Dichter, Ayesha Patel, In Sub So

Medical Need: Human error in the process of targeting lesions leads to extravasation (0.01%) of bone substitute material



<u>Objective:</u> Design a single use tool to target, aim, and stabilize a cannula, minimizing the chance of extravasation during SCP.



Modular cannula port attaches to guide.

Radiopaque probe inserted into incision.

Hemispherical frames maneuvered and locked to aim cannula to lesion.

Drilled to edge, for 5mm offset minimizing error

Michael Esch

Approach: Compatible with existing

surgery and patients, user friendly, visually

direct cannula to lesion, and biocompatible

Dr. Steven Kurtz, Shaun Hanson,

Cadaver lab showed improved accuracy by > 20%

Screening Patients For CRISPR-Cas9 Excision Therapy Suitability

Paul Jacobs, Parth S. Patel, Shuo Wang, Thomas Yeckley, Valeria Berlfein Dr. Will Dampier



A Microfluidics Device for Production of Stabilized Microbubbles for Ultrasound Imaging

Euler Santi, Tianheng Liang

Dr. Margaret Wheatley



Poroelastic Nanofibrous Composite Material for Compressive Energy Dissipation

Sebastian Fernandez, Joseph Grieco, Alexander Lam, Thomas Li, Ryan Tabit Dr. Lin Han



Taylor Caton, Carly Deusenbery, Raji Elangovan, John Lim

Dr. Kara Spiller, Dr. Joseph Abboud, Dr. William Warrender

CLINICAL NEED: SOLUTION: (C_t - C_b) 2πEw F.=uF.=uAP Most frequently ruptured tendon (18 in 100,000 people) [ref. 1] (C. - C.) C,C EXISTING SOLUTION: Surgical Reconstruction Compressive Circumference force of tendon High risk for suture tear through Friction braid/tendon Re-rupture rate: 5-10% [ref. 2] Circumference of braid C, Retaining force due to friction F, **Objective:** Produce a fixation device that can maintain Elastic Modulus of braid E a minimum gap between tendon ends during the А Contact Area healing process while in a walking boot Pressure Braid thickness APPROACH: Material Braid Load Failure **RESULTS & IMPACT:** Materials Fabrication 369N Î Polypropylene Polylactic Acid Select at Failure Reg 2. Braid Reg. 1 Math Material olycapro-actone . Valid Fabrication >369N <5mm Gap Model Silk Ribbon • -oad Tensile Constant Cyclic Nylon Low-Density Polyethylene Load Test • Load Load Horse Hair Test Test Passed Failed Tes Addtional optimization of this design could serve as an alternative approach for Achilles tendon repair in sports medicine & worker's compensation

TEAM Neonatal Nasal Cannula Fixation Device

Sonali Dadoo, Melissa Mathew, Harsh Patel, Parth P. Patel Dr. Kenneth Barbee, Dr. Vinay Nadkarni

Clinical Need / Existing Solution

NICU patients swipe at nasal cannulae, which dislodge them from the nares and potentially causes symptoms of respiratory distress (e.g. tachypnoea and tachycardia), and hence calls for device innovation





Current "Gold Standard" -Tender Grips™

Point of Securement Receding securement from swipes and gap in securement lead to device failure

Solution / Prototype

Clip that feeds cannula through a canal, secures cannula within cylindrical cavity, and adheres to skin patch (all units are in mm)



Approach / Requirements



Forces: Temporary Failure - 4.59N horizontal, 2.06N vertical; Permanent Failure - 3.53N vertical Surface Area: Adhesive portion is less than 9.68 cm² Fatigue: Withstand more than 300 minutes of simulated fatigue to reach 1 mm displacement in vertical direction Flow: Maintain flow within 1L/min at 54,115,and 158 cmH₂O

Results / Impact



- May give nurses more time to attend to other patient issues

- Could be modified to secure other types of cannulae

- Applied to other populations such as geriatric, disabled, and discharged patients

Advanced Medea Tapping Device for Characterization of Rhythmic/Auditory Sequences

Rong Chen, Victoria Filipova, Jin Li, Michelle Riddle, Carolyn Schafer Dr. Kurtulus Izzetoglu, Dr. Caterina Piazza, Dr. Ambra Cesareo

Clinical Need Solution MATLAB Dyslexia affects between 5-10% of U.S. children. Lack of an affordable, comprehensive assessment tool to for the screening, diagnosis, and training for dyslexia in children. Constraints Objective: to advance existing Medea tapping prototype into Time: 9 Months an assessment tool for the Budget: \$500 targeted pediatric population Policies: IEEE Analysis of the rhythmic imitation ability: Example: 802.15.4 better performance compared to baseline assessment - decrease in dyslexia symptoms Approach **Results & Impact** Requirements Auditory Stimulus and Tapping Associated With It Limited resolution Operates in 2.4 GHz frequency, Detection of touch Rhythm imitation forces up to 89.2 N data rate of 250 kb/s of the sensor dyslexia analysis Weight: Less than 10 pounds resulting from the Resolution: 0.2 N R Intensity was developed 60 sensor's low Dimensions: Smaller than 21cm x by Eugenio 40 Operate for 4-5 hours 21cm x 18cm (3D printer limits) quality. Medea Clinic in \mathfrak{S}_6 **Force Detection** Italy. 0,2 0,4 voltage (Impact: An assessment tool Time (s) to measure the progression Final prototype developed Response v of dyslexia in children and as esponse voltag with wireless capabilities O detection of 89.2 N an evaluation of the and housing. effectiveness of dyslexia 0 50 100 treatment. Force (N)



Dielectric Barrier Discharge Plasma Treatment of 3D Printed Polylactic Acid (PLA)

Solution:

PLASARA TREATS

Spencer Bass, Calan Farley, Forrest Lang, Shane McCredle, Dan Schoenborn Dr. Greg Fridman, Dr. Michael Frohbergh, Dr. Judd Day

H VOLTAGE DBD ELECTRODE

UNDED ALUMINUM FOIL

DUAL EXTRUDERS INSULTING ELECTRODE

Unmet Need:

- 3D printed PLA structures are being investigated as a method of creating orthopedic structures, but suffer from poor adhesion between printed layers that can fail when subjected to shear stress.



Approach:

Increased roughness has been linked to increased shear modulus, plasma treatment has been found to increase roughness. Will adapt a 3D printer and plasma discharge device to allow for concurrent printing and treatment of PLA.

- Unchanged chemical composition
- Roughness increased by factor of 2 from control
- Shear modulus significantly greater than 18.26MPa

Results/Impact:

Unchanged chemical composition 15sec of plasma treatment surface roughness almost doubled.

PLASMA FYTR

712111

3	reatment Time (s)	R _e (µm)
	0	0.668 ± 0.021
	1	0.717±0.0
	5	0.578 ± 0.028
	16	1059+0.017

PRINTING SURFACE

Method of rapid manufacturing of customized orthopedic devices. Process not limited to creating orthopedic devices.

TEAM Astronaut Hibernation Monitor

Marina Digregorio, Lananh Ho, Shreya Rane, Kajal Jhonsa, Cindy Nguyen Dr. Marek Swoboda, Dr. Kambiz Pourrezaei, Dr. K. Drew



Advanced Hypercapnia System for Ambulatory Assessment of Cerebrovascular Reactivity (CVR)

Rachel Ackerman, Mohammad Bilash Hossain, My Duyen Le, Jennifer Uzokwe, William Washington

- Dr. Ramon Diaz-Arrastia,
- Dr. Michael Sangobowale,
- Dr. Kurtulus Izzetoglu



TEAM Electromyography Upper Extremity Prosthetic

Talvon Brown, Andrew Kulasegram, Andrea Martinez, Saumik Routh, Jesse Rush Dr. Sri Balasubramanian

CLINICAL NEED

<u>No transhumeral prosthetic arm</u> can achieve <u>simultaneous degrees of freedom</u> (DOF) with biosignal control without Targeted Muscle Reinnervation (TMR)

SOLUTION



APPROACH

Design a transhumeral EMG prosthetic limb that uses signal from controllable muscles to produces two simultaneous motions





IMPACT

Removes TMR surgery. More realistic functions to a human by creating simultaneous movements.

Uterine Simulator Model for Training in Manual Vacuum Aspiration

Melissa Cirillo, Zoe Greenhall, Feyone La, Jacqueline Park Dr. Elizabeth Datner, Dr. Michele Marcolongo



TEAM **Social Communication Over Brain-Computer** Interface Dylan Davis, Gabe Cas, Haneul Kim, Ian Bilofsky

Dr. Jaimie Dougherty

Medical Need: Pseudocoma/Locked-In Syndrome (LIS)

- Unable to communicate as LIS patients are unable to produce any musculoskeletal movements
- No form of social communication leads to detraction from health, treatment prognosis, and overall quality of life
- Current solutions for restoring linguistic communication are slow and inefficient lead to stress/frustration

Objective:

Design and provide platform/environment which would allow patient to interact with caregiver in order to fulfill social communication need

Approach:

- Cooperative videos games can provide pro-social interaction
- Patient can use brain-computer interface (BCI) to control video game using EEG
- Steady-state visual evoked potential (SSVEP) for control options by recognizing frequency





Results

1. True-Positive Rate (TPR): Accuracy in identifying user's intent in gameplay

- 2. Real-Time Classification
- (Identifying user's intent) 3. Social Presence in Gaming
- Questionnaire (Scale: 0-4)

#	Requirement	Subject Ex.
1	TPR>50%	76%
2	115ms-690ms	198 ms
3	Score ≥ 2	2.29

Impact

SSVEP targeted control paradigms promising for pro-social communication focus BCI applications

TEAM **Determining Sacral Tissue Thickness Using Piezoelectric Finger (PEF) Technology**

Krishna Dhanani, Erin Dierkes, Andrea Fodera, Mayank Gandhi, Thao Nguyen

Dr. Wan Shih, Dr. Peter Lewin, Dr. Michael Weingarten



TEAM Modernized Universal Eating Monitor (UEM)

Henry Tse, Khang Vu, Cory Zheng

Dr. Hasan Ayaz



TEAM Drop Foot Assistive Device for Flat Foot Squat in Low Income Countries

Claudia Duguay, Mary Hayles, Komal Mehta, Andrew Wilson Dr. Fred Allen, Dr. Sri Balasubramanian, Dr. Adrian Shieh, Dr. Wan Shih, Dr. Shannon Márquez, and Mr. Idris Robinson

Unmet Ne	ed						Solu	ition	
Drop Foot •Nerve damage that affects tibialis anterior •Tibialis anterior needed to squat •Unstable user falls forward		<u>Goal:</u> transl device to lo materials fou in low inco countries	Adjustable Hinge local found ncome Shell Bamboo Peg						
No Current Solutions 75% of t		the World A Rubber Foot							
Approach & Requirements Population		Population	Utilizes Flat			Results & Im	pact		
θ=47±5°	M _A = 8.53 Nm	<7.6	Foots	Squats	User	User is stable in squat			
	1	Adjustments	Stable	Advanta	ages F	R1	$\theta = 49 \pm 2^{\circ}$		
\bigwedge	Fcog		Squat	 Return to dai Inclusion/Ind ↓ Cultural 	ependence Stigma	R2	F _{peg} < F _{critical} 36 N < 3600 N	✓	
6	FGRF MA	Time (s)		<u>Disadva</u> The	ntage ft	R3	1.2 adjustments per minute	✓	

TEAM An Autonomously Expanding Shunt for Pediatric Patients

Krianthan Govender, Jacqueline Muscella, Kaitlyn John, Nathaniel Neavling Dr. Amy Throckmorton, Dr. Kara Spiller,

Dr. Randy Stevens



Doppler Ultrasound for Frequent Carotid Artery Stenosis Monitoring

Crus Ahmadi, Matthew Coates, Mark Welsh

Dr. Marek Swoboda



TEAM Non-Antibiotic Antimicrobial Coating for Urinary **Catheters**

Kathryn Howarth, Kanishka Patel, Chaitali Vyas

Dr. Wan Shih, Dr. Wei-Heng Shih

reduction after a 24 hour incubation period.





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