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Empowering Individuals with Limited Joint Mobility: An Embedded Interdisciplinary Program between Occupational Therapy and Industrial Design

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Additional Information

What is Fibrodysplasia Ossificans Progressiva (FOP)?

- A rare genetic disease that turns muscles, tendons, and ligaments into bone via progressive and uncontrolled growth.
- Permanent fixation occurs in most major joints of body over time (neck, back, arms, hips, jaw), locking individuals in positions that limits independence in daily tasks/activities.

Project Objectives

- A 9-month embedded interdisciplinary collaborative program between occupational therapy doctoral (OTD) students, master of industrial design (ID) students, OT/ID department faculty, and individuals living with Fibrodysplasia Ossificans Progressiva (FOP client experts) to co-develop assistive devices that improve functioning during daily tasks/activities.
- FOP client experts experience complex and evolving needs, necessitating ongoing construction of homemade assistive devices. Their solutions are not durable or appealing and do not effectively address the complex needs of individuals living with the condition.
- Further expand the usability of these assisted devices to other populations.

Occupational Therapy & Industrial Design Interdisciplinary Collaboration Background

- **Occupational Therapists (OTs):** Licensed healthcare professionals helping individuals regain independence and achieve desired goals through meaningful tasks that they need or want to do.
- **Industrial Designers:** Focus on making and creating objects iteratively; have a robust understanding of materials, prototyping, manufacturing, and aesthetic requirements for product development beyond single-use solutions.
- **FOP Client Experts (end users):** Recipient of OT services, user of assistive devices, and experts in their lives.
- **Combined:** Collaboration between designers, OTs, and end users has demonstrated improved benefits for end-user experience by contextualizing client conditions, translating user-feedback, expanding on environmental influences, and analyzing performance in everyday activities (Wagenfeld et al. 2017; Young et al. 2019).

FOP Project Team Demographics and Methodology

- 2 OTD students, 5 industrial design students, 1 OT faculty, 2 ID faculty
- FOP client experts: 8 individuals with FOP, 3 caregivers of individuals with FOP
- IRB-approved data collection procedure informed assistive device development

Canadian Occupational Performance Measure (COPM)

- OT assessment identifying participation barriers in self-care, productivity, and leisure
- Administered by OTD students
- Purpose/goal: to objectively evaluate effectiveness of prototype use

Phase I Design Interview

- Administered by design students with OTD student support
- Purpose/goal: understand how FOP client experts engage in daily activities with supports, barriers, and current device use

Phase II Design Interview

- Administered by design students with OTD student support
- Purpose/goal: obtain user feedback on how FOP client experts use the device prototypes in their daily lives

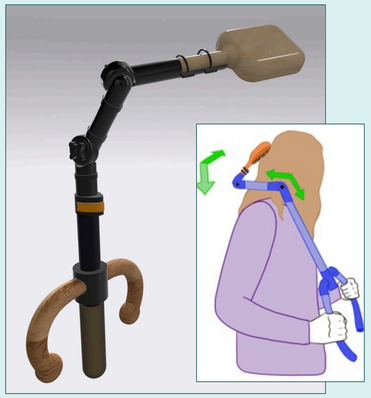
FOP Expert Panels

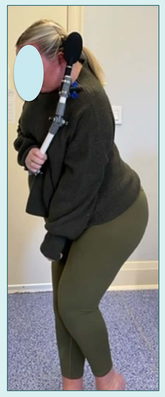
- Informal group feedback sessions with FOP client experts on design student devices
- Purpose/goal: expand upon information obtained in COPM and design interviews
- Not a traditional aspect of OT practice!

Design Students: Jennifer Hegelein, Maitri Doshi, Armando Ayala, Aaron Anderson, Justin Horst, and Monique Chabot.

Personal Grooming Device

- **Problem:** Fusion in the neck, back, shoulders, and elbows prevents reaching the top and the back of the head.
- **Collaboration Impact:** COPM and design interviews demonstrated desire for independence in grooming (hair brushing); current products are unsuitable due to limited grip and reach.

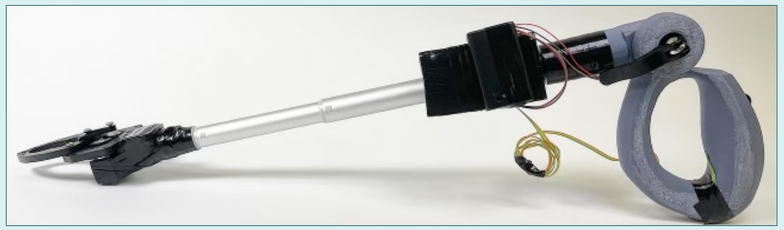




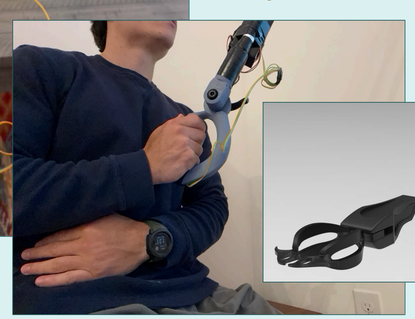
- **Solution:** Multi-angular adjustment to reach the skull, telescoping handle to adjust height, and multiple handles for variable positioning.

Electromechanical Reacher

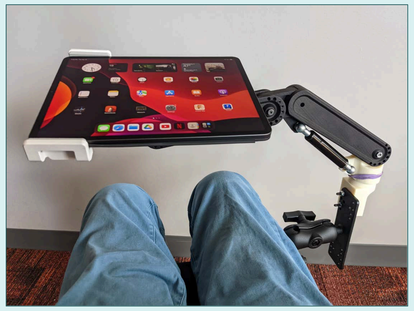
- **Problem:** Current reachers require a reliance on arm, neck, trunk mobility to retrieve items.
- **Collaboration Impact:** Contextualization of interviews led to understanding of variable body positioning of FOP community to improve useability.



- **Solution:**
- Adjustability in length/angle to reduce reliance on arm mobility.
- Handle shape allows for multiple grasps and orientation.
- Servo claw controlled by a handle-mounted scroll wheel affords precise control when picking up objects of various sizes and weights.

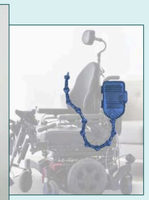


Wheelchair Electronics Mount



- **Problem:** Current wheelchair electronics mounts offer stability or flexibility but not both.
- **Collaboration Impact:** Current solutions force reliance on environmental positioning and caregiver assistance.
- **Solution:**
- Provides increased control over the location and orientation of their devices.
- Joints can be indexed to hold position.
- Mount compensates for electronic device weight.
- Mount folds for compact storage on wheelchair.

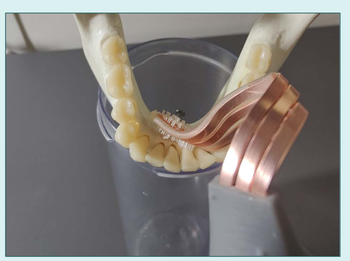
Power Straw



- **Problem:** Eating is limited by fused positions of the arms/jaw. Pureed foods are easier to eat through a closed jaw. No current devices effectively deliver the food without manual suction.
- **Collaboration Impact:** *"With the jaw locking… you have to* **have** *somebody else feed you… but it's easier to figure out how to feed yourself." [FOP client expert]*
- **Solution:**
- Motorized device eliminates need for manual suction.
- Allows user full control over the rate and flow of food.
- Refillable pouch personalizes food choice.
- Straw provides flexibility in positioning.

Oral Hygiene Tool

- **Problem:** Many dental tools are too large to reach in between a fused jaw to clean the backs of teeth, leading to plaque buildup and health complications.
- **Collaboration Impact:** Idea for supplemental device for routine described by one FOP client expert like a *"Pipe cleaner with a wire so thin and bristles on the outside."*



- **Solution:** Features a thin, flexible head that can be contoured to the back of teeth via tongue, and a telescoping handle for variability in arm positions.

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