



Easy-PASS Chair

Pediatric Adjustable Seating System

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SCAN ME

Background

What are pediatric videofluoroscopic swallow studies?

- Enable providers to identify patient's difficulties with swallowing in order to reduce risks through interventional surgeries or feeding tubes
- Take X-rays in real time while patient swallows liquids/foods mixed with barium
- Often performed on kids with developmental and/or birth defects, but swallowing issues may arise later in adolescence due to late-onset disease or a traumatic brain injury



Fig. 1. Swallow study X-rays
<https://ofvcat.com/rails/spdv>

Problem Statement

The chair currently in use at Vanderbilt Children's Hospital is:

- Unstable and unsupportive for children with motor deficiencies
- Incompatible with other medical machinery
 - X-ray arm restricts width to 19" and has 28" vertical range of motion
- Not adjustable for patients of different ages and sizes



Fig. 2. Current chair/system in use for VFSS

Needs Assessment & Clinician Feedback

- Primary design focuses:
- Must fit within the design parameters without compromising stability
 - Must be able to safely support children from a newborn infant to a 6 ft, 200 lbs child
 - Must be easily operated and frequently sanitized by clinicians

Needs identified by the clinicians:

Design Aspects (1-5; 1=low priority)	Mean Score
Child-friendly design	3
Removable tray built-in	2.5
Head and trunk braces	3.75
Ability to recline	5
Seat belt strap	5
Adjustable height	3.5

Prototype - SolidWorks CAD Model

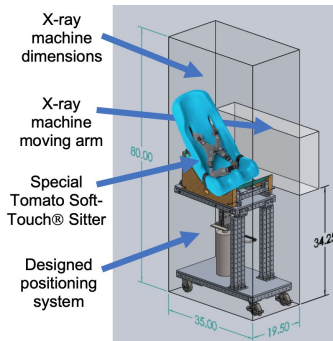


Fig. 3. CAD model of prototype with dimensions and restrictions of X-ray machine used for swallow studies

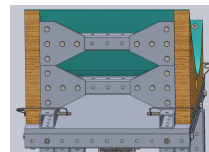


Fig. 4. Back view: adjustable rails and pin-lock system

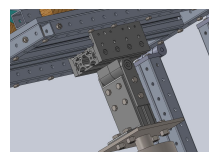


Fig. 5. Hinge allows for rotation as hydraulic lift raises/lowers



Fig. 6. Full-size prototype with Special Tomato Soft Touch Sitter (designed for special needs children)

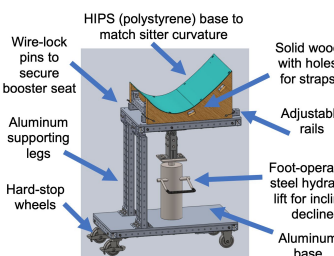


Fig. 7. CAD prototype of Easy-PASS Chair, assembled from custom-made parts and parts available from McMaster-Carr

Economic/Market Consideration

What are potential markets and economic implications?

- Primary functionality designed for imaging procedures
- Target customers would include imaging centers and Hospitals with pediatric departments
 - 6,146 US Hospitals (1/20 are Children's)
- Networking Channels include:
 - Medical Conferences
 - Physician Forums
- The device costs about \$1800 to manufacture
- The key value added by our product is the customization based on size constraints and physician preferences and thus price may vary

Performance Prediction & Safety/Risk Analysis

Shear Force and Bending Moment Diagrams

Reclined

Upright

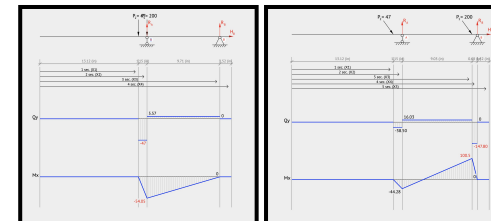


Fig. 8. Shear force and bending moment diagrams for positioning system at its extremes: fully reclined (L) and fully upright (R) while holding a 6 ft, 200 lb male

The above diagrams represent the analysis of the positioning system at its extremes (fully reclined and fully upright) while holding a 6 foot, 200 pound male. The hydraulic lift can hold up to 800 pounds and the front supports are rated for over 1,000 pounds, both which far exceed the maximum reactionary forces. Additionally, articulating between the extremes of the chair displaces the 200 lbs. male's center of gravity by fewer than 10 inches, confirming the chairs ability to remain stable regardless of the patient or position.

Conclusions & Discussion

Our team has designed, prototyped, virtually constructed, and mathematically confirmed the utility and functionality of the Easy PASS Chair. Due to the COVID-19 outbreak, we are unable to deliver a final physical product and have requested this seating system become a legacy project. In doing so, we:

- Created a professional CAD file of the entire seating system
- Conducted failure analyses on this virtual model using real parts and systems from McMaster Carr
- Communicated with the VFSS clinicians and confirmed appropriate future directions
- Drafted clear, detailed instructions for the incoming design team

This project is not possible without support from the VFSS clinicians, Dr. Matthew Walker III, and Dr. Kevin Galloway. Thank you.