Designing a G-tube Stabilizer: A Device to Stabilize the Percutaneous Endoscopic Gastrostomy (PEG) Tube Stoma

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Summary of Project

G-tubes are inserted into the stomach through a stoma on the surface of the skin where it can produce an inflammatory response due to friction or an infection of the skin due to open exposure at the site of insertion. Since g-tubes currently cannot endure that much mechanical stress, breakage of the g-tube is also a major risk. The g-tube stabilizer is a device that we have designed to prevent the issues listed above from arising and to maximize the effectiveness of g-tubes.

Background

- G-tubes are used by individuals of all ages for a variety of medical purposes to directly deliver nutrition, medication, and fluids to the stomach while bypassing the mouth and esophagus.
- There are limitations associated with the current attempts at a solution including break-way PEG tubes and balloon g-tubes. Break-way PEG tubes lack the ability to reinforce the tube to the insertion site and balloon g-tubes do have the possibility of the balloon breaking or deflating.

Depiction of a G-tube

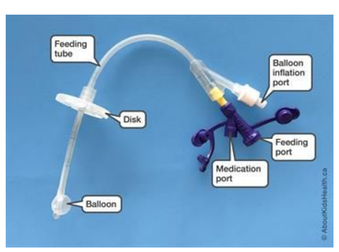


Diagram of a setup of a g-tube. (2018). *Retrieved from https://www.aboutkidshealth.ca/Article?contentid=2908&language=English*

Design Goal

The purpose of our design project is to design a device that will resolve the issues associated with g-tubes at the moment and address the limitations of current attempts at a solution.

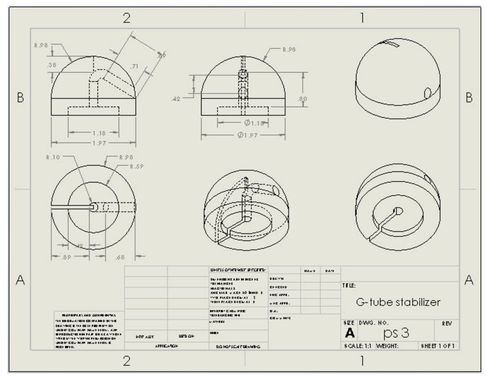
Key Design Criteria

G-tubes often cause immense discomfort and restrict mobility, thus the first criterion is that the g-tube stabilizer should be as compact as possible to maximize mobility while retaining the functions of g-tubes.

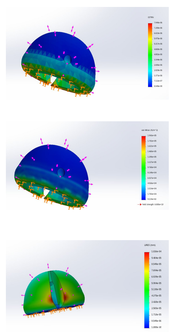
To significantly reduce the occurrence of g-tube breakage, our second criterion is that the stabilizer must be able to withstand substantial mechanical stress from external forces.

The third criterion is that the device we design should prevent irritation/inflammation and buried bumper syndrome. Hence, the stabilizer should be comfortable and not irritate the patient at the insertion site.

Schematics



CAD Design of Stabilizer

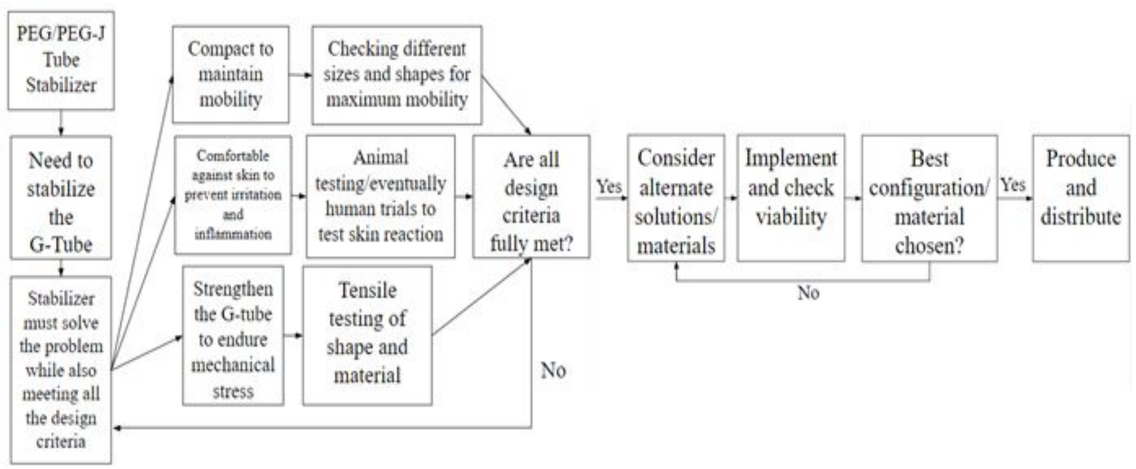


Strain

Stress

Displacement

Flow Chart for the Iterative Process of Design (showing tests needed)



Detailed Design and Relevant Testing

- We will be integrating cellulose fibers in our rounded hub design over the insertion site.
- Biocompatible adhesive under the bumper to attach to the skin without irritation arising.
- Create multiple models of the same design and minimum size, but different materials.
  - Choose the strongest material.
- Create a custom material on CAD that has the properties of cellulose fibers which allows us to model how it would perform. This is demonstrated under schematics.
- Test comfort and irritation by having the patients experience the stabilizer themselves.

Conclusions

- Our solution for a g-tube stabilizer:
  - Rounded hub over the insertion site, tube, and adjustable bumper to guard the stoma
  - Stronger, reinforced materials to prevent breakage
  - Comfortable, biocompatible adhesive
- Limitations:
  - Only the base is stabilized
  - Price point and weight of the hub were not considered and it may be too heavy, especially for children
- Possible fixes:
  - Develop an extension that covers the tube
  - Further research into different possible materials that are cheaper and/or lighter

Key References

Gammon, K. (2018, June 19). World's strongest biomaterial now comes from a tree. Retrieved from https://cen.acs.org/materials/biomaterials/Worlds-strongest-biomaterial-comes-tree/96/web/2018/06.

Kaneshiro, N. (2019). Feeding tube insertion - gastrostomy: MedlinePlus Medical Encyclopedia. Retrieved 30 September 2019, from https://medlineplus.gov/ency/article/002937.htm

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