DEVELOPMENT OF A NEONATAL CANNULATION TRAINING SIMULATOR FOR ARTIFICIAL PLACENTA CONNECTION

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1. Introduction

The ArtPlac project aims to develop a combined lung and kidney support system for critically ill preterm neonates. This device will be connected through umbilical cannulation. A neonatal cannulation simulator is designed to aid in the cannula development and training for this procedure. Previous research determined that more flexible materials are needed for mimicking the umbilical arteries, the umbilical vein, and Wharton's Jelly in the simulator [1].

2. Objectives

The aim of this project is to define materials and design properties to develop vasculature models and simulated umbilical cords for use in a realistic neonatal cannulation simulator.

3. Methods

Shore hardness and puncture force tests were conducted on fresh human and piglet umbilical cords. The umbilical vein, umbilical arteries, and Whartons Jelly were tested using a durometer and a force meter with 3 repetitions per measurement over 7 umbilical cords. Mechanical properties of 3D-printed blood vessels were compared with real umbilical vessels and evaluated for further umbilical cord development.

4. Results

The 3D-printed vessels showed a relative shore hardness of 81 A compared to 82 A in real umbilical vessels. The puncture force in the printed arteries showed 1.9 N compared to 2.1 N in real umbilical arteries, where the printed veins showed 1.6 N compared to 4.6 N in real umbilical veins.

5. Conclusion

3D-printed vascular models successfully mimicked the relative shore hardness required for umbilical vessels and the puncture force required for the umbilical arteries. Nevertheless, a higher puncture resistance is required for the printed vein.

6. References

1. *Woerd, L.G. (2024), Development of a Neonatal Umbilical Cannulation Simulator: Design and User Validation, Master's Thesis, University of Twente.*