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Promoting Technology and Collaboration

Development of Dynamic Patient-Specific ED Thoracotomy Model for Surgical Training

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Background: The role of effective simulation continues to be of great importance, particularly in preparation for complex scenarios. One such lifesaving procedure is the left-anterolateral thoracotomy or emergency department (ED) thoracotomy, employed as a last resort for trauma patient resuscitation. Low survival rates raise the importance of expertise and efficiency, but the paucity of educational opportunities for trainees makes each patient presentation a unique opportunity for both resuscitation and training. The range of current models varies in cost-effectiveness and levels of fidelity, but most designs only serve to highlight the steps involved at the expense of practicing specific maneuvers. We present a dynamic ED thoracotomy model with compliant ribs to allow trainees to practice maneuvers such as spreading the ribs.

Technology Overview: A 3D model of the ribs was acquired from an open-source 3D model repository and modified in Meshmixer and Autodesk Fusion360. Pegs in the costal cartilage region beginning on the 4th, 5th, and 6th ribs were implemented to attach extension springs to mimic cartilage compliance. The new rib model was then resin-printed within 24 hours. The proposed spring joint method allows rotational movement of the ribs in three dimensions and simulated rib compliance force.

Potential Application in Surgical Simulation and Education: Users can spread the ribs as they would do in a real ED thoracotomy case. The model has high fidelity, dynamic, requires a short turnaround time, and is scalable and customizable.

Potential Opportunities to Collaborate: The proposed model is the result of collaboration with surgeons, residents, simulation experts, and engineers. Future work includes continued collaboration with surgeons, engineers, simulation experts, and cardiologists to introduce a heart model for a full ED thoracotomy simulation.

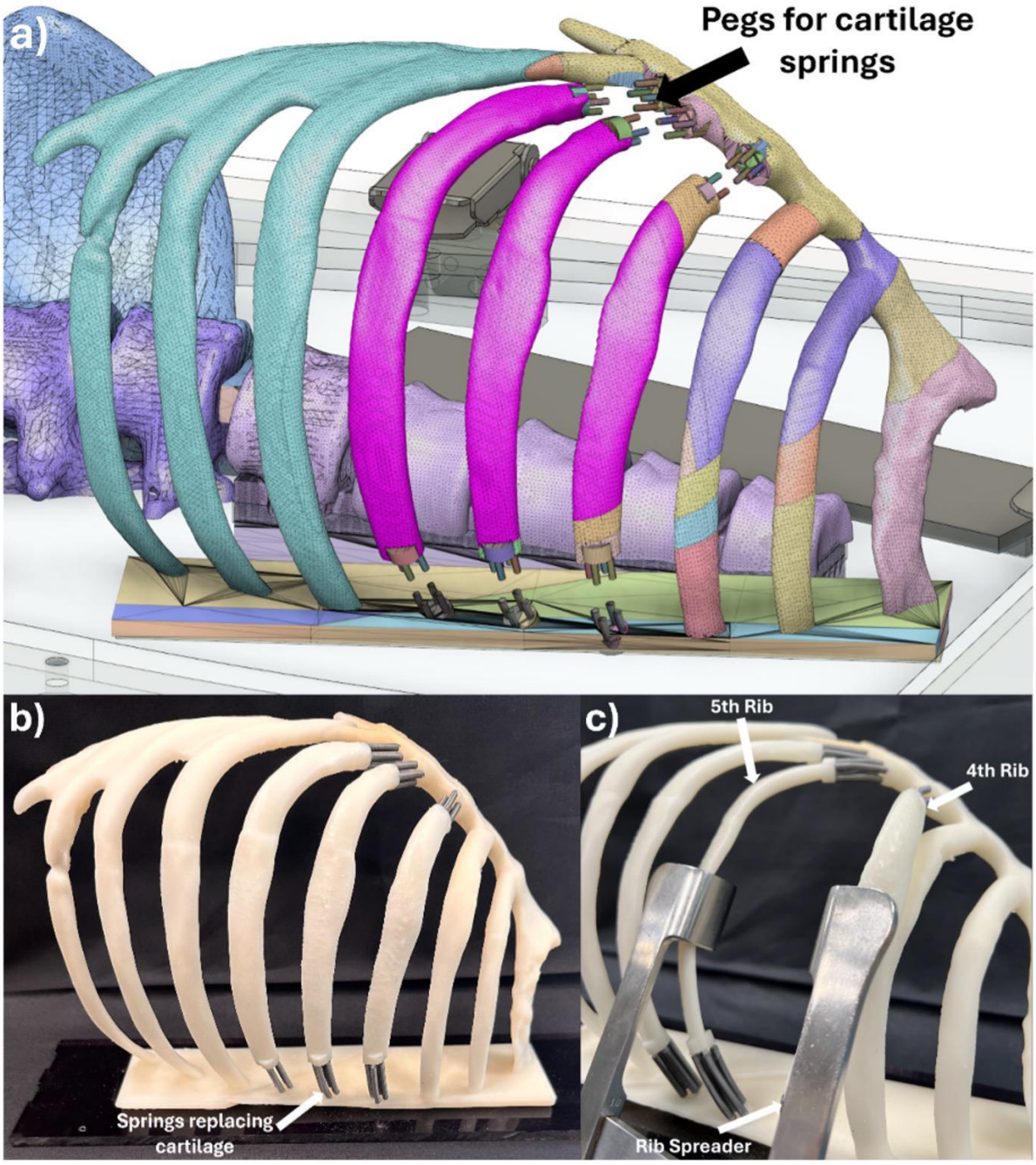

Figure 1. a) 3D design of thoracotomy model with modified pegs, b) resin-printed physical model with springs, c) demonstration of model with rib spreaders.