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Anatomical pediatric model for craniosynostosis surgical training

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Introduction: Several simulators have been created as a tentative to improve the learning curve of the residents in neurosurgery and plastic surgery. However, there are many limitations for craniosysnostosis surgical simulation. To represent the pathological condition presence, to obtain the ideal resistance and consistence of the bone and to simulate the craniotomy so far can be considered notable challenges.
Indeed, the laboratory training is fundamental for acquiring familiarity with the techniques of surgery and skill in handling instruments. By the other side, the adequate craniosynostosis surgical anatomical model should be able to present all required steps of surgery, from the patient position, correct identification of anatomical landmarks to the depth perception and skin closure.
The aim of this study is to introduce a new simulator for craniosynostosis surgical training, specifically for the scaphocephaly type.

Methods: This real simulator is built with a synthetic thermo-retractile and a thermo-sensible rubber which, when combined with different polymers, produces more than 30 different formulas. These formulas present textures, consistencies and mechanical resistance similar to many human tissues. Regarding the anatomical aspects, the skull shape is based on Computerized Tomography (CT) images of a real patient (six-month old female), thin slices, that allowed the tridimensional reconstruction.
The fiberglass moulds, in the shape of the skull, constituted the basic structure of the craniosynostosis module trainer. It is possible to perform CT scan due to the radiopacity of this simulator and, consequently, to compare the pre and post operative images.

Results: The authors presented a training model to practice the biparietal remodeling used in the scaphocephaly correction. The Renier's "H" Technique was selected to test the simulator and it was operated by three experienced surgeons to evaluate its practical applicability. It was possible to simulate from the patient's positioning until the own surgery.
The experienced surgeons could observe multiple possibilities to practice such as: the skin incision; the subcutaneous and subperiostal dissection; the osteotomies, and finally the cranial remodeling with absorbable microplates. The presence of superior sagital and transversus sinus filled with liquid could simulate emergence situations with bleeding, a possible risk during this specific approach.
They noticed that the scaphocephalic cranial shape, the consistence and resistance of the bone and the dissection of the plane were very similar to the real surgery.
Thereby, this craniosynostosis simulator could be used successfully during teaching purposes.

Conclusion: At present, there is no available real simulator with these anatomical and technical characteristics for craniosynostosis surgical training in pediatric neurosurgery.
The authors conclude that this training model can represent a fairly useful method to accustom trainees to the required surgical techniques and simulates rather the steps of a standard surgery for scaphocephaly.
This training provides an alternative to use the human cadavers and animal models. Besides, they have no ethical objections, there is no risk of the exposition to toxicity during the training and they can be used in Computerized Tomography equipments without any kind of restriction.
Furthermore, it can represent the anatomical alteration precisely as well the surgical emergence situations.
Therefore, it is important to emphasize that this simulator can be extremely useful to abbreviate the learning curve during the qualification of young surgeons. The future perspectives can be considered excellent because not only other surgical techniques can be applied (as the endoscopic approaches) but also the possibility of errors in operating room can be reduced significantly.