

Suitability of Fix4Life Cadavers for Medical and Surgical Training and Comparison with Fresh-Frozen and Formalin Fixed Preservation Methods

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Introduction: For centuries now, cadaver training has been a pillar of surgical education. Two methods of preservation for surgical training are ubiquitous nowadays: formalin-fixation and freezing (fresh-frozen cadavers). Each offers its own unique advantages and disadvantages¹ (fig. 1). Fix4Life (F4L) is a novel fixation method, introduced in 2015, which promises a long-lasting and lifelike preservation of morphology², effectively combining the benefits of formalin fixation and fresh-frozen preservation. The effectiveness of F4L cadavers for medical and surgical training is still unknown. The purpose of this study is to evaluate the suitability of F4L cadavers for medical and surgical training and simulation.

Method	Advantages	Disadvantages
Formalin	Long-term preservation Minimal infection risk Low Cost	Stiffening of tissue Discoloration Health hazards
Fresh-frozen	Flexible joints and tissues Realistic color Minimal tissue change	Rapid putrefaction Risk of infection High costs

Fig. 1 Advantages and Disadvantages of Formalin and Fresh-frozen preservation

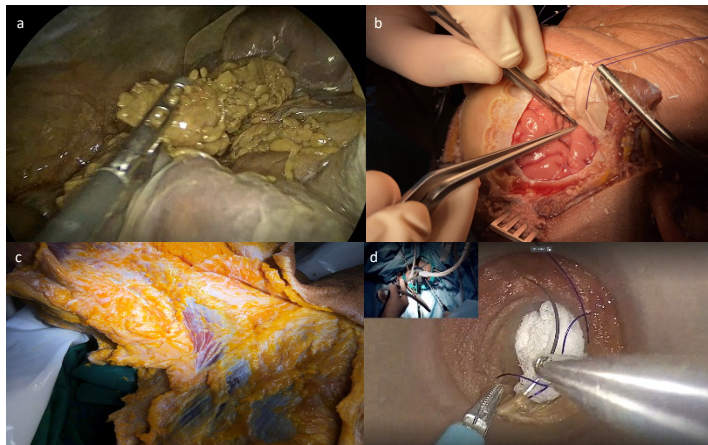


Fig. 2 Various procedures, which have been done in our institute with F4L Cadavers. A. Laparoscopic complete mesocolic excision (LapCME). B. Craniotomy and manipulation of cerebral blood vessels. C. Dissection of the trapezius from posterior. D. Transanal total mesorectal excision (TaTME).

Methods: A F4L cadaver was prepared in November of 2020. Since then, 19 surgeons and anatomists have worked with this cadaver (fig. 2). These included general surgeons, neurosurgeons, ENT surgeons, and orthopedics. Their experience levels ranged from students to department heads. We created a questionnaire to evaluate their experience with F4L, as well as with Formalin-fixed and fresh-frozen cadaver. Participants were asked to rate, among other things, statements about the gross anatomy, feel, look, and suitability for medical training, for each preservation method. These questions utilized a Likert scale to show level of agreement with each statement (e.g. Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree). For the statistical analysis, the answer choices were converted into a nominal one to five scale, with five being the highest level of agreement and one being the lowest.

IBM SPSS Statistics for Windows, version 28 (IBM Corp., Armonk, N.Y., USA) was used for the statistical analysis of the responses.

Results:

16 of the 19 participants filled out the questionnaire. The profile of the participants can be seen in fig. 3. Figures 4,5, and 6 highlight the average score for each parameter, each specialty, and the total average score for each preservation method, respectively. Fig. 7 represents the preferred preservation method of the participants.

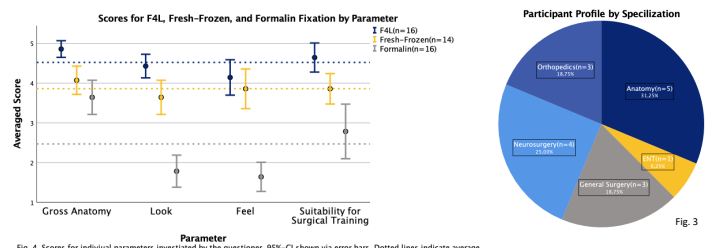


Fig. 4. Scores for individual parameters investigated by the questionnaire. 95%-CI shown via error bars. Dotted lines indicate average score across all four parameters for each preservation method. For each investigated parameter, F4L received better average scores than fresh-frozen and formalin-fixed cadavers.

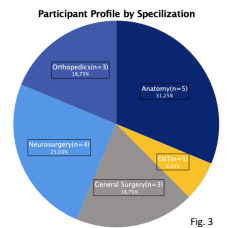


Fig. 3

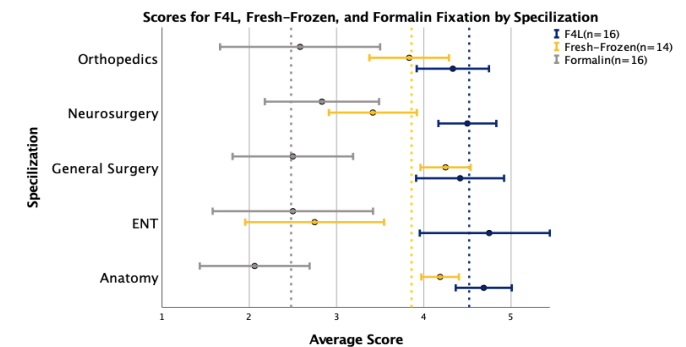


Fig. 5. Scores organized by medical specialization of participants. 95%-CI shown via error bars. Dotted lines indicate average scores across all specializations for each fixative. F4L outranks fresh-frozen and formalin-fixed cadavers for every specialization.

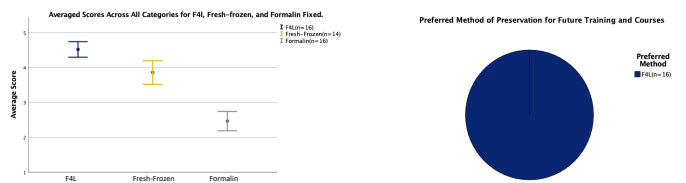


Fig. 6. Total average scores across all parameters and specialities.

Fig. 7. Given the choice between F4L, fresh-frozen, and formalin-fixed cadavers, 100% of the participants indicated, that they would choose F4L for their future courses and trainings.

Conclusion: F4L provides a comparative, if not in certain aspects better, morphology to formalin-fixed and fresh frozen cadavers. Our survey showed that fix4life cadavers are not only a suitable model for surgical and medical training, but might even provide a better model than fresh-frozen and formalin-fixed cadavers. As this method of fixation provides benefits not conveyed by other methods of preservation, especially for training within the neurosurgical domain, further studies should be conducted to establish validation, safety, and standardization.

References:

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- van Dam, A., van Munsteren, C. and de Ruiter, M. (2015), Fix for Life. The Development of a New Embalming Method to Preserve Life-like Morphology. *The FASEB Journal*, 29: 547.10.