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ORIGINAL ARTICLE

Silicone injected cadaveric head for neurosurgical dissection: Prepared from defrosted cadaver

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ABSTRACT

Background: Most reports of cadaveric specimen preparation for neurosurgical dissection describe methods using fresh cadavers. Our cultural limitations prevent us from obtaining fresh cadaveric heads.

Objective: To study and report on an alternative method of preparation of head specimens for neurosurgical dissection using defrosted cadavers.

Materials and Methods: Twenty-four head specimens were procured through the Department of Anatomy, received by donation three to seven days after funeral activity. The specimens were sectioned through the neck, and preserved by refrigeration at a temperature of -10°C for a period of one week to three months prior to preparation. The process began with defrosting the frozen head specimens for 48 hours in a refrigerator, in which the temperature was controlled within the range of -2° to -8°C. The great vessels were identified and cannulated. These were then irrigated with tap water until clear, following which colored silicone was injected. The specimens were preserved in 95% ethyl alcohol, and were assessed for quality one week after the preparation process. They were then re-assessed at monthly intervals for 12 months.

Results: When compared with specimens prepared from fresh cadavers, our method provided similar quality specimens for dissection. The scalp and muscles of all specimens remained soft. The vasculature was good, and the colored silicone made identification easy. The brain tissues were soft and easily retracted, and still in good condition for dissection after a long preparation period (12 months).

Conclusion: The head specimens prepared with this method were of good quality for dissection, and were comparable in quality to those prepared from fresh cadavers as in published methods. We were thus able to provide a suitable substitute to fresh head specimens in situations where access to fresh cadavers is unavailable.

Key words: Defrosted cadaver, neurosurgical dissection, silicone injected cadaveric head

Introduction

Cadaveric dissection remains the best available method for understanding human anatomic features, and to refine the various surgical approaches and skills needed by neurosurgeons and neurosurgical residents. Preparation of well-preserved and injected cadaveric heads is an important step toward more meaningful anatomic dissection.[1] However, local cultural limitations prevent us from obtaining fresh head specimens for preparation. Thus, we report on a new technique for preparing defrosted head specimens for cadaveric dissection.

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Materials and Methods

Following three or more days of funereal activity by the deceased's relatives, most donated bodies would reach the Department of Anatomy after three days. The dead body would be in a cold coffin in which the temperature was controlled at about 8°C without any preservative material injection during the funeral activity. After the body reached the Department of anatomy, the head was sectioned through the neck and refrigerated at -10°C until the preparation for dissection began. Storage times ranged from one week to three months. Specimen preparation began by defrosting the frozen head at a temperature of -2 to - 8°C for 48 hours. Then the following steps were completed:

1. Identification of the internal carotid arteries, vertebral arteries, and jugular veins on both sides. All vessels were cannulated with appropriately sized plastic tubes and

tightly affixed with 2-0 silk.

2. Irrigation of all vessels with tap water at room temperature to wash out any clotted blood. The flow rate of the tap water was low initially, then slowly increased until clear fluid flowed from the vessels on the other side. This took between 30 minutes and 1 hour. All leakage through muscular and subcutaneous branches was secured with silk ligation [Figure 1].
3. Red and blue colored silicone was prepared and injected into the main arteries and veins (compositions shown in Table 1). The injection was given with a 50 cc syringe into one side of the main vessels, with the contralateral vessels left open. Injection continued until a free flow of mixture escaped from the open vessel.
4. Each specimen was preserved in a bucket of 95% ethyl alcohol bucket until dissection, which occurred about one week to three months after the complete preservation process.

After dissection activities, the specimens were again placed in the 95% ethyl alcohol buckets, and were observed monthly for good dissection qualities.

Results

All preserved cadaveric specimens were in good conditions for dissection. The soft tissue, scalp, and muscles had a soft consistency and minimal toxic odor. The brain tissue was soft and easy to retract in all cortical areas [Figure 2]. In deeper locations, especially in the periventricular area, the brain tissues of five specimens appeared to have areas of liquefaction. All the injected cerebral vasculature including the external carotid arteries and their branches, the internal carotid arteries and the cortical vessels were in good condition and filled with red silicone. The venous system was in similar good condition; the major cerebral veins and the dural sinus filled with blue silicone. After one year of observation, the specimens remained in good condition for dissection with no significant change in quality. This method of preparation yielded specimens comparable in quality to those using the conventional method, and is better suited in situations where there is no access to fresh cadavers.

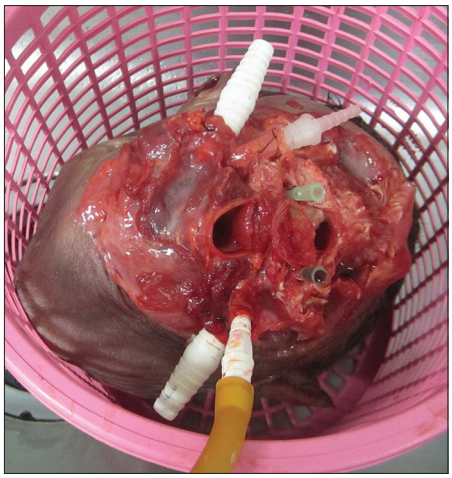

Figure 1: A specimen after cannulation, and during irrigation process

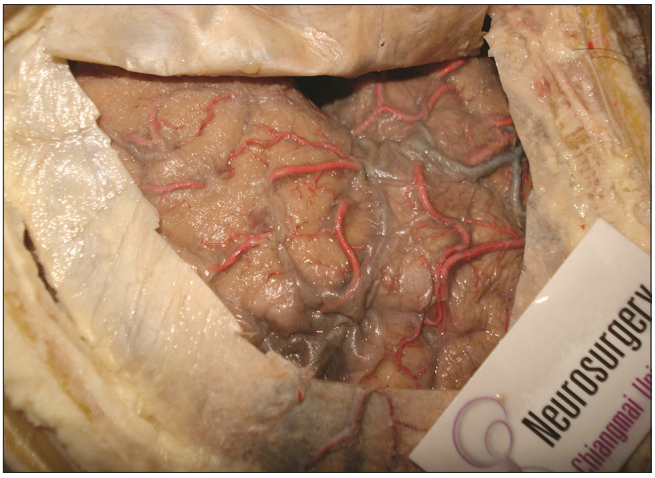

Figure 2: Soft tissue, bone, cortical surface and vasculature of the right fronto-temporal area of a cadaveric head prepared from a defrosted specimen

Table 1: Composition of colored silicone for cadaveric head injection

	Silicone (cc)	Catalyst (cc)	Thinner (cc)	Color powder (cc)
Blue	100	10	75	60
Red	50	10	50	60

Discussion

Cadaveric head preparation is very important prior to dissection. The desired properties are: Good long-term structural preservation with minimal distortion, no desiccation, no bacterial or fungal growth, and minimal environmental chemical hazards.[2] The embalming fluid mixture used to preserve the cadaver is an important factor in achieving both good dissection properties, and long term preservation. Formaldehyde has been the main component in embalming fluids since the late 19th century due to its excellent preservation properties, low cost, and ready availability.[3] On the other hand, formaldehyde solutions have a toxic smell, produce undesired tissue rigidity, and there are major risks of malignancy development from formaldehyde exposure.[4] Coleman *et al.*[2] and O'Sullivan *et al.*[5] worked to reduce the amount of formaldehyde while maintaining good preservation results. Sanan *et al.* reported good long term preservation over two years with 66% ethyl alcohol solution. We obtained good results when preparing fresh cadaveric heads using the earlier published method described by Sanan *et al.*,[1] but with defrosted, non-fresh cadavers we experienced a problem of decay. This may have resulted from bacterial overgrowth during overnight vascular irrigation using the conventional method,

which may have rendered it unsuitable for the defrosted cadaver. In our method, the major differences in technique (compared with conventional methods) include: (1) shortening of the vascular irrigation time, (we irrigated only until clear fluid was obtained from the contralateral vessels) to prevent specimen decay from bacterial over growth, which may follow longer irrigation; (2) leaving the contralateral vessels open while colored silicone was injected. This allowed reduced effort to inject the colored silicone into the vessels, yet still achieving had good vascular filling; and (3) preserving the specimens with 95% ethyl alcohol, which is readily available. The liquefaction of the deep brain tissue in the periventricular region in five specimens may be the result of the defrosting process, or decay prior to the preservation procedure.

Conclusion

Our method of preparation yielded specimens in good condition for dissection and with qualities comparable to those prepared using methods published earlier. However, our method is better suited for those situations where access to fresh cadavers is unavailable, or requires additional expense.

Disclaimer

The authors report no conflict of interest concerning the materials or methods used in this study, or with the findings specified in this paper.

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