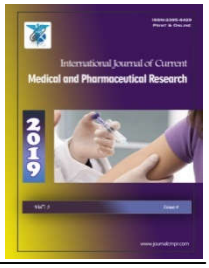
Research Article

INTERNATIONAL JOURNAL OF CURRENT MEDICAL AND PHARMACEUTICAL RESEARCH

ISSN: 2395-6429, Impact Factor: 4.656
Available Online at www.journalcmpr.com
Volume 5; Issue 04(A); April 2019; Page No. 4123-4125
DOI: http://dx.doi.org/10.24327/23956429.ijcmpr201904637



MODIFIED LARSSEN SOLUTION (MLS) FOR CADAVER DISSECTIONS: FROM THE PLASTIC SURGEON ASPECT

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ARTICLE INFO

Article History:
Received 10th January, 2019
Received in revised form 2nd February, 2019
Accepted 26th February, 2019
Published online 28th April, 2019

Key words:
Cadaver, Dissection, Nose,Plastic Surgery,Rhinoplasty, Otolaryngology.

ABSTRACT

Although there are many types of cadaver embalming, most of them don't give a real tissue feeling, that is especially important for surgical education. Nevertheless, fresh frozen cadavers are the most used types for such hands-on courses. However, techniques with embalmed cadavers have been started to be used recently. One of these techniques, embalment with MLS is used in Ege Uni-versity. Dissections on such cadavers were evaluated in this study with a suitable questionnaire, and significant results were obtained, in favor of MLS' advantages.

INTRODUCTION

Modern embalming technologies have been evolving since its first introduction by Ambroise Paré on the 16th century. With discovery of formaldehyde (FA) by von Hofmann on 1869, a leap forward came [1]. Its long-lasting preservation effect was highly suitable for this purpose. However, FA has many disadvantages also. It is known to be a hazardous material for human body. It causes acute toxicity such as dermatitis, tissue necrosis, allergic reactions, mucosal irritation, pulmonary complications, nausea and dizziness [2-4]. Additionally, in 2006, the International Agency for Research on Cancer and the US Environmental Protection Agency (IARC) classified formaldehyde as a probable human carcinogen [2]. As a common additive of these solutions, FA is still a major preservative because of its low cost and high fixative efficacy. But other ingredients of novel techniques still alter the cost, and high costs of preserving cadavers still confuse the scientists.

A novel technique with low costs, which have been used in veterinary medicine, was modified to use on human cadavers, recently. It was shown that a solution called "Modified Larssen Solution (MLS)" preserve the cadavers without distorting the tissue strength and adherence with low costs. A study introducing human cadaver dissection courses of MLS-cadavers has been introduced from our facility, endorsing the use of MLS on surgical courses [5]. Thus, we tried to investigate this technique and aimed to clarify if it is suitable for plastic surgery training courses.

MATERIAL AND METHOD

11 MLS and 7 10% FA embalmed cadavers were dissected by two experienced plastic surgeons for nasal base anatomy. Both surgeons evaluated all the cadavers separately for tissue properties, by a questionnaire built by the researchers, depending on Bilge&Celik's study. The feel of the dissected MLS-tissues were compared with living human tissues encountered every day in the operating room and 10% FA fixed cadavers by a 10-point Likert-scale questionnaire. Also, previous experiences with fresh frozen cadaver (FFC) dissections were included to the evaluation. After each dissection, surgeons filled the form (**Table 1**). Questions were evaluated and applied to statistics separately. Results were compared statistically with by TY statistics ver. 01 (http://www.tyevolution.com/pd.jsp?id=14#_pp=2_306).Points for all the questions' answers were evaluated separately with Shapiro-Wilk test for distribution. Results showed statistical normal distribution. Therefore, Mann-Whitney-U test was performed.

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RESULTS

MLS cadaver questionnaires revealed mean values of 8.91, 9.218, 1.55, 8.77, 9.14 points with 0.80, 0.34, 0.69, 0.65, 0.50 SDs, respectively. 10% FA cadaver dissections had mean values of 2.57, 5.14, 9.07, 2.71, 1.93 points with 0.91, 0.77, 0.35, 0.54, 0.47 SDs, respectively. The statistics revealed significant differences between all of the parameters ($p<0.01$).

Table 1 Evaluation form for scaling the dissection experience.

Please give a score to the topics below between 1 to 10.
Pliability, color, tone and texture of tissues are live-like.
Quality of tissues is suitable for surgical methods.
Disturbing smell and mucosal irritation.
My experience is better than my previous fresh cadaver experiences.
MLS/F10 preserved cadaver dissection is almost similar to real tissue dissection.

DISCUSSION

In spite of the high costs, cadaveric surgery courses are still a must for surgery residents. It was shown to raise self-esteem in the operating room. Additionally, it was shown that autonomy can be gained by cadaveric dissections [6]. In this way, with confidence of no adverse effects on the patient, especially residents can learn new operative techniques and strengthen their current skills. MLS was introduced in Silva's work on 2007 [7]. Lowering the FA amount, this solution also preserves the tissue planes without sacrificing the aseptic properties, with the help of chloral hydrate and salts [5]. On the other hand, because awful odour of FA is disposed of the solution, the dissections could be made much more comfortably.

There are many techniques to embalm and preserve cadaveric tissues. Classically, FA is a widely known agent of fixation. Despite it has very useful advantages, high concentrations are known to cause mucosal irritation and complicate any intervention on the cadaver [9]. Moreover, it causes discoloration, distortion and stiffening in tissues [8]. Cheapest choice is this one, but it is not a suitable technique for surgical courses.

Fresh-frozen cadavers (FFC) are the most commonly used cadavers for this purpose recently. Pioneer countries of medical science mostly use FFCs [10]. As we experienced before, it is financially disadvantaged, in addition to risk of infections [6, 11]. Additionally, freezing process probably break the bonds between the tissues, the texture of the tissue gets battered and eventually, it loses the support of tissue turgor on skeletal hardware. Repeated thawing causes the tissue bridges to break further. When reused, FFCs lose much of the tissue support. In a study, cryopreservation was shown to have less traction force of brain to solutions which includes FA [2]. However, we examined the loss of tissue quality especially when after we osteotomised the nasal bone. Because of the lack of support and turgor, we observed that it had tendency to collapse into the aperture, rather than sitting on to the lateral wall. We tried osteotomies on MLS-cadavers. Osteotomised nasal bones stood still on the frontomaxillary buttress and didn't collapse towards the nasal cavity, with the support of soft tissue turgor.

The expense to attend in an FFC course financially overwhelms the earnings [6, 11]. FFC courses as most commonly used, force scientists to pay high costs or seek financial supports for this training-learning method. However, as previously described, different methods of embalming can eliminate this difficulty. Therefore, techniques have been described to mimic surgical techniques within both the anatomical relations and the tissue texture. Additionally, because the chemicals distort the tissues to fixate them, solutions to aim this problem have been suggested.

One of the most fashionable method is Thiel's method, which was introduced on 1992. This method has been advocated to preserve the cadaver without any distortion of tissues, even with the statement "*it feels just like a patient, just colder"* [8]. Hence, it is defended for being a suitable method for cadavers that will be used for surgical courses. Yet, it is still not the best option, because of its cost is exceeding $330 per cadaver, while costs of the same amount of MLS do not exceed $70 [2, 5]. In our experience, a facelift and rhinoplasty course with use of imported cadavers (head only) costed as much as $1800 for one head. However, if it was embalmed with MLS, that heads' cost could be reduced by using them in multiple courses for different specialties, such as otolaryngology, neurosurgery, cardiovascular surgery or ophthalmology, instead of use as FFC in one course. This could highly reduce the costs, even to $150 *per capita* [2, 5]. Moreover, the specimens can be used again as educational materials in license education.

In our study, we evaluated two experienced surgeon's perspectives on dissections of the MLS-cadavers and 10% FA-cadavers. The questionnaire which was used for this study, originated and modified from Bilge&Celik's study [5]. It was not statistically evaluated. However, it may be a starting point for such a quastionnaire. Our future studies will focus on improvement of this questionnaire for its use in further studies. Statistical analysis showed a better dissection experience on MLS-cadavers than 10% FA cadavers in all aspects of our evaluation. Additionally, although no fresh cadavers were used in this study; previous experiences of the surgeons indicate that a better dissection quality was perceived with live-like tissue quality and color. Further analysis with more accuracy can be done between MLS and FFCs in different aspects in the future.

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How to cite this article:

Yegin, Mehmet Emre *et al* (2019) 'Modified Larssen Solution (Mls) for Cadaver Dissections: From the Plastic Surgeon Aspect', *International Journal of Current Medical and Pharmaceutical Research,* 05(04), pp 4123-4125.

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