



VISUALIZATION OF KNEE ARTHROSCOPIC STRUCTURES ON CADAVER WHICH IS EMBALMED BY USING THIEL SOLUTION

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ABSTRACT

Objectives: a) To provide a composition of body-preservation fluid which is effective in providing lifelike flexibility of knee joint and which is also non hazardous for surgical procedures and environmentally safe.

b) To compare the flexibility of knee joint after using thiel solution and traditional formalin solution for visualizing intra capsular structures of knee joint

METHOD- 3 cadavers 2 male and one female cadavers were selected for this study. embalming was done by Walter Thiel solution. 10 liters embalming fluid was injected in the body. later body was kept in mortuary up to 4 degree temperature. Remaining 25 cadavers were embalmed by using traditional formalin solution. We had used portable pressure sprayer which was connected to carotid artery for speedy embalming process.

RESULTS - Thiel cadavers were found to be soft than formalin which were found firm and rigid. For joint flexibility, at least 86 % of delegate of workshop strongly agreed for Thiel and at least 80 % of the delegate of workshop strongly disagreed for formalin. Tissue colour was closer to natural in Thiel embalmed cadavers compared to the formalin cadavers. There were no complaints due to unpleasant odor in Thiel cadavers as commonly found with the formalin. At least 87% of participants had opinion that it was more easy and comfortable to identify structures in the Thiel cadavers than traditional formalin. Thiel embalming method offers good quality cadavers for arthroscopic procedures.

CONCLUSION- Thiel embalming method offers good quality cadavers that were found very soft, more flexible and the tissue colour was found very close to natural one. it was observed that it effectively disinfect the cadavers without any fungus formation. Formalin fumes are not detected in dissection hall.

KEYWORDS : Thiel embalming, knee arthroscopy.

INTRODUCTION:

Human cadavers have always been a best tool for the medical students for teaching and learning gross anatomy in dissection hall where the budding doctors found three dimensional structure of the human body which is learn by visual, auditory and tactile mode of perception. Embalming by using formalin prevents the growth of microorganisms which are responsible for the decomposition and putrefaction. usually we use 10% formalin as fixator. Formalin is easily available in the market and is economical. The most common fixative used is Formalin. But it is toxic and harmful to staff and students. The practice of surgical procedures on the joint of cadaver difficult because of joint stiffness. Traditionally, surgery has been taught and practiced on real patients while preparing for operations and during operative procedures some times also in the operating room. it is often time consuming, increase duration of operative procedures and also duration of anesthesia is prolonged. It may lead to some complications of patient and may some times lead to poor patient outcomes. soft-embalmed human bodies made using Thiel solutions are notable and more suited to train students for surgical procedures with maximum flexibility. Human cadavers are exceptional because they always show variation and give confidence to the learners to complete operations under the most realistic conditions.

It is observed by Walter Thiel that concentrations of 3 % formalin still caused tissue hardening and discoloration, while concentrations down to 2 % fail to preserve cadaver. Thiel solution mainly constitute formalin, ammonium nitrate, boric acid, chlorocresol, sodium sulphite and morpholine for embalming solutions. Use of this solution it was found that results after an embalming meets high standards of preservation of human body. The skin color and consistency of the tissues are very close to those of living Individuals. It shows maximum joint flexibility required for arthroscopic procedure. it was found that these cadavers can be preserved for a long period. It is observed that the embalming solutions are mostly odorless and doesn't cause any irritation of skin, mucosa and eyes. it was found that the Thiel solution remain stable on prolonged storage and it was observed that it effectively disinfect the cadavers without any fungus

formation. Formalin fumes are not detected in dissection hall.

Thiel solution is not easily available in market and it found to be more expensive but joint flexibility is very good with thiel solution embalming. It was found to be very useful for student teaching the surgical procedures. In this study we will compare muscle softness, joint flexibility especially of knee joint, color of intra capsular structures of knee joint formalin smell and level of difficulty to identify the structures between traditional formalin solution and thiel solution.

We had arranged workshop on hands on experience of arthroscopic surgeries in collaboration with orthopedic department. Traditional formalin embalming results in blackening of skin, joint stiffness that make visualization of intra articular structures of knee joint very difficult. So we had tried thiel solution for embalming.

Formalin based embalming results in tissue firmness and rigidity with very low joint flexibility, tissue tanning and discoloration of intra articular structures which results in failure in identification of most of structures of the joint. Dehydration of structure is also one of the problem we come across.

Thiel solution embalming gives soft tissue and maximum joint flexibility. It restore natural tissue color. It preserve tissue integrity and dehydration is very slow. It is odorless and there are no complaints associated with formalin based embalming.

MATERIAL AND METHODS:

This study was conducted in department of human anatomy Dr. Vasantrao Pawar medical college and research center Nashik. As per requirements for cadaveric arthroscopic workshop only 3 cadavers two male and one female cadaver were selected for study and after embalming with Thiel solution cadavers were kept in mortuary at 2 to 4 degree celcius temperature. other cadavers were embalmed by traditional formalin solutions and stored in 10 percent formalin tank.

Material - Table no. 1 Formalin embalming solution

Chemical	Percentage	Quantity
Formalin	40 %	4 liters
Distilled water	100	4 liters
Methyl alcohol		1 liter
Glycerine		500 ml
Eosin		25 ml
Eucalyptus oil		25 ml

Table no. 2 Modified Walter Thiel solution A

Chemical	Percentage	Quantity
Boric acid	3%	500 ml
Ethylene glycol	30 %	1 liter
Ammonium nitrate	30 %	500 ml
Potassium nitrate	5 %	500 ml
Distilled water	100%	12 liter
Formalin	3%	1 liter

Table no. 3 Modified Walter Thiel solution B

Chemical	Percentage	Quantity
Ethylene glycol	10%	500 ml
Methyl phenol	1%	25 ml

The cadaver is first wash with tap water thoroughly and the clots and remaining blood is drained. The embalming solution is prepared by combination of solution A and solution B. embalming solution was inserted into carotid artery with help of portable pressure sprayer connected with nasal cannula into common carotid artery. This same mixture is introduced to the body orally and rectally to try to incorporate it into the digestive tract and respiratory tree

RESULTS:

For joint flexibility, at least 86 % of delegate of workshop strongly agreed for Thiel and at least 80 % of the delegate of workshop strongly disagreed for formalin. Tissue colour was closer to natural in Thiel embalmed cadavers compared to the formalin cadavers. There were no complaints due to unpleasant odor in Thiel cadavers as commonly found with the formalin . At least 87% of participants had opinion that it was more easy and comfortable to identify structures in the Thiel cadavers than traditional formalin

Table no. 4

Formalin based embalming	Thiel embalming
Tissue firm and rigid	Soft and floppy tissue
Skin discoloration	Natural skin color
Tissue dehydration	Gradual tissue dehydration
	Preserve tissue integrity
Constricts capillaries	
Unpleasant odor	Mostly odorless
Deteriorates on storage of solution	Mostly stable solution for long time storage
widely used all over world	Mostly used in western country
body preservation for long duration	Body preservation for long duration
Preserved in open air and water tank 10% formalin	Preserved in bag or tank with thiel solution
Bactericidal, fungicidal and insecticidal	Effective cadaver preservation
Relatively limited application	Many application
Suitable for dissection	Difficult for dissection as muscle rupture easily Suitable for surgical procedures only because of flexibility
Cheap and easily available in market	Expensive and complex

The acute exposure of embalming fluid fumes containing formalin was associated with significant decrease in FEV1/FVC ratio. The chief subjective complaints of the

participants were pungent smell, throat congestion, burning sensation in eye, headache, nausea and rhinorrhoea .

DISCUSSION :

The traditional embalming fluid commonly used in our anatomy department is a mixture of chemicals as shown in table no. 1 . formalin prevents putrefaction of body and act as strong fixator and retain normal anatomical relations . The fixative properties of formalin is because of irreversible changes in proteins , DNA and RNA.

Edmundo Denis-Rodríguez¹ and Angel Augusto Aguirre-Gutiérrez from the Institute of Forensic Medicine, Universidad Veracruzana found that the success of the Thiel Soft-Fix technique depends on the complete and orderly completion of the stages that compose it (Bertone, 2011)²:

Initial Embalming

Usually before embalming body is completely washed and blood is drained, clots if found are removed. Embalming solution is introduced by dissecting carotid triangle and injecting fluid in common carotid artery in cervical region Solution A as shown in table 2 total volume was approximately of 14-15 liters. Solution B contains 10% ethylene glycol and 1% 4- chloro-3-methylphenol for a total volume of 500 ml. Both are mixed and used

Immersion

Then body is kept in the Immersion Solution which contains 10% of ethylene glycol, 2% of formaldehyde, 2% of solution B of Thiel, 3% of boric acid, 10% of ammonium nitrate, 5% of potassium nitrate, 7% of sodium sulphite and 65% % of water. The recommended total immersion time is 30 days. Then the body is removed from the pool and placed in a bag with airtight seal if signs of dehydration are observed over time, the body can be submerged again in the same basin for a period of 5-7 days . But because of lack of sufficient Thiel solution and time we had kept body in mortuary for 7 days till date of workshop. Anatomy is the cornerstone of medical education for budding doctors cadavers are found to be excellent teaching tool in the medical curriculum. Formalin is economical and easily available.but is toxic to staff and students . Anatomists strive to find an embalming technique that allows the preserved specimen to accurately resemble the living tissue, preserve the body for a long period of time and reduces health risk concerns related to working with cadavers. Balta³ J Y has opinion that there is a need for embalming to shift to an independent modern day science with well-founded research.

Kritsana Homwutthiwong and Maneerat Ongwandee⁴ Mahasarakham University, Thailand investigated formaldehyde concentrations in a gross anatomy laboratory . they had conducted area-based sampling for three scenarios: (1) a laboratory cleaning period, (2) three periods of teaching classes and (3) a non-teaching class period. They had used cartridges filled with dinitrophenylhydrazine coated silica gel. Samples were analyzed by high performance liquid chromatography. Results showed that the average area based concentrations during the dissection classes ranged from 9.3 to 17.6 ppb, while the non teaching class concentration was 5.5 ppb. The concentration increased to 3.1×10³ ppb during the laboratory cleaning. They had estimated The lifetime cancer risk were 5.8×10⁻⁶ , 2.9×10⁻⁶ and 8.1×10⁻⁷ , respectively.they had found that the clinical symptoms by medical students were associated with formaldehyde concentrations above 16 ppb at the significance level of 0.05. These included unpleasant odor, general fatigue or fatigue after awakening and dizziness .they had suggested that Improvement of the ventilation of dissection hall and source control measures are essential for reducing formaldehyde emissions in the gross anatomy laboratory.

In a study carried out by (Benkhadra, 2011)⁵ on muscle and connective tissue, it was observed that in the samples taken from embalmed cadavers with the Thiel Soft Fix technique, the muscle tissue presented focal degradation and loss of fiber distribution, unlike on-embalmed corpses or embalmed corpses with formaldehyde.

Eisma R⁶ from the Centre for Anatomy and Human Identification, College of Life Sciences, University of Dundee, United Kingdom also commented on thiel embalming . In 2009 they started using Thiel embalming on a small scale to assess (i) the suitability for our current medical curriculum (ii) the possibilities for new collaborations and surgical procedures (iii) feasibility of changing our embalming method from formalin to Thiel solution.they had suggested that there is a wide scope for new collaborations related to postgraduate anatomy teaching and advanced training in surgical and clinical skills without any complications.In the study carried by Kennel L⁷ from University of Dundee UK, they had investigated student about their attitudes toward the dissection experience with Thiel- compared to formalin-embalmed cadavers. They had found that the Thiel group of students felt more confident about recognizing anatomy in the living individual and dissected anatomical structures due to the retained flexibility of the cadaver. However, on testing, no significant difference in functional anatomy knowledge was found between the two cohorts.

CONCLUSION

There is universal need for replacement of formalin solution. Modified thiel solution can be used only for embalming bodies which are used for surgical procedures. For dissection purpose othe ravailable options are Natekar⁸ composition of body-preservation fluid which is effective in preventing decomposition of cadavers, maintaining a desired life-like appearance of the body which is non hazardous for dissection and environmentally safe. It was observed that chemical composition of the embalming fluid was very effective in prevention of growth of bacteria, fungus and also decay and discoloration. The other is solution recommended by Yoshinori Haizuka and others the NVP– embalmed corpses showed no sign of decomposition or fungal growth. The bodies remained soft and flexible. Notably, the shoulder, elbow, wrist, phalangeal, hip, knee, cervical spine, and temporo mandibular joints were highly mobile, almost equivalent to those of living individuals. Dr. Nader Goodarzi⁹ claim that 40% ZnCl₂ solution could embalm and preserve anatomical specimens as well without using formalin, alcohol, glycerin, or thymol.

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