



Rev Mex Med Forense, 2017, 3(2):91-98

ISSN: 2448-8011

Thiel Soft-Fix method for long term preservation

Review article

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SUMMARY

Long term cadaveric preservation represents a medical challenge, considering the toxicological consequences of formaldehyde in the environment and personal health status; stiffness of the tissues increases the difficulty of their manipulation in medical school and teaching hospitals. In recent years a new method of long-term preservation has emerged; it was proposed by Walter Thiel, known as Thiel Soft-fix method; it uses low concentrations of formaldehyde, also avoiding tissue stiffness for longer periods. In this review, we analyze the features of Thiel Soft-Fix method for long-term preservation of cadaver and tissues.

Keywords: Embalming, Preservation, Thiel Soft-Fix method

Received: May 15th, 2018, Accepted: June 5th, 2018, Online: August 15th, 2018

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INTRODUCTION

The long term preservation of corpses represents a medical challenge. Traditional embalming uses high concentrations of preservatives, especially formaldehyde (Okada, 2012). From numerous studies, formaldehyde has been related to various pathologies, both acute (skin irritation and conjunctiva, respiratory distress) and chronic (chronic dermatitis, corneal opacity, chronic respiratory and renal alterations). In addition to the aforementioned pathologies, special mention deserves the relationship between the prolonged use of formaldehyde and the appearance of malignant neoplasms, especially hematological ones (Hayashi, 2016).

In addition to the individual and environmental toxicological implications, it is known that the traditional technique of long-term preservation hardens the bodily tissues in an important way, which is why it is difficult to manipulate them by medical students in Faculties of Medicine and Teaching Hospitals (Hammer, 2015). From the above, the importance of having a long-term preservation method in which the tissues retain most of their pre-mortem consistency without reducing the preservative efficacy becomes important.

The Thiel Soft-Fix method is an embalming technique originally proposed by the Austrian anatomist Walter Thiel (Anatomy Institute of Graz, Austria) (Thiel, 1992). After several years of improvement, the original publication was

made in a German-language magazine, which is why it was not generally known at first. 10 years later a second article was published in English, which has led to the implementation of this technique in various centers around the world (Thiel 2002).

The technique of Walter Thiel, known as Thiel Soft-Fix Method, has been gaining popularity in the world (Hammer, 2015). In 2011, a study was conducted in which they observed this technique is known in 53% of the departments of anatomy, dissection and forensic sciences in the world, although its routine use as an embalming method is only done in 10% of the included centers (Benkhadra, 2011b). Its main use is in Europe, although in recent years it has begun to be used in other countries, such as India, Thailand, Japan and Argentina (Sangchay, 2014).

SCIENTIFIC BASIS

Modern embalming uses several preservatives, but the most frequent is formaldehyde; although surfactants and modifiers are currently used to improve the cosmetic result of this technique, when corpses require embalming for prolonged periods, high concentrations of formaldehyde are required (Benkhadra 2011). As a result, tissues dehydrate, harden and change their color and general appearance, making it difficult to use in Anatomy, Surgery and Interventionist Techniques. Figure 1 shows the tissue preserved in a traditional way with formaldehyde.



Figure 1. Tissue preserved with the traditional formaldehyde technique at high concentrations.

The Thiel Soft Fix technique uses preservatives other than formaldehyde (in fact, although it contains it, its concentration is very low) (Thiel, 2002). It is a technique designed so that tissues, especially the muscular and integumentary types, retain most of their premortem texture and tone (Hassan 2014). In a study carried out 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 non-embalmed corpses or embalmed corpses with formaldehyde (Benkhadra, 2011); This observation suggests that muscular and connective changes could explain the soft consistency observed in the Thiel Soft Fix technique (Joy, 2015, Liao, 2015). Figure 2 shows the tissue preserved by the Thiel method.



Figure 2. Tissue preserved using the Thiel Soft-Fix method.

TECHNIQUE DESCRIPTION

The success of the Thiel Soft-Fix technique depends on the complete and orderly completion of the stages that

compose it (Eisma, 2013b). This technique has two stages (Bertone, 2011):

Initial Embalming

After washing and draining the entire vascular tree, to eliminate clots and any other factor that decreases the circulation of the fluid, the injection solution is introduced by the cervical route (internal carotid or common carotid artery), which is obtained by combining the Solution A and solution B (proposed by Thiel) and adding 300 ml of formaldehyde and 700 g of sodium sulfite, for a total volume of 15.7 liters. Solution A contains 3% boric acid, 30% ethylene glycol, 20% ammonium nitrate, 5% potassium nitrate and 42% water for a usual total volume of 14-15 liters. Solution B contains 10% ethylene glycol and 1% 4-chloro-3-methylphenol for a total volume of 500 ml. This same mixture is introduced to the body orally and rectally to try to incorporate it into the digestive tract and respiratory tree.

Immersion

Once the injection solution was incorporated into the cadaver, it is placed in a pool or tub, which contains the so-called Immersion Solution. This solution 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 sulfite and 65% % of water, for a total volume that will depend on the size of the pool, but enough to submerge the body in its entirety. The recommended total immersion time is 30 days, which allows it to retain its characteristics even after repeated use (Munirama, 2016). Once past this period, 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 (Thiel, 2002). Even body fragments can be introduced into the immersion solution and after a period of 2-3 months they recover

their original tonicity in vivo (Hunter, 2014).

CURRENT USE

Cadavers preserved using the Thiel Soft-Fix method have been used in various areas of the interventional medical field. In general, its soft consistency has allowed Medicine and Surgery students to perform dissection practices in conditions very similar to those they would present in a living corpse. In fact, studies have been carried out in which the subjective experience of medical students is evaluated using the preserved cadaver with the Thiel Soft-Fix method (Balta, 2015).

Cadavers preserved with this technique have been used in the practice and assessment of interventional diagnostic studies, such as urinary tract endoscopy (Bele, 2016) and magnetic resonance (Guerguieva, 2014). It has also been used in the practice of surgical or invasive procedures such as renal transplantation (Cabello, 2015), abdominal laparoscopy (Eisma, 2011), thyroid surgery (Eisma, 2013a), urological procedures (Healy, 2015), surgery oral (Hölzle, 2012), vascular microsurgery (Obedescu, 2014), nephrectomy (Prasad, 2012; Rai, 2015) and orotracheal intubation (Szücs, 2016). Finally, they have been used in various studies of tissue physiology, such as biomechanical studies of the tendinous tissue (Fessel, 2011), studies of the acoustic mechanics of the middle ear (Guignard, 2011) and determination of the mechanical properties of cortical bone (Unger, 2010). It is evident that with the increase of the worldwide knowledge about this technique, the diagnostic and surgical applications will be more and more numerous.

CONCLUSION

For more than 60 years, the traditional technique of embalming uses several preservatives; the most frequently used is formaldehyde; this substance has been linked to various pathologies, both acute and chronic, which give it its obviously toxic nature.

When it is intended to embalm a corpse for a long time, whether for academic or didactic purposes, high concentrations of formaldehyde are required, which increases its risk of toxicity to the embalmer.

Various techniques have arisen in which minimal or no formaldehyde quantities are used for long-term preservation. Since 1992, a technique called Thiel Soft-Fix has been proposed; prolonged preservation of a corpse is achieved without the toxic effects of formaldehyde and, as an additional benefit, conserving the texture of the tissues in vivo almost completely.

In Mexico this type of technique has not been implemented; consequently, the response that the corpses can have, histologically, to a humid warm medium has not been evaluated either. For more than 20 years the use of the Thiel Soft-Fix technique has been implemented worldwide, which is a technique that allows the long-term preservation of corpses, with a minimum and non-toxic amount of formaldehyde and with the benefit additional to allow tissues to retain their soft consistency similar to in vivo conditions.

It is convenient the implementation in our environment of techniques like the one mentioned, with no toxicity for the embalmer. Also, once it is implemented, the histological changes that occur in the embalmed corpse should be studied, both to know objectively the changes that are made in a humid warm climate and to understand histologically the reason why this technique ensures tissues of the body to maintain a similar appearance to their premortem condition.

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