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**Title: Do dental undergraduates think that Thiel-embalmed Cadavers are a more realistic model for teaching exodontia?**

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## **Abstract**

**Introduction:** Teaching exodontia to novice undergraduates requires a realistic model. Thiel-embalmed cadavers retain the flexibility of the soft tissues and could be used to teach exodontia.

**Objective:** The objective was to determine whether Thiel-embalmed cadavers were perceived to be a more realistic model by undergraduates in comparison to mannequins.

**Materials and Methods:** Over a period of four years (2011-2014) students were randomly assigned into two groups, those taught exodontia on mannequins only (NT) and those who also experienced cadaveric teaching (T). This was followed by an assessment.

**Results:** There were 174 students in the T group and 108 in the NT group. Sixty-five percent of the T group and 69% of the NT group provided feedback. Ninety-eight percent (98%) felt that they had been advantaged by being included in the group compared with 95% in the NT who felt disadvantaged. The majority (98%) thought that using the cadavers was advantageous, gave a realistic feel for soft tissue management (89%) and that it was similar to managing a patient (81%). Self-reported confidence in undertaking an extraction was not different between the two groups ( $p=0.078$ ) and performance in the extraction assessment was not significantly different between the two groups over the four years ( $p=0.8$ ).

**Conclusion:** The Thiel-embalmed cadavers were well received by the students who found it a more realistic model for exodontia than a mannequin, even though this did not impact on their performance in a following assessment. Future work on these cadavers may be expanded to include surgical procedures.

Word count = 249

## Introduction

According to the General Dental Council, new dental graduates should be able to “extract erupted teeth and roots in the permanent and deciduous dentition” (1). One survey has suggested that in the United Kingdom a new graduate will have extracted on average 51 teeth (2), which does not seem a large number over the three clinical years. With increasing student numbers, there is some concern that clinical experience will be reduced, leaving graduates less well prepared for the challenges of foundation training (3). This highlights the need for robust teaching early in the course and assessment of clinical skills.

In oral surgery exodontia verisimilitude is difficult to model. In dental schools in the United Kingdom, if a model is used it is either an animal model or a mannequin simulator (4). These models lack a realistic feel and do not give the desired depth of transferable skill. Ultimately the student can watch an extraction demonstration given by a member of staff, but this still lacks that one element, the operating feel of an extraction. Using cadavers may provide a more realistic experience, especially in relation to normal human variation, as well as familiarity with techniques, and therefore may build confidence.

Anatomy legislation now allows for cadaveric practice of surgical procedures. Therefore, the use of the Thiel-embalming technique was explored by the Dundee Centre for Anatomy and Human Identification (CAHID) (5). Thiel embalming (6,7) uses a low concentration of formaldehyde/formalin (8.9%) to fix the tissues; the water based salts solution contains boric acid & chloro-cresol for disinfection, and ammonium & potassium nitrate, sodium sulphite, ethanol and ethylene glycol emulsified by morpholine, resulting in a cadaver that retains flexible soft tissues. This embalming method consists of intravascular perfusion, followed by at least 2-3 months of submersion. Cadavers can be retained long term (up to 3 years limit prescribed by Scottish legislation) without refrigeration; instead, cadavers are sealed in plastic bags or remain submerged (8). This method has been advocated for a large number of training needs, as reviewed by Healy et al (9), and also as a valuable method for teaching oral surgery and implantology (10). However, the use of this method of embalming is not well known and little used (11).

The primary objective of this project was to determine whether Thiel-embalmed cadavers were perceived to be an acceptable and improved model for the teaching of

exodontia by the undergraduates. A secondary objective was to determine if teaching on Thiel-embalmed cadavers had any impact on self-reported confidence at undertaking an extraction, or on performance in an objective structured clinical examination (OSCE).

## **Materials and Methods**

From 2011 to 2014, second year undergraduate dental students were assigned into one of two groups: those taught using commercially available mannequins (Frasaco GmbH, Oberhoferstrasse 18, 88069 Tettwang, Germany) in a clinical setting followed by observation of patient treatments, and those who also attended cadaveric teaching at the Centre for Anatomy and Human Identification (CAHID). The teaching was essentially the same over two four hour sessions, with the non-Thiel group (NT) group having two sessions of teaching on a mannequin and the Thiel group (T) attending for one session on the mannequin and one session on the Thiel-embalmed cadavers. The number of students attending CAHID was dependent upon availability of the cadavers.

Following this period of teaching, all of the students had to complete an extraction OSCE successfully on a mannequin before proceeding to treat patients under supervision. At the end of the first semester, after three months of treating patients, the students were asked to complete a questionnaire about their perception of the utility and acceptability of the Thiel-embalmed cadavers. The questionnaire was designed to accommodate both those who had the opportunity to use the Thiel-embalmed cadavers and those who had not. The questions were in a simple binary format, yes/no, except for assessment of self-confidence, when a five point Likert scale (12) was used. A free text box gathered any additional comments they wanted to contribute.

A Wilcoxon signed rank test was used to determine differences between assessed self-confidence of the two groups, while a T test was used to determine differences between OSCE scores.

## Results

In total, 174 students of 282 attended CAHID. Completed questionnaires were received from 114 students in the T group (65%) and 75 in the NT group (69%).

In the T group none of the students had a moral or cultural objection to using the cadavers for extraction teaching and practice, while 92% had no aesthetic qualms about using the cadaver. Ninety-eight percent (98%) felt that it was an advantage to be in the T group. Ninety-two percent (92%) agreed that this model gave a good understanding of the feel of an extraction.

Seventy-three percent (73%) agreed that the cadaveric extraction was more difficult than the mannequin and 95% agreed that the patient extraction was more difficult than the cadaver. Ninety-eight percent (98%) agreed that the cadaver helped them to learn how to apply forceps and 88% agreed that it helped them to learn how to manipulate and support the soft tissues. At the end of the first semester, 56% would have liked to use the Thiel-embalmed cadavers to practise extractions (Table 1).

Eighty-one percent (81%) indicated that all students should have access to the Thiel-embalmed cadavers, while the remainder indicated that it should be voluntary.

In the NT group, 98% of the students did not have a moral objection to the use of the cadavers and none of them had a cultural objection. Ninety-three percent (93%) of them had no aesthetic qualms about using the cadaver. Ninety-seven percent (97%) would have liked to practise extractions on the cadavers and 95% felt disadvantaged by not being included in the T group. Eighty-seven percent (87%) thought that all students should be allowed to use the cadavers, while the remainder thought it should be voluntary (Table 2).

At the end of the first semester, those who had undertaken an extraction on a patient were asked to rate their self-confidence. Of those students that had completed an extraction, 36% (102) responded with the majority (61%) being in the T group. Figure 1 shows that a greater number of students in the T group scored their self-confidence at high or very high than the NT group, but this was not statistically significant (Wilcoxon signed rank test  $z=1.761$ ,  $p=0.078$ ).

All students completed the OSCE, which was scored out of 30 marks. The mean OSCE score for the T group overall for the four years was 24.4 +/- 3.79 and for the NT

group was 24.3 +/- 4.6 which was not significantly different (t-test p=0.8). When analysed by each year, there was no difference between the groups in 2011, 2012 and 2013 (p=0.236, p=0.295, p=0.295) but there was a significant difference between the groups in 2014 where the T group had a higher score in the OSCE than the NT group (p=0.005) (Table 3) .

The students' free text comments included the following:

*"The experience was very useful"*

*"It gave me more confidence – getting the feel of hand placement "*

*"The Thiel experience was very beneficial."*

*"I would have liked more attempts at extractions – I only did it once and would have loved to have done more."*

*"I would have liked to practise on multiple bodies with different landmarks"*

*"A mixture of Thiel and clinical during the term would make people feel more confident before their first extraction."*

*"I believe a Thiel extraction might provide us with better preparation"*

*"It was a great learning experience"*

*"Compared to a patient the teeth are easier to take out. In general good opportunity and improved my confidence for extractions."*

*"The Thiel was harder as bodies were laid flat."*

*"The tissues are not very similar to a patient with teeth that are easier to take out."*

## Discussion

There is a paucity of information in the literature about the use of Thiel-embalmed cadavers specifically as a teaching model for dental students. This is possibly due to the fact that very few anatomy departments have adopted this method of embalming (11). When this model was introduced, staff at the Dundee Dental School were afforded an opportunity to use this model for teaching. The students were already familiar with this model from their pre-clinical anatomy teaching and it was initially used to teach the administration of local anaesthetic. This project was never designed as a prospective randomised trial but was piloted to determine how the students perceived this as a model for teaching. There was no attempt at randomisation as the groups invited to take part were determined by the availability of the facilities. Student feedback was positive so this model continued to be used. This is a fundamental weakness in this work and our findings must be interpreted with this caveat in mind.

There are accounts of Thiel-embalmed cadavers being used for teaching of surgical skills (13), urologic skills (10) and microvascular anastomosis (14), as well as in human anatomy teaching (15). In this last study, a third of undergraduate medical students expressed the view that Thiel-embalmed cadavers made them feel more uncomfortable because of their life-like appearance (15).

Our survey seems to suggest that the use of the Thiel-embalmed cadavers was generally well received by the students. They had no moral or ethical issues about this model, although we did not specifically ask if they made the students feel uncomfortable. Only one student refused to touch the cadaver, but asked to observe, not wishing to miss out on the experience completely. The majority of those students who did not get an opportunity on the Thiel-embalmed cadavers would have liked to do so, and felt that they had been disadvantaged. This model offers a more realistic feel of extractions for novice students to learn the basic technique of extraction and should better prepare them to undertake their first extraction on a patient without the stress associated with the patient interaction. The big advantage is that it allows a realistic feel of management of the soft tissues and support of the jaw, particularly the mandible, during the extraction. The disadvantages relate to positioning on the table and the relative ease with which the teeth could be removed, possibly due to effects on the periodontal ligament, as it has been shown that this type of embalming causes



softening of ankle tendons and ligaments (16). However, our students did have an opportunity to experience some common peri-operative complications, such as fracturing teeth, dentoalveolar fractures and the creation of oro-antral communications, complications that would not be possible to experience on a mannequin.

It is difficult to determine whether using Thiel-embalmed cadavers had a positive effect on the students' self-reported confidence when undertaking an extraction on a patient. Only a third of the students' completed this part of the questionnaire, which may reflect their limited experience in the first semester, three months, in that not all of the students had actually carried out an extraction in that time period. Those that did respond were mostly in the T group, and tended to give responses that were in the high or very high confidence level although statistically there was no difference between the two groups overall. Performance in the assessment did not seem to be dependent on the model used as there was no difference in performance for the four years overall. Only in the last year, 2014, was there an improved performance in the T group. It is worth mentioning that the assessment was performed on a mannequin and so the T group may have been disadvantaged with only one teaching session on the mannequin, but there was no feedback that they felt this was the case.

The limitations of this work was the time available, one session only, to teach using the cadavers. However, this equates to accounts of teaching reported at another European schools (17). It would be interesting to see if a series of tutorials on the Thiel-embalmed cadavers would have an impact on student ability and confidence. The students did feel that increased exposure may be of benefit, as half of the students in the T group would have like to continue to use this model, while almost all of the NT group would have liked to use it. Other limitations include the relatively small sample size, the lack of randomisation and the unequal numbers in each group.

Future work in this area may be to allow the students more access to the Thiel-embalmed cadavers at the beginning of their training, or interspersed throughout, so that surgical skills could also be taught and possibly assessed. This approach may then determine whether these skills are readily transferable.

## **Conclusion**

The use of Thiel-embalmed cadavers to teach exodontia was well received by dental students, who felt they were a more realistic model for extractions than the mannequin, and that all students should have the opportunity to use the Thiel-embalmed cadavers. Ideally we would like to offer all of our students an opportunity to practise extraction technique on these cadavers prior to treating patients. Future work on these cadavers may be expanded to include surgical procedures, thus better preparing our undergraduates.

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## **Conflict of Interests:**

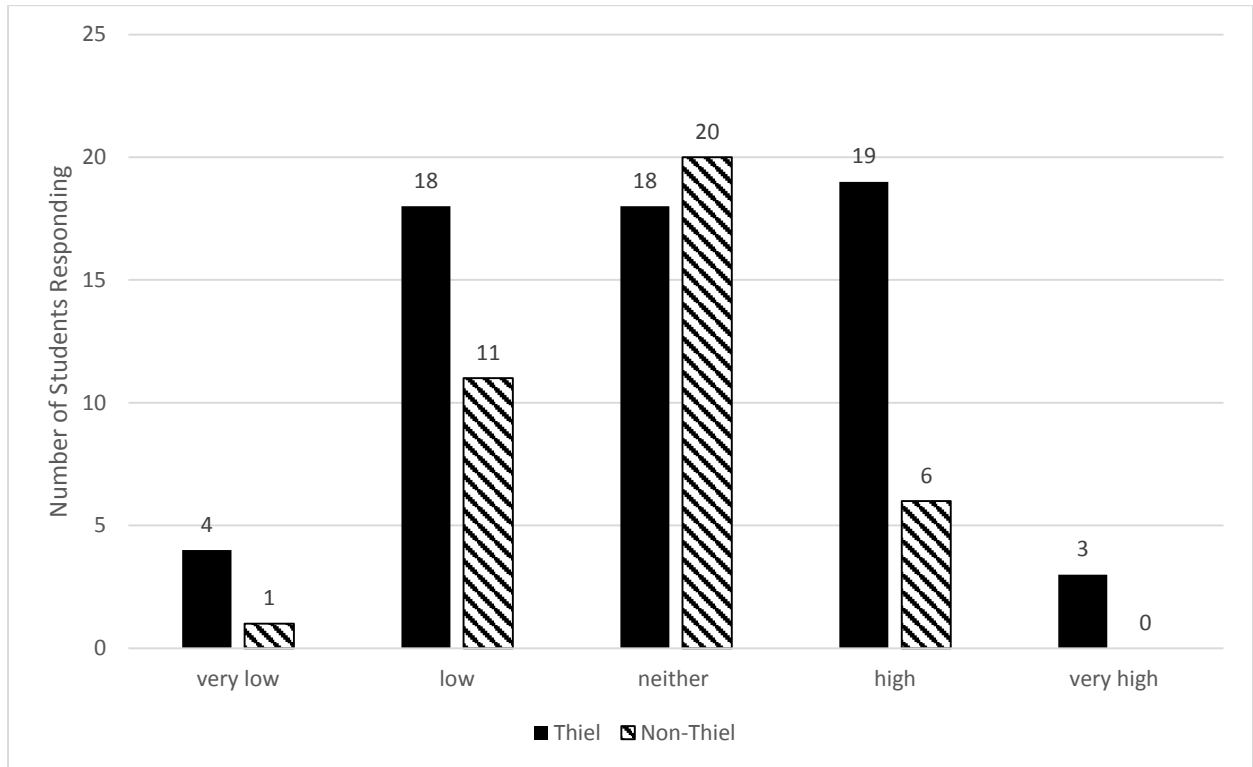
There are no conflicts of interest.

## References:

1. Preparing for practise. Dental team learning outcomes for registration. General Dental Council 2011. <http://www.gdc-uk.org/Newsandpublications/Publications/Publications/GDC%20Learning%20Outcomes.pdf> accessed August 23rd 2016.
2. Macluskey M, Durham J. Oral surgery undergraduate teaching and experience in the United Kingdom: a national survey. *Eur J Dent Educ* 2009;13(1):52-7.
3. Gilmour A, Jones R, and Bullock A. Dental Foundation Trainers' Expectations of a Dental Graduate. 2012  
<http://copdend.org//data/files/Research/Final%20Dental%20Foundation%20Trainers%20Expectations%20of%20a%20Dental%20Graduate%20COPDEND%20Sept%202012.pdf> accessed August 23rd 2016.
4. Macluskey M, Durham J. Oral surgery undergraduate teaching and experience in the United Kingdom: a national survey. *Eur J Dent Educ*. 2009 Feb: 13(1):52-7.
5. Eisma R, Wilkinson T. From "silent teachers" to models. *PLoS Biol*. 2014 21:12(10):e1001971.
6. Thiel W. Die Konservierung ganzer Leichen in naturlichen Farben [The preservation of the whole corpse with natural colour]. *Ann Anat* 1992a:174:185–195.
7. Thiel W. Eine Arterienmasse zur Nachinjektion bei der Konservierung ganzer Leichen [An arterial substance for subsequent injection during the preservation of the whole corpse]. *Ann Anat* 1992b:174:197–200.
8. R. Eisma, S. Mahendran, S. Majumdar, et al. A comparison of Thiel and formalin embalmed cadavers for thyroid surgery training. *Surgeon* 2011;9:142–146.
9. Healy SE, Rai BP, Biyani CS, Eisma R, Soames RW, Nabi G. Thiel embalming method for cadaver preservation: a review of new training model for urologic skills training. *Urology* 2015;85(3):499-504.
10. Holze F, Franz EP, Lehmbrock J, et al. Thiel embalming technique: a valuable method for teaching oral surgery and implantology. *Clin Implant Dent Relat Res* 2012;1:121-6.

11. Benkhadra M, Gérard J, Genelot D, et al. Is Thiel's embalming method widely known? A world survey about its use. *Surg Radiol Anat.* 2011;33(4):359-63.
12. Likert R. A technique for the measurement of attitudes. *Arch Psychol* 1932; 140: 1–55.
13. Hayashi S, Homma H, Naito M, et al. Saturated salt solution method: a useful cadaver embalming for surgical skills training. *Medicine Baltimore* 2014;93(27):e196.
14. Hassan S, Eisma R, Harry LE. Surgical training of anastomotic technique using Thiel cadavers. *J Plast Reconstr Aesthet Surg* 2014;67(10):e250-1.
15. Balta JY, Lamb C, Soames RW. A pilot study comparing the use of Thiel- and formalin-embalmed cadavers in the teaching of human anatomy. *Anat Sci Educ* 2015;8(1):86-91.
16. Liao X, Kemp S, Corner G, Eisma R, Huang Z. Elastic properties of Thiel-embalmed human ankle tendon and ligament. *Clin Anat* 2015;28(7):917-24.
17. Stelzle F, Farhoumand D, Neukam FW, Nkenke E. Implementation and validation of an extraction course using mannequin models for undergraduate dental students. *Acta Odontol Scand* 2011;69(2):80-7.

**Figure 1: Self-reported confidence following their first extraction on a Likert Scale (n=102)**



**Table 1: Results of the questionnaire completed by the T group over the four years (2011-2014) presented as a percentage of student responses.**

Year	2011 N=11		2012 N=35		2013 N=22		2014 N=46	
Response	YES	NO	YES	NO	YES	NO	YES	NO
Do you have a moral objection to using a cadaver for extractions?	0%	100%	0%	100%	0%	100%	0%	100%
Do you have any cultural objection to using a cadaver for extractions?	0%	100%	0%	100%	0%	100%	0%	100%
Do you have aesthetic qualms to using a cadaver for extractions?	5%	95%	11%	89%	18%	82%	0%	100%
Did you feel advantaged to be included in the Thiel extraction group?	95%	5%	100%	0%	100%	0%	98%	2%
Did this give you an understanding/'feel' of extraction?	89%	11%	89%	11%	91%	9%	98%	2%
Did a Thiel extraction have an overall similarity to a patient extraction?	72%	28%	86%	14%	86%	14%	69%	31%
Was a Thiel extraction more difficult than mannequin?	67%	33%	71%	29%	96%	4%	63%	37%
Was the patient extraction more difficult than Thiel?	95%	5%	94%	6%	96%	4%	96%	4%

Did the Thiel help to learn how to apply forceps?	95%	5%	100%	0%	96%	4%	100%	0%
Did the Thiel help with learning to manipulate soft tissue & jaws?	83%	17%	94%	6%	82%	18%	89%	11%
Would you like to go back to the Thiel and practice?	72%	28%	49%	51%	82%	18%	50%	50%

**Table 2: Results of the questionnaire completed by the NT group over the four years (2011-2014) presented as a percentage of the students responses.**

Year	2011 N=32		2012 N= 11		2013 N=15		2014 N=17	
	YES	NO	YES	NO	YES	NO	YES	NO
Do you have a moral objection to using a cadaver for extractions?	0%	100%	9%	91%	0%	100%	0%	100%
Do you have any cultural objection to using a cadaver for extractions?	0%	100	0%	100	0%	100	0%	100%
Do you have aesthetic qualms to using a cadaver for extractions?	0%	100	18%	82%	0%	100%	18%	82%
Would you have liked to have practiced on a Thiel cadaver?	100%	0%	82%	18%	100%	0%	100%	0%
Did you feel disadvantaged not to be included in the Thiel extraction group?	100%	0%	64%	36%	100%	0%	100%	0%

**Table 3: Comparison of OSCE scores for tooth extraction by the T group compared with the NT group in each year (2011-2014) using a T test.**

<b>Year</b>	<b>Number in Groups</b>	<b>OSCE score mean +/-SD</b>	<b>p value</b>
2011 N=77	T = 28 NT= 49	25.5 +/- 2.7 26.1 +/- 2.4	0.236
2012 N=61	T = 47 NT= 14	20.9 +/- 2.9 19.9 +/- 3.9	0.295
2013 N=71	T = 46 NT= 25	25.5 +/- 2.5 24.6 +/- 4.8	0.295
2014 N=73	T = 53 NT= 20	25.8 +/- 4.0 22.2 +/- 6.2	0.005*

SD = standard deviation