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Evaluating The Use of Plastinated Specimens Among Anatomy Postgraduate Students/Residents of Bangladesh in Anatomy Education

Syed Abu Yousof[1]*, Tajrin Akhter Munni[2], Samira Sultana Amee[3], Tanzina Rahim[4], Rezwana Sharmin Zisa[5], Jurdi adam[6], Tasnim Al-Qureshi[7], Rydwana Munmun[8]

1 Assistant Professor, Department of Anatomy, President Abdul Hamid Medical College, Kishoreganj
2 Associate Professor, Department of Anatomy, Jahurul Islam Medical College, Kishoreganj
3 Assistant Professor, Department of Anatomy, Shaheed Syed Nazrul Islam Medical college, Kishoreganj
4 Assistant Professor, Department of Anatomy, Uttara Adhunik Medical College, Dhaka
5 Associate Professor, Department of Anatomy, President Abdul Hamid Medical College, Kishoreganj
6 Assistant Professor, Department of psychiatry, President Abdul Hamid Medical College, Kishoreganj
7 Assistant Professor, Department of Anatomy, Sir Salimullah Medical College, Dhaka
8 Assistant Professor, Department of Anatomy, Bikrampur Bhuiya Medical College, Munshiganj

Check for updates

∗**Corresponding author**:
Dr. Syed Abu Yousof
Email: dr.shakil0805@gmail.com

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ABSTRACT: To keep specimens intact, anatomy requires the use of preservation procedures. Many approaches have been employed over decades in various parts of the world. Among them plastination is a popular method that is very effective to overcome the drawbacks of embalming procedures. Although some research shows some advantages of plastinated specimens, nevertheless embalmed specimens are commonly used in Bangladesh as teaching-learning and assessment tools. In this study some plastinated specimens were made and taught to the postgraduate students/residents along with the embalmed specimens. After teaching, the OSPE based on comparative between plastinated and embalmed specimens were distributed to the postgraduate students/residents. Their feedback were collected, then compared and statistically analyzed. This part of the research was cross-sectional analytical in nature.

Keywords: Anatomy education, Plastinated specimens, Embalmed specimens, OSPE.

INTRODUCTION

The study of gross anatomy is an integral part of learning anatomy in medical education. Although virtual tools are increasingly becoming popular, the appeal of cadavers and anatomical specimens has not been diminished. For the use of cadavers and anatomical specimens as teaching-learning tools, preservation is essential. Preserved specimens play an important role in teaching-learning of gross anatomy, and students get practical experience on anatomy of external and internal body parts using these learning tools. Plastination is a tissue preservation technique in which "water and lipids

in biological tissues are replaced by curable polymers that harden, producing specimens that are dry, odorless, and long-lasting (International Society for Plastination,). In embalming procedures, cadavers and biological specimens of the human body are preserved in formalin. The decomposition process can be significantly slowed down by the use of formalin. Formalin along with phenol and glycerin was used to embalm cadavers world-wide for a long time[1]. However, tissue fixed with formalin cannot be preserved forever. They become discoloured and fragile after a period of time. The unpleasant odour of formalin spreads in the environment. Oostrom and Med identified several disadvantages of embalmed specimens such as burning of eyes, irritation of upper respiratory tract, tightening of the chest, palpitation of heart and pneumonia.[2] As a result, students face difficulty in concentrating in a practical classroom. The National Institute of Occupational Safety and Health (NIOSH) recommends that "formaldehyde be handled as a possible occupational carcinogen and that applicable controls be used to reduce worker exposure.[2]

Research on the gross anatomy teaching-learning tools, especially on the preserved specimens, is crucial. The initial preparation of these tools by the traditional embalming method (chemical preservation) is thought to be cheap, but unfortunately, their storage and handling is discouragingly difficult[3]. Despite this specimen being very important in developing proper understanding of human anatomy, most of these specimens are not preserved or prepared in our medical institutions.

Moreover, there was no attempt that has been made in this country to evaluate the quality of plastinated specimens over the embalmed specimen as teaching-learning and assessment tools by assessing the performances of the postgraduate students/residents. Thus, results of this type of study would help the teachers in improving their way of teaching and also would help the students in improving their way of understanding anatomy.

METHODS

This research was cross-sectional analytical in nature. It was done to determine the performance of the postgraduate students/residents of the participants of the 'postgraduate students/residents taught using plastinated specimens' in answering OSPE questions compared to that of the participants of the 'postgraduate students/residents taught using embalmed specimens.

Anatomy postgraduate students/residents were selected through convenience sampling technique were invited in the department of Anatomy BSMMU to participate in this study. All the participating anatomy postgraduate students/residents were divided into two groups 'anatomy postgraduate taught using plastinated specimens' and 'anatomy postgraduate taught using embalmed specimens. 19 anatomy postgraduate students/residents of each group and total 38 anatomy postgraduate students/residents were considered as participants. Proper instructions were given by the researcher, then informed written consent papers were given for taking consent from each of the participants The informed written consent from the authorities of the respective institution and also from each participant were taken before the classes and conduction of the test.

Two lesson plans were prepared for conducting the classes on mixed tissue (hand) by using a 'lesson plan format' formulated by Sultana[4]. The duration of each class was two (2) hours. The researcher planned to conduct the classes in a structured way and prepared the lesson plans in consultation with his research guide and faculties of the department for every class, so that the postgraduate students/residents can develop the habit of relating his/her understanding of anatomy to functional interpretations and of explaining clinical and diagnostic findings and procedures from an anatomical perspective.

After getting written permission from the respective medical college authorities and informed written consent from each participant, four (4) classes were organized for demonstration of the selected topics on the gross anatomy of mixed tissue 'hand'. 38 anatomy postgraduate students/residents of dhaka were selected as participants for the classes through the convenience sampling. A total of 38 anatomy postgraduate students/residents were divided into two groups. Among them, 19 anatomy postgraduate students/residents were considered as the participants of the 'anatomy postgraduate students/residents taught using plastinated specimens' and another 19 anatomy postgraduate students/residents were considered as the participants of the 'anatomy postgraduate students/residents taught using embalmed specimens. At first, a dissection class was

delivered to the participants of the 'anatomy postgraduate students/residents taught using plastinated specimens' where 'Plastinated hand' was used as the teaching tool. Then another class was delivered to the 'anatomy postgraduate students/residents taught using embalmed specimens' where 'Embalmed hand' was used as the teaching tool. Additional time was provided after each class, so that each of them could observe the specimens by themselves and develop their own understanding and perception about the specimens.

An OSPE examination was arranged to assess the performance of the students, allowing some time after all four classes had been delivered. Four (4) OSPE stations each using plastinated mixed tissue 'hand' were arranged for 'anatomy postgraduate students/residents taught using plastinated specimens (PS-PS group)' and another four (4) OSPE stations were arranged for the 'anatomy postgraduate students/residents taught using embalmed specimens (PS-ES group)'. However, the questions were kept the same for both the groups. During the OSPE, those who had completed all the stations were isolated into a separate room till the end of the exams of all the participants to prevent any leakage of the OSPE questions among the students. The number and marks of questions are shown in (Figure. 1 and Figure. 2)

OSPE Station no.1			**Statement**	**Marks**
		a.	In this specimen, triangular depression on the radial side of the wrist become visible when the thumb is fully _____.	1.5
		b.	Contraction of the **'A'-** marked structure causes extension of the_____.	1.5
		c.	In this specimen, the **'B'**-marked structure is seen here inserted into the dorsal surface of the _____ phalanx of the finger.	1.5
		d.	The tendon of **'B'**-marked structure is seen here acts as a prime mover for extension of finger at the _____ joint.	1.5
OSPE Station no.2			**Statement**	**Marks**
		a.	In this specimen, roof of the carpal tunnel is formed by _____ _____.	1.5
		b.	It is shown that the tendon of the **'A'-**marked structure splits in two and inserted into the either side of the _____ phalanx.	1.5
		c.	The **'C'-** marked structure is the branch of _____ artery which appear in the palm & form the _____ _____ arch.	1.5
		d.	The **'B'-** marked structure _____ the little finger.	1.5
OSPE Station no.3			**Statement**	**Marks**
		a.	In this specimen, roof of the carpal tunnel is formed by _____ _____.	1.5
		b.	It is shown that the tendon of the **'A'-**marked structure splits in two and inserted into the either side of the _____ phalanx.	1.5

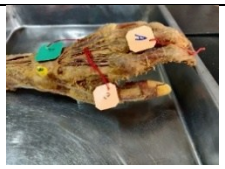
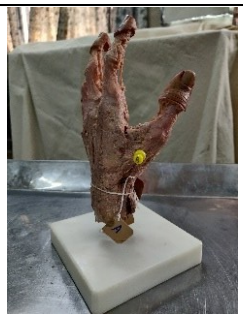
		c.	The **'C'-** marked structure is the branch of _____ artery which appear in the palm & form the _____ _____ arch.	1.5
		d.	The **'B'-** marked structure _____ the little finger.	1.5
OSPE Station no.4			**Statement**	**Marks**
		a.	The **'A'**-marked structure is devoid of sebaceous gland.	1.5
		b.	In this specimen, the **'B'-**marked structure is a modified deep fascia.	1.5
		c.	The lumbrical muscles inserted into the **'C'**-marked structure which produce flexion at the interphalangeal joint.	1.5
		d.	The **'D'**-marked structure is extended the little finger.	1.5

Figure 1: Assessment questions of anatomy postgraduate students/residents for the test of the research by using plastinated hand

OSPE Station no.1			**Statement**	**Marks**
		a.	The **'A'**-marked structure is the major contributor to the deep palmar arterial arch.	1.5
		b.	The **'B'-**marked structure lies beneath the palmar aponeurosis.	1.5
		c.	The second (2nd) lumbrical muscles take origin from the tendon of **'C'**-marked structure.	1.5
		d.	All the thenar muscles take origin from the **'D'**-marked structure.	1.5
OSPE Station no.2			**Statement**	**Marks**
		a.	In this specimen, triangular depression on the radial side of the wrist become visible when the thumb is fully _____.	1.5
		b.	Contraction of the **'A'-** marked structure causes extension of the_____.	1.5
		c.	In this specimen, the **'B'**-marked structure is seen here inserted into the dorsal surface of the _____ phalanx of the finger.	1.5
		d.	The tendon of **'B'**-marked structure is seen here acts as a prime mover for extension of finger at the _____ joint.	1.5
OSPE Station no.3			**Statement**	**Marks**
		a.	In this specimen, roof of the carpal tunnel is formed by _____ _____.	1.5
		b.	It is shown that the tendon of the **'A'-**marked structure splits in two and inserted into the either side of the _____ phalanx.	1.5

		c.	The **'B'-** marked structure is the branch of _____ artery which appear in the palm & form the _____ _____ arch.	1.5
		d.	The **'C'-** marked structure _____ the little finger.	1.5
OSPE Station no.4			**Statement**	**Marks**
		a.	The **'A'**-marked structure is devoid of sebaceous gland.	1.5
		b.	In this specimen, the **'B'-**marked structure is a modified deep fascia.	1.5
		c.	The lumbrical muscles inserted into the **'C'**-marked structure which produce flexion at the interphalangeal joint.	1.5
		d.	The **'D'**-marked structure is extended the little finger.	1.5

Figure 2: Assessment questions of anatomy postgraduate students/residents for the test of the research by using embalmed hand

RESULTS

Performances (expressed as correct, incorrect, and unattempted responses) of the anatomy postgraduate students/residents taught using plastinated specimens (PS-PS) and those taught using embalmed specimens (PS-ES) of 'mixed tissue (hand)'were analyzed. At first, the normality distribution of data from both groups was determined by 'Shapiro-Wilk' test. The result of the test indicated that the data of correct responses from the anatomy postgraduate students/residents taught using plastinated specimens (PS-PS) were non-normally distributed where Z = -0.425 and the data of correct responses those taught using embalmed specimens (PS-ES) were also non-normally distributed where Z = 0.776. The data of incorrect responses from the anatomy postgraduate students/residents taught using plastinated specimens (PS-PS) and those taught using embalmed specimens (PS-ES) were also non-normally distributed where Z = 0.818 and Z = -0.370. Moreover, there were no unattempted responses from the respondent both groups.

For the comparison of the performances, the values of the correct, incorrect responses of the two groups were expressed as means and medians (as there were non-normal distributions). The hypothesis testing was done for the differences between the two groups (regarding performances) for the outcome variables using the Mann-Whitney U test. It was done because of non-normally distributed data.

The results of the hypothesis testing determined that the two groups differed significantly regarding correct and incorrect responses that are shown in table 1. Here the performances in OSPE of the anatomy postgraduate students/residents taught using plastinated specimens (PS-PS) were significantly (p = 0.00, p = 0.00 respectively) better than those taught using embalmed specimens (PS-ES). The mean and median frequency of correct responses was higher combined with a lower mean frequency of incorrect responses of the anatomy postgraduate students/residents taught using plastinated specimens (PS-PS) as compared to those taught using embalmed specimens (PS-ES). The means of correct and incorrect responses are compared visually in Figure 3.

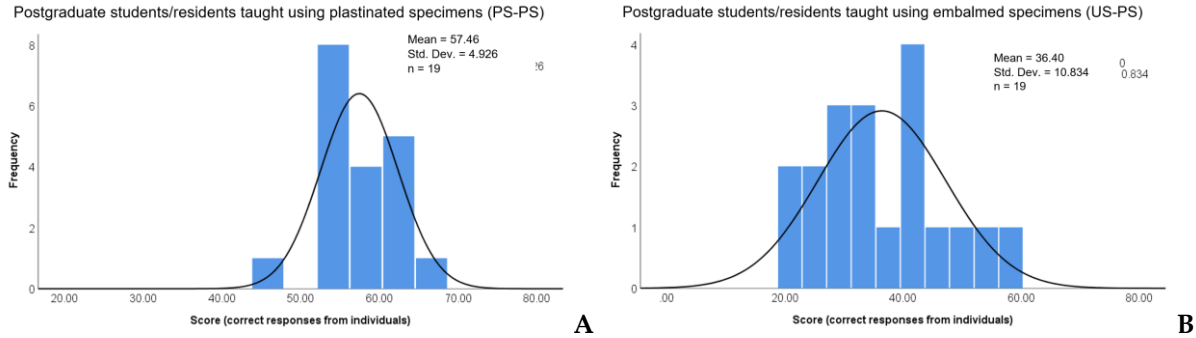


Figure 3: Comparison of frequency distributions of 'Scores' between the anatomy postgraduate students/residents using plastinated specimens (PS-PS) and those taught using embalmed specimens (PS-ES) of 'mixed tissue (hand)'.

Histogram A is non-normally distributed and it shows a skewness to the left. Histogram B is non-normally distributed also and it shows a skewness to the right.

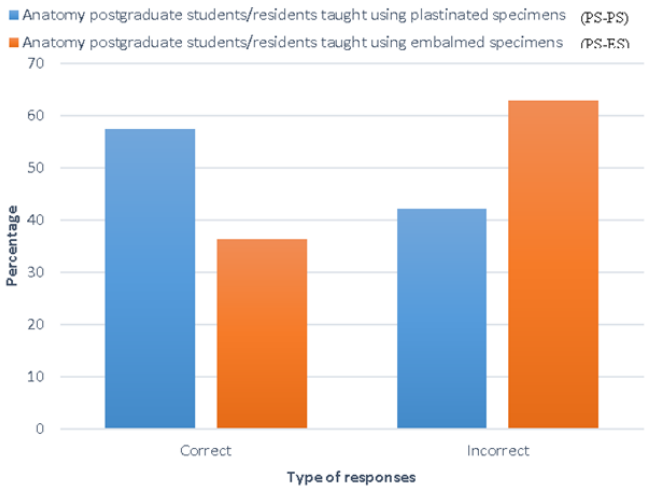


Figure 4: Comparison of the mean percentage frequencies of correct and incorrect responses in OSPE between the anatomy postgraduate students/residents taught using plastinated specimens (PS-PS) and those taught using embalmed specimens (PS-ES) of 'mixed tissue (hand)

Table 1: Comparisons of the performances in OSPE between the anatomy postgraduate students/residents taught using plastinated specimens (PS-PS) and those taught using embalmed specimens (PS-ES) of 'mixed tissue (hand)'

Response	**Performance (I.E, Frequency of Responses) * Mean ± SD Median (25th And 75th Percentile)**		**Probability (p) and Significance (2-tailed)**	**95% Confidence Interval Of The Mean Difference**
	PS-PS2	**PS-ES2**		
Correct	57.45 ± 4.92 58.33 (14.17; 62.50)	36.40 ± 10.83 45.83 (50; 75)	0.00 Significant	15.51 to 26.59
Incorrect	42.10 ± 4.98 41.67 (16.67; 50)	62.93 ± 10.74 58.33 (25; 50)	0.00 Significant	-26.34 to -15.31

n (no. of medical undergraduate students who participated in each group) = 19
* No. of correct/incorrect responses to four (4) questions.
P ≤ 0.05 was considered significant in Mann-Whitney U test

DISCUSSION

Results of the assessment of the performances of the anatomy postgraduate students/residents in the present study revealed significantly higher (p = 0.00) scores obtained by 'postgraduate students/residents taught using plastinated specimens' than the 'postgraduate students/residents taught using embalmed specimens' on the selected topic 'hand'. The reason why postgraduate students/residents performed better with plastinated specimens may be that the gross structures of the hand, especially hand musles, arterial arches those were taught in the class are more clearly seen in plastinated specimens.[5] Lattore et al. (2007) also found that plastinated specimens were useful for anatomy students (mean 2.34/3). In a well-dissected plastinated specimen, anatomical structures can be more easily distinguished from each other in comparison to embalmed specimens[5]. Moreover, in the study of Azu[6] 33.3% of the participating workforce considered that plastinated specimens could not replace cadavers, although approximately 80% argued that plastinates could be used alongside cadavers. The reason is the postgraduate students/residents were not exposed to the plastinated specimens before the class. As previously mentioned, the fact that many of postgraduate students/residents of Bangladesh did not have any experience with plastinated specimens as teaching-learning tools. But in case of embalmed specimens, to reach into the deeper structures they learned by manipulation of different anatomical structures. They also learned the action of the hand muscles by manipulation. However, the fact that the structures are hard and difficult for students in reaching deeper structures[7]. Conversely, postgraduate students/residents may feel that the use of plastinated specimens limits their emotional development because the sections are less human[7], suggesting that the use of plastinated specimens can have either positive or negative consequences on the emotional development of students who have contact with cadaveric material. Bayko[8] have felt that plastinates are less flexible and caused difficulty in visualizing deeper structures of hand. In addition with Dhanwate[9] mentioned that, despite being of great quality, plastinated specimens don't have the same feel and touch as embalmed specimens. However, there is a positive outlook on the future of using plastinated specimens as teaching-learning tools with the enthusiasm and interest shown by respondents in the present research.

CONCLUSION

The performances of postgraduate students/residents taught using plastinated specimens were significantly better in OSPE compared to that of postgraduate students/residents taught using embalmed specimens. With the increasing challenges in obtaining donated cadavers experienced in many parts of the world, the use of plastinated specimens as a supplementary educational tool will bring about in a new era in the teaching and learning of anatomy.

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