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A study to compare the utility of plastinated versus formalin emersed preserved specimens based on undergraduate students feedback

Ruchika Dhankar, Sushma K Kataria, Bharat and Leena Raichandani

Abstract
Aim and Objective: To evaluate the utility of plastinated models for detailed study, to increase the depth of the knowledge of anatomical structure and receive the feedback regarding the quality of plastinated specimens versus formalin specimens by MBBS 1st year students.
Material and Methods: The present study has been conducted in Department of Anatomy, Dr. S.N medical college, Jodhpur. The formalin preserved specimens were labeled as group A and plastinated specimens were labeled as group B. Questionnaire for Group A was provided to the students prior to demonstration of plastinated specimen. Group B questionnaire was provided after the demonstration of plastinated specimens and feedback received regarding the plastinated specimen and formalin preserved specimens were collected from the MBBS 1st year students.
Results: Plastinated specimens was more preferred because they have excellent longevity, easy to hold, devoid of unpleasant formalin odour, students agree that we can use these plastinated models in day to day demonstrations. According to the feedback of students toward the formalin & plastinated specimen – students agreed that plastinated specimens were more helpful in understanding 3-D orientation of specimens and internal structure of organ. Most of questions have significant P value.
Conclusion: Plastinated specimens can be a better alternate of formalin preserved specimens. Plastinated models are utilized as teaching aid & anatomical museum models.

Keywords: medical education, museum models, plastinated specimens, questionnaire

Introduction
In the medical colleges formalin has been used for years to preserve the cadavers. In recent times formaldehyde has paying attention due to its health hazards. Inhalation is the main way to exposure the formaldehyde, where it is absorbed by the lungs and through gastrointestinal tract and lesser extent through the skin [7]. In the museum, specimens are preserved in jars with formalin; if formalin solution reduced in volume specimen appears decolorized and pungent odor arises. We cannot touch the specimen from bare hand due to formalin present in chemical solution in which specimens preserved. [3, 8]. In the medical education, anatomist use human cadaver to teach medical students. The cadavers are used as educational tools. Different educational technologies are introduced in medical education to increase the depth of knowledge. The different type of models introduce in teaching methodology [6]. Recently plastination is a used for preservation of specimen. For educational purposes, plastination is a good method for construction of models for demonstration in day to day lectures, also for museum. Plastinated models are clean, dry, odorless, non- toxic, can handled with bare hand, not require any special jars for storage [4]. In our present study we used plastinated models for teaching MBBS 1st year student, these models prepared in our department by different methods.
Aim of this study to evaluate the utility of plastinated models for detailed study and to increase the depth of the knowledge of anatomical structure by MBBS 1st year students. Provides an important teaching and learning aid for students.
Objective of this study was to receive the feedback regarding the quality of plastinated specimens versus formalin specimens from the MBBS 1st year students.

Material and Method

The present study has been conducted in Department of Anatomy, Dr. S.N medical college, Jodhpur. We divided the specimens in 2 groups –

Group A-Specimens were prepared by formalin preservation method. The embalming fluid composed of formalin, glycerin, methanol and phenol. These cadavers will be stored in formalin (30-40%).

Group B-Specimens were prepared by plastination method. We selected sheet plastinated specimen of kidney & brain, luminal plastination of lung & heart.

Methods

To receive the feedback regarding the plastinated specimen and formalin preserved specimens from the MBBS 1st year students.

The feedback questionnaire was researcher made & prevalidated using peer teacher review using a pilot study carried out in 1st year MBBS students to assess the comprehension regarding the questionnaire. Total numbers of students were 250.

Questionnaire provided in two parts

1. Part A
2. Part B

Part A questionnaire provided to the students prior to the demonstration on plastinated models.

Part B questionnaire provided to the students after the demonstration on plastinated models.

11 closed ended questions in each part, each question was to be rated in Likert scale 1-5 (1- Strongly disagree, 2- Disagree, 3-neither agree or disagree, 4- agree, 5- strongly agree)

Students well informed about the questionnaire. The results were tabulated, compared and statistically analyzed.

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Questionnaire

Part – A Name - Age –

S. No.	Questions	Answers
1.	I know about plastination	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
2.	The formalin preserved specimens is clearly seen	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
3.	The spillage & leakage of formalin is disturbing & not much aesthetic	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
4.	Formalin preserved specimens is flexible	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
5.	There is difficulty in holding the formalin preserved specimens	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
6.	The internal structure is clearly distinguishable in formalin preserved specimens	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
7.	3-D orientation of structure &its spatial relationship can be visualized	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
8.	Formalin preserved specimens can preserved for decades with in jars	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
9.	The odor of formalin preserved specimens is distressing	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
10.	The fumes of formalin are causing irritation	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
11.	Difficult to use formalin preserved in day to day demonstration due to slippery &wet in texture	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree

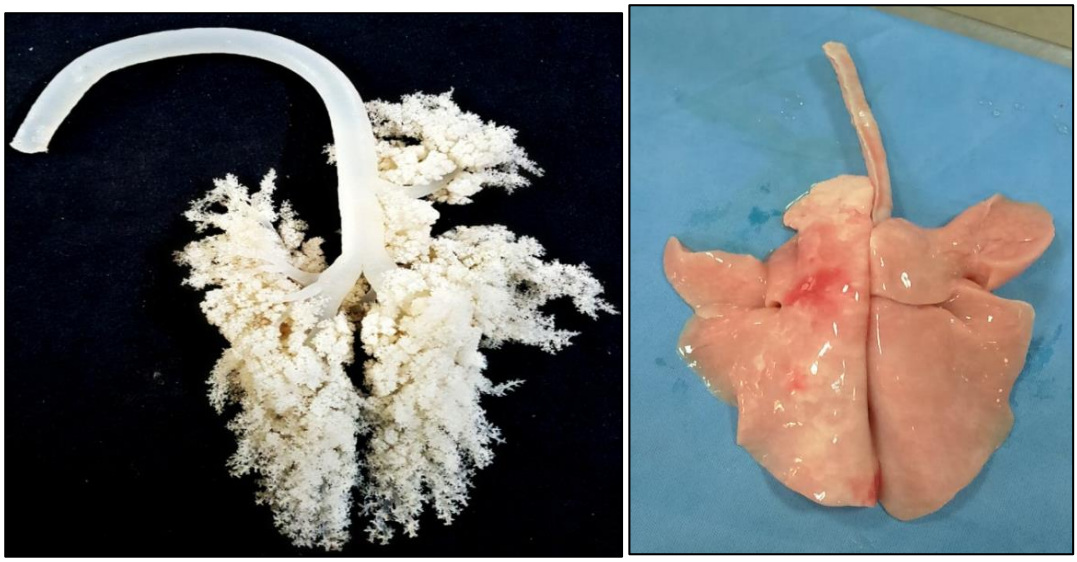
PART – B NAME - AGE –

S. No.	Questions	Answers
1.	I know about plastination	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
2.	Plastinated specimens can be seen more clearly than formalin	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
3.	Plastinated specimens is aesthetic & there is no issue of leakage & spillage of formalin, as in formalin preserved specimen	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
4.	Plastinated specimens is flexible	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
5.	Plastinated specimens is easy to handle	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
6.	In plastinated specimens internal structure of organ understood better	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
7.	Plastinated specimens is more helpful in understanding of 3-D orientation of structure & its spatial relationship	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
8.	Platinated specimens may replace wet cadaveric specimens in the future learning anatomy as it store indefinitely	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
9.	Learning on plastinated specimens has inspired me to study further anatomy as it is odorless	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree

10.	Plastinated specimens can be studied for several times as it has fumeless	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree
11.	Would you prefer to use these plastinated specimens in day to day demonstration	A)Strongly disagree B) Disagree C) Neither agree or disagree D) Agree E) Strongly agree

Plastinated models

Sheet plastination of kidney (in this segmental arteries, arcuate arteries, interlobular arteries are appreciable



Luminal plastination of lung (Bronchopulmonary segment seen after plastination)

Plastination of heart with arch of aorta (relationship of pulmonary trunk & ascending aorta appreciable)

3. Observation and Result

Table 1: Response of students to Part A questionnaire

S. No.	Questions	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
1.	I know about plastination	43 (17.26%)	84 (33.73%)	34 (13.65%)	72 (28.91%)	16 (6.42%)
2.	The formalin preserved specimens is clearly seen	03 (1.20%)	45 (18.07%)	25 (10.04%)	146 (58.63%)	30 (12.04%)
3.	The spillage & leakage of formalin is disturbing & not much aesthetic	06 (2.40%)	09 (3.61%)	24 (9.63%)	101 (40.56%)	109 (43.77%)
4.	Formalin preserved specimens is flexible	15 (6.02%)	25 (10.04%)	32 (18.47%)	134 (53.81%)	43 (17.26%)
5.	There is difficulty in holding the formalin preserved specimens	26 (10.44%)	45 (18.07%)	50 (20.08%)	107 (42.98%)	21 (8.43%)
6.	The internal structure is clearly distinguishable in formalin preserved specimens	02 (0.80%)	63 (25.30%)	104 (41.76%)	51 (20.48%)	29 (11.64%)
7.	3-D orientation of structure &its spatial relationship can be visualized	03 (1.20%)	61 (24.50%)	139 (55.82%)	29 (11.64%)	17 (6.82%)
8.	Formalin preserved specimens can preserved for decades with in jars	06 (2.40%)	63 (25.30%)	122 (49.00%)	52 (20.88%)	06 (2.40%)
9.	The odor of formalin preserved specimens is distressing	05 (2.00%)	18 (7.22%)	36 (14.45%)	134 (53.81%)	56 (22.48%)
10.	The fumes of formalin are causing irritation	08 (3.21%)	21 (8.43%)	25 (10.04%)	164 (65.86%)	31 (12.44%)
11.	Difficult to use formalin preserved in day to day demonstration due to slippery &wet in texture	04 (1.60%)	15 (6.02%)	100 (40.16%)	118 (47.38%)	12 (4.81%)

According to this table in Part A questionnaire (that provided before plastination demonstration) student's response for formalin preserved specimens are follows –

For quest no 1-50.99% students don't know about the plastination, only 35.33% students are knew about plastination, 13.65 % student's response is neutral.

For quest no 2-70.67% students says that internal structure in formalin preserved specimen is clearly seen,19.27 students says that internal structure not seen clearly, 10.04% students response is neutral.

For quest no 3-84.33% students says that they have problem with spillage & leakage of formalin during demonstration with formalin preserved specimen, only 6.01 % students are disagree & 9.63% students response is neutral.

For quest no 4-71.07% students response that formalin specimens are flexible, 16.06% students are disagree, 18.47% students response is neutral.

For quest no 5-51.41% students says that they have problem in holding the formalin specimen, 28.51% students don't have any problem during holding the specimen, 20.08% students response is neutral.

For quest no 6-32.12% students says that internal structure distinguishable in formalin specimen, 26.1% students disagree, 41.76% student's response is neutral.

For quest no 7-only 18.46% students are understand about 3-D orientation of structure & its spatial relationship, 25.7% students are not able to understand, 55.82% students response is neutral.

For quest no 8-23.20% students says formalin specimen can preserved for decades in jars, 27.70 % students are not agree with that & 49% students response is neutral.

For quest no 9-76.29% students have experienced that odour of formalin preserved specimen is distressing, 9.22% students disagree & 14.45% student's response is neutral.

For quest no 10-78.3% students says that fumes of formalin specimen cause irritation, 11.64%students not agree with that, 10.04% students response is neutral.

For quest no 11-52.19% students experienced that difficulty to holding the specimen due to its wet & slippery surface in day to day demonstration, 7.62% students disagree, 40.16% students response is neutral.

Table 2: Response of students to Part B questionnaire

S. No.	Questions	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
1.	I know about plastination	08 (3.21%)	04 (1.60%)	16 (6.42%)	141 (56.62%)	80 (32.12%)
2.	Plastinated specimens can be seen more clearly than formalin	06 (2.40%)	06 (2.40%)	20 (8.03%)	135 (54.21%)	82 (32.93%)
3.	Plastinated specimens is aesthetic & there is no issue of leakage & spillage of formalin, as in formalin preserved specimen	07 (2.81%)	09 (3.61%)	35 (14.05%)	131 (52.61%)	67 (26.90%)
4.	Plastinated specimens is flexible	08 (3.21%)	114 (45.78%)	53 (21.28%)	56 (22.48%)	18 (7.22%)
5.	Plastinated specimens is easy to handle	02 (0.80%)	08 (3.21%)	24 (9.63%)	112 (44.97%)	103 (41.36%)
6.	In plastinated specimens internal structure of organ understood better	01 (0.40%)	08 (3.21%)	50 (20.08%)	120 (48.19%)	70 (28.11%)

7.	Plastinated specimens is more helpful in understanding of 3-D orientation of structure & its spatial relationship	03 (1.20%)	22 (8.83%)	50 (20.08%)	101 (40.56%)	73 (29.31%)
8.	Platinated specimens may replace wet cadaveric specimens in the future learning anatomy as it store indefinitely	07 (2.81%)	17 (6.82%)	53 (21.28%)	101 (40.56%)	71 (28.51%)
9.	Learning on plastinated specimens has inspired me to study further anatomy as it is odorless	10 (4.01%)	08 (3.21%)	56 (22.48%)	112 (44.97%)	63 (25.30%)
10.	Plastinated specimens can be studied for several times as it has fumeless	01 (0.40%)	01 (0.40%)	15 (6.02%)	128 (51.40%)	104 (41.76%)
11.	Would you prefer to use these plastinated specimens in day to day demonstration	03 (1.20%)	08 (3.21%)	95 (38.15%)	115 (46.18%)	28 (11.24%)

According to this table in Part B questionnaire (that provided after plastination demonstration) student's response for formalin preserved specimens are follows –

For quest no 1-88.74% students says that they know about the plastination, 4.81% students don't know about that,6.42% students response is neutral.

For quest no 2-87.14% students says that plastinated specimen seen more clearly, 4.8% disagree, 8.3%students response is neutral.

For quest no 3-79.51%students experienced that there is no issue of leakage & spillage of formalin, 6.42%students disagree, and 14.02% students' response is neutral.

For quest no 4-48.99%students have experienced that plastinated specimens lost their flexibility, 21.28% students response is neutral

For quest no 5-86.33% students experienced that plastinated specimens are easy to handle.

For quest no 6-76.3% students are agrees that plastinated specimens are more helpful in understanding internal structure of organ.

For quest no 7-69.07% students are agrees that 3-D orientation of specimen & its spatial relationship easily understood by plastinated models.

For quest no 8-69.07% students agree that plastinated specimen may replace wet cadaveric specimen as it store indefinitely.

For quest no 9-70.27% students says that plastinated specimens are odorless

For quest no 10-93.16% students experienced that plastinated models are fumeless & these models can study for long duration without causing any irritation.

For quest no 11-57.42% students agree that we can use these plastinated models in day to day demonstration.

Table 3: Part A questionnaire according to the perception score.

S.No.	Questions	Score
1.	I know about plastination	2.73
2.	The formalin preserved specimens is clearly seen	3.62
3.	The spillage & leakage of formalin is disturbing & not much aesthetic	4.20
4.	Formalin preserved specimens is flexible	3.66
5.	There is difficulty in holding the formalin preserved specimens	3.21
6.	The internal structure is clearly distinguishable in formalin preserved specimens	3.17
7.	3-D orientation of structure &its spatial relationship can be visualized	2.98
8.	Formalin preserved specimens can preserved for decades with in jars	2.96
9.	The odor of formalin preserved specimens is distressing	3.88
10.	The fumes of formalin are causing irritation	3.76
11.	Difficult to use formalin preserved in day to day demonstration due to slippery &wet in texture	3.48

Table 4: Part B questionnaire according to the perception score

S. No.	Questions	Score
1.	I know about plastination	4.12
2.	Plastinated specimens can be seen more clearly than formalin	4.12
3.	Plastinated specimens is aesthetic & there is no issue of leakage & spillage of formalin, as in formalin preserved specimen	3.97
4.	Plastinated specimens is flexible	2.84
5.	Plastinated specimens is easy to handle	4.22
6.	In plastinated specimens internal structure of organ understood better	4.00
7.	Plastinated specimens is more helpful in understanding of 3-D orientation of structure & its spatial relationship	3.88
8.	Platinated specimens may replace wet cadaveric specimens in the future learning anatomy as it store indefinitely	3.85
9.	Learning on plastinated specimens has inspired me to study further anatomy as it is odorless	3.84
10.	Plastinated specimens can be studied for several times as it has fumeless	4.33
11.	Would you prefer to use these plastinated specimens in day to day demonstration	3.63

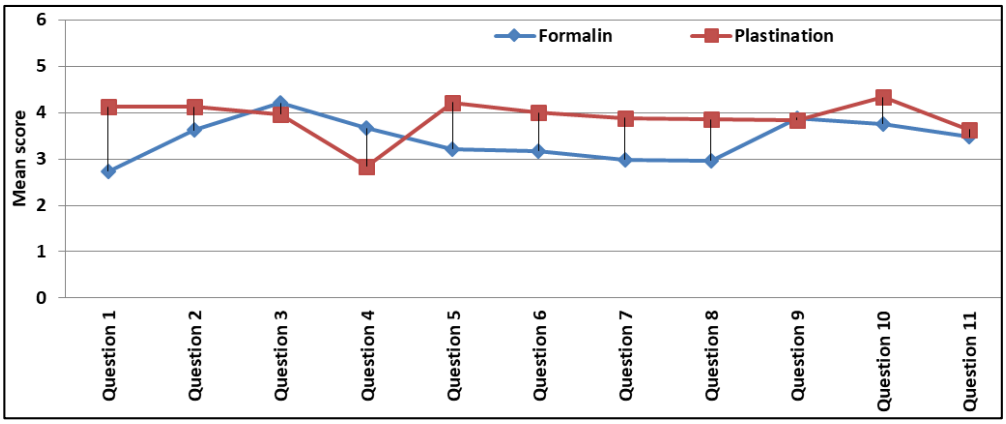


Fig 1: Mean score in both groups

Graph explains the mean score of each question for formalin preserved specimen & plastinated specimen. Plastinated specimens shows the high score

Table 5: Question 1 answer given for both groups with P value

Type of Answer	Formalin	Plastination	Total (%)	P value
A	43 (17.26%)	08 (3.21%)	51 (10.24%)	<0.0001
B	84 (33.73%)	04 (1.60%)	88 (17.67%)	<0.0001
C	34 (13.65%)	16 (6.42%)	50 (10.04%)	0.011
D	72 (28.91%)	141 (56.62%)	213 (42.77%)	<0.0001
E	16 (6.42%)	80 (32.12%)	96 (19.27%)	<0.0001
Total	249	249	498	
Mean ±SD	2.73 ±1.22	4.12±0.85		<0.0001

Table 6: Question 2 answer given for both groups with P value

Type of Answer	Formalin	Plastination	Total (%)	P value
A	03 (1.20%)	06 (2.40%)	09 (1.80%)	0.501
B	45 (18.07%)	06 (2.40%)	51 (10.24%)	<0.0001
C	25 (10.04%)	20 (8.03%)	45 (9.03%)	0.531
D	146 (58.63%)	135 (54.21%)	281 (56.42%)	0.366
E	30 (12.04%)	82 (32.93%)	112 (22.48%)	<0.0001
Total	249	249	498	
Mean ±SD	3.62±0.95	4.12±0.84		<0.0001

Table 7: Question 3 answer given for both groups with P value

Type of Answer	Formalin	Plastination	Total (%)	P value
A	06 (2.40%)	07 (2.81%)	13 (2.61%)	0.778
B	09 (3.61%)	09 (3.61%)	18 (3.61%)	0.999
C	24 (9.63%)	35 (14.05%)	59 (11.84%)	0.165
D	101 (40.56%)	131 (52.61%)	232 (46.58%)	0.009
E	109 (43.77%)	67 (26.90%)	176 (35.34%)	0.0001
Total	249	249	498	
Mean ±SD	4.20 ±0.92	3.97 ±0.89		0.005

Table 8: Question 4 answer given for both groups with P value

Type of Answer	Formalin	Plastination	Total (%)	P value
A	15 (6.02%)	08 (3.21%)	23 (4.61%)	0.200
B	33 (13.25%)	09 (3.61%)	42 (8.43%)	0.0002
C	46 (18.47%)	24 (9.63%)	70 (14.05%)	0.006
D	134 (53.81%)	124 (49.79%)	158 (31.72%)	0.419
E	21 (8.43%)	84 (33.73%)	105 (21.08%)	<0.0001
Total	249	249	498	
Mean ±SD	3.45 ±1.02	4.07 ±0.93		<0.0001

Table 9: Question 5 answer given for both groups with P value

Type of Answer	Formalin	Plastination	Total (%)	P value
A	26 (10.44%)	02 (0.80%)	28 (5.62%)	<0.0001
B	89 (35.74%)	08 (3.21%)	97 (19.47%)	<0.0001
C	35 (14.05%)	24 (9.63%)	59 (11.84%)	0.165

D	78 (31.32%)	112 (44.97%)	190 (38.15%)	0.002
E	21 (8.43%)	103 (41.36%)	124 (24.90%)	<0.0001
Total	249	249	498	
Mean ±SD	2.91±1.19	4.22±0.81		<0.0001

Table 10: Question 6 answer given for both groups with P value

Type of Answer	Formalin	Plastination	Total (%)	P value
A	02 (0.80%)	01 (0.40%)	03 (0.60%)	0.999
B	11 (4.41%)	08 (3.21%)	19 (3.81%)	0.641
C	08 (3.21%)	50 (20.08%)	58 (11.64%)	<0.0001
D	123 (49.39%)	120 (48.19%)	243 (48.80%)	0.857
E	105 (42.16%)	70 (28.11%)	175 (35.14%)	0.001
Total	249	249	498	
Mean ±SD	4.27±0.79	4.00±0.80		0.0002

Table 11: Question 7 answer given for both groups with P value

Type of Answer	Formalin	Plastination	Total (%)	P value
A	03 (1.20%)	03 (1.20%)	06 (1.20%)	0.999
B	09 (3.61%)	22 (8.83%)	31 (6.22%)	0.026
C	26 (10.44%)	50 (20.08%)	76 (15.26%)	0.004
D	149 (59.83%)	101 (40.56%)	250 (50.20%)	<0.0001
E	62 (24.90%)	73 (29.31%)	135 (27.10%)	0.313
Total	249	249	498	
Mean ±SD	4.03±0.77	3.87±0.97		0.047

Table 12: Question 8 answer given for both groups with P va**lue**

Type of Answer	Formalin	Plastination	Total (%)	P value
A	06 (2.40%)	07 (2.81%)	13 (2.61%)	0.778
B	26 (10.44%)	17 (6.82%)	43 (8.63%)	0.201
C	41 (16.46%)	53 (21.28%)	94 (18.87%)	0.207
D	155 (62.24%)	101 (40.56%)	256 (51.40%)	<0.0001
E	21 (8.43%)	71 (28.51%)	92 (18.47%)	<0.0001
Total	249	249	498	
Mean ±SD	3.63±0.86	3.85±1.00		0.011

Table 13: Question 9 answer given for both groups with P value

Type of Answer	Formalin	Plastination	Total (%)	P value
A	05 (2.00%)	10 (4.01%)	15 (3.01%)	0.294
B	18 (7.22%)	08 (3.21%)	26 (5.22%)	0.069
C	36 (14.45%)	56 (22.48%)	92 (18.47%)	0.028
D	134 (53.81%)	112 (44.97%)	246 (49.39%)	0.059
E	56 (22.48%)	63 (25.30%)	119 (23.90%)	0.528
Total	249	249	498	
Mean ±SD	3.87±0.90	3.84±0.97		0.703

Table 14: Question 10 answer given for both groups with P value

Type of Answer	Formalin	Plastination	Total (%)	P value
A	08 (3.21%)	01 (0.40%)	09 (1.80%)	0.043
B	21 (8.43%)	01 (0.40%)	22 (4.41%)	0.021
C	25 (10.04%)	15 (6.02%)	40 (8.03%)	0.137
D	164 (65.86%)	128 (51.40%)	292 (58.63%)	0.001
E	31 (12.44%)	104 (41.76%)	135 (27.10%)	<0.0001
Total	249	249	498	
Mean ±SD	3.75±0.89	4.33±0.64		<0.0001

Table 15: Question 11 answer given for both groups with P value

Type of Answer	Formalin	Plastination	Total (%)	P value
A	04 (1.60%)	03 (1.20%)	07 (1.40%)	0.703
B	16 (6.42%)	08 (3.21%)	24 (4.81%)	0.143
C	43 (17.26%)	42 (16.86%)	85 (17.06%)	0.905
D	148 (59.43%)	115 (46.18%)	263 (52.81%)	0.004
E	38 (15.26%)	81 (32.53%)	119 (23.90%)	<0.0001
Total	249	249	498	
Mean ±SD	3.80±0.83	4.05±0.85		0.0009

Discussion

For long term preservation of organs & parts of cadaver plastination play an important role. Even though they are costlier, plastinated specimens are dry, non- toxic,durable odorless, fumeless, easy to handle, require less maintenance and not require special jars to store, easy to transport. Internal structure of specimen is more understood by these models. [2]

The purpose of this study to evaluate the utility of plastinated specimens for anatomy learning by MBBS 1st year students

Previously this type of study done by Kishwor bhandari *et al* 2016 stated that according to the feedback of the students, the 3-D structures was clearly seen in plastination specimen than wet specimen. Students were agreed that plastinated specimens are dry, non- toxic and light so it is easy to hold in the hand [2].

Kaori tamura *et al* 2014 stated that 98.6% of participants agreed that the plastinated specimens were helpful in understanding the 3-D orientation of anatomical structures. [5]

ATM Emdadul Haque *et al* 2017 stated that 56.6% of respondents agreed that platinated can be seen more clearly compared to the wet specimen. 69.9% of respondents agreed that plastinated specimen is easier to hold. 59.4% of respondent agreed that plastinated specimen is more helpful in differentiating structures [1].

The findings of the present study were in consistent with the previous studies. In the present study, According to the feedback of students toward the formalin & plastinated specimen- (Table no 1&2).

Plastinated specimens was more preferred because they were devoid of formalin odor (70.27%) and easier to handle (86.33%), majority of students agreed that plastinated specimen could enhance the learning anatomy (93.16%).

87.14% students agreed that plastinated specimens seen more clearly than formalin preserved specimens. 76.3% students agreed that plastinated specimen is more helpful in understanding internal structure of organ.

Luminal cast plastination of lung bronchopulmonary segments the students understood the complex structure of primary bronchus & its further divisions. Bronchial tree was not visible & it was assumed in cadaveric specimens.

In plastinated models of heart with ascending aorta, pulmonary trunk, arch of aorta & branches of arch of aorta brachiocephalic artery, left common carotid artery, left subclavian artery. Its spatial arrangement, Curvature & diameter are clearly seen. Origin of thoracic aorta from right to left was not clearly understand from the cadaver as it was anteriorly hidden by the supplementary structures.

Each kidney is supplied by a renal artery, divided into segmental arteries & these further divided in to interlobar artery then into arcuate artery & then in to interlobular artery, these are end arteries. This view is not possible in the cadaveric specimen. In sheet plastination of kidney this view is clearly visible & understandable

In the present study 69.07% students also agreed that 3-D orientation of specimen & its spatial relationship easily understood by plastinated models.

This result is similar of the study done in Malaysia by ATM Emdadul Haque *et al*. 2017 and Kishwor bhandari *et al* 2016.

According to present study 57.42% students agree that we can use these plastinated models in day to day demonstrations.

In this present study feedback of students towards the questionnaire (11 questions in each part) of both groups compared, most of questions have significant P value (Significant difference obtain from both groups, table no 9 to table no 19).

Average score also calculated according to the response given by the students for part A & part B questionnaire,we used likert scale & score given according to that-1- strongly disagree, 2-disagree, 3- neither agree nor disagree, 4- agree, 5- strongly agree.

Score calculated by –

1. multiply the number of students selecting each rating by the corresponding rating value (1-5)
2. add the results of those calculations together
3. divided that result by the total number of response to the question

Plastinated specimens obtain more score compare to formalin specimens, conclude that students are agree with plastinated specimens (table no 7 & 8).

The topic of plastination seemed to be still new and did not have enough exposure to the students; therefore there are few students who are unaware of this matter.

Conclusion

Plastinated specimens can be a better alternate of formalin preserved specimens. Plastinated models are utilized as teaching aid & anatomical museum models. Students are also agreed that plastinated models help in understanding the 3-D orientation of organs & its spatial relationship. Through luminal cast plastination of lung students can understood about bronchial pattern which not visible by cadaveric specimen. Sheet plastination of kidney appreciate the division of renal artery in kidney which also not visible by cadaveric specimen. Even though the initial cost of plastination is significantly higher than formalin preservation, advantages like better handling, no odour and most importantly the long term preservation without any degradation make it an ideal preservation technique

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