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Original Research Article

Medical Students' Feedback Regarding Sheet Plastinated Kidney Section Versus Formalin Fixed Kidney Section

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Abstract

Background: In Human Anatomy subject, dissection of cadaver has been the main source of learning macro-anatomy or gross anatomy. Plastination is an innovative technique to preserve the body or body parts, first developed by Gunther von Hagens in 1977. Students' feedback is having pivotal role in reviewing the effectiveness of any newer teaching learning methods.
Materials and Method: Feedback was obtained from 157 medical students of 2nd semester of Phase I MBBS regarding the formalin fixed kidney specimen as well as plastinated kidney specimen (questionnaires prepared based on 5 point Likert scale) after taking due permission from Institutional Ethics Committee as well as after taking consent from all the participants by conducting these four sessions in the dissection hall: Demonstration and self-study of coronal section of formalin fixed kidney specimen, Distribution of questionnaire based on formalin fixed kidney specimen, Demonstration and self-study of sheet plastinated kidney specimen, Distribution of questionnaire based on sheet plastinated kidney specimen.
Results & Conclusion: Most of the students agreed that the sheet plastinated specimen is more clearly seen, aesthetic, easy to handle, internal structure of the organ understood better, and it can be studied for several times. Further they stated that the sheet plastinated specimen may replace the wet cadaveric specimen in the future learning of anatomy and they would prefer to use these sheet plastinated specimens in day-to-day demonstration classes. Plastination has a great future in all fields of teaching and research. Natural appearance of the specimens makes the plastination a boon for anatomy learners.

Keywords: Medical student, Feedback, Formalin fixed, Plastination, Kidney specimen.

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Introduction

Ultimate aim of the medical education is to produce knowledgeable, skillful and professional health care provider. [1] Training in the preclinical basic sciences form a strong foundation over which the piles of the knowledge of para-clinical and clinical subjects can be made easily. [2] In Human Anatomy subject, dissection of cadaver has been the main source of learning macro-anatomy or gross anatomy. [3] Use of innovative teaching learning methods or tools while teaching preclinical subjects, provides backbone to convert complex concepts into simpler one. [4] Plastination is an innovative technique to preserve the body or body parts, first developed by Gunther von Hagens in 1977. [5] In this technique, the water and fat present in the tissue are replaced by certain plastic material, which makes them dry, non-toxic, durable and the same can be touched, do not smell or decay, and even retain its original properties. [6-11] Different methods of plastination are: sheet plastination, luminal plastination, whole organ plastination. [12] Students' feedback plays pivotal role in assessing and reviewing the effectiveness of any newer teaching learning methods or tools to be introduced in medical education. [13-16] Analysis of student feedback is very important to know about the extra needs of students for their learning, lacunae and strength of teaching and learning process. Further it will also evaluate the effectiveness of teaching and learning methods. Thus, student feedback is having pivotal role in generating the ideas for the improvement and modification of curriculum of any subject. [17-21]

Aims & objectives of the study:

- To obtain the medical students' feedback regarding the formalin fixed kidney specimen.
- To obtain the medical students' feedback regarding the sheet plastinated kidney specimen.
- To compare and correlate the medical students' feedback regarding sheet plastinated kidney specimen and the formalin fixed kidney specimen.
- To find out the possibility to use the sheet plastinated specimen as an alternative newer educational tool to the formalin fixed specimen.
- To find out the possibility to use sheet plastinated specimen as a supplementary educational tool over and above the formalin fixed specimen

Materials & Methods:

This study was conducted in the Department of Anatomy, Banas Medical College & Research Institute, Palanpur, Gujarat, India in December 2021 after obtaining due permission from Institutional Ethics Committee. 157 medical students of 2nd semester of Phase I MBBS participated in this study. All 157 participants had given their consent for the voluntary participation in this research project. Specimens of formalin fixed kidney section (coronal) as well as sheet platinated kidney (showing coronal section) available in the Department of Anatomy; Banas Medical College & Research Institute, Palanpur, Gujarat, India were used in the present study.

Table 1: Questionnaires based on the formalin fixed kidney specimen

MEDICAL STUDENT'S FEEDBACK QUESTIONNAIRE (PART A) – FORMALIN FIXED KIDNEY SECTION

Roll number:_____Semester:_____Email address:_____
Mobile number:_____Age (Years):_____Gender: Male/Female

Please grade the following questionnaires as 1- Strongly disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly agree

Sr No	Questions	1	2	3	4	5
1	I have heard about sheet plastination					
2	The formalin specimen is clearly seen					
3	The spillage & leakage of formalin is disturbing					
4	There is difficulty in holding the formalin preserved kidney specimen					
5	The internal structure is clearly distinguishable in formalin preserved kidney specimen					
6	The fumes of formalin are causing irritation					
7	The odor of formalin specimen is distressing					
8	Spatial orientation of the organ in the body can be visualized					
9	Formalin specimen is flexible					
10	We can easily dissect the formalin specimen					
11	Formalin specimen can be preserved for decades within jars					

Table 2: Questionnaires based on plastinated kidney specimen

MEDICAL STUDENT'S FEEDBACK QUESTIONNAIRE (PART B) – SHEET PLASTINATED KIDNEY SECTION

Roll number:_____Semester:_____Email address:_____
Mobile number:_____Age (Years):_____Gender: Male/Female

Please grade the following questionnaires as 1- Strongly disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly agree

Sr No	Questions	1	2	3	4	5
1	I know about sheet plastination					
2	Sheet Plastinated specimen can be seen more clearly					
3	Sheet Plastinated specimen is aesthetic					
4	Sheet Plastinated specimen is not very much flexible					
5	Sheet Plastinated specimen is easy to handle					
6	In sheet plastinated specimen internal structure of organ understood better					
7	Sheet Plastinated specimen is more helpful in understanding of 3-D orientation of structure & its spatial relationship					
8	Sheet Platinated specimen may replace wet cadaveric specimens in the future learning anatomy					

9	Learning on sheet plastinated specimens has inspired me to study further anatomy					
10	Sheet Plastinated specimens can be studied for several times					
11	Would you prefer to use these sheet plastinated specimens in day-to-day demonstration?					

Questionnaires were prepared in two parts, Part A based on the formalin fixed kidney specimen (Table 1) and Part B based on the sheet plastinated kidney specimen (Table 2) by using Likert's five points scale method (1- Strongly disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly agree). Both the sets of questionnaires were validated by using peer teacher review as well as by using a pilot study carried out in MBBS students to assess the comprehension regarding the questionnaire. During dissection session of kidney in the dissection hall, after dividing all the participants in 6 batches (each batch having 26 to 27 students) following four sessions were conducted:

1. Demonstration and self-study of coronal section of formalin fixed kidney specimen: Faculties of Department of Anatomy demonstrated the coronal section of formalin fixed kidney to all the batches of participants. After completing the demonstration session, time was given to all the batches for the self-study of the coronal section of formalin fixed kidney.
2. Distribution of questionnaire based on formalin fixed kidney specimen (Part A- Table 1): The questionnaire, based on formalin fixed kidney specimen was circulated among all the participants via a link of Google form and responses were obtained in the Google drive.
3. Demonstration and self-study of sheet plastinated kidney specimen (showing coronal section): Faculties of Department of Anatomy demonstrated the sheet plastinated kidney specimen to all the batches of participants. After completing the demonstration session, time was given to all the batches for the self-study of the sheet plastinated kidney specimen.
4. Distribution of questionnaire based on sheet plastinated kidney specimen (Part B- Table 2): The questionnaire, based on sheet plastinated kidney specimen was circulated among all the participants via a link of Google form and responses were obtained in the Google drive.

Responses for both the sets of questionnaires were retrieved in the Excel sheet from the Google drive. Response 1 (strongly disagree) and 2 (disagree) of each question were clubbed together and considered as disagree/ dissatisfactory/ inadequate. The response "3 (neutral)" was considered median bias as per Likert's scale and was omitted while making inferences. Response 4 (agree) and 5 (strongly agree) were clubbed together and considered as agree/ satisfactory/ adequate. The results were tabulated, compared, graphed and statistically analyzed.

Results:

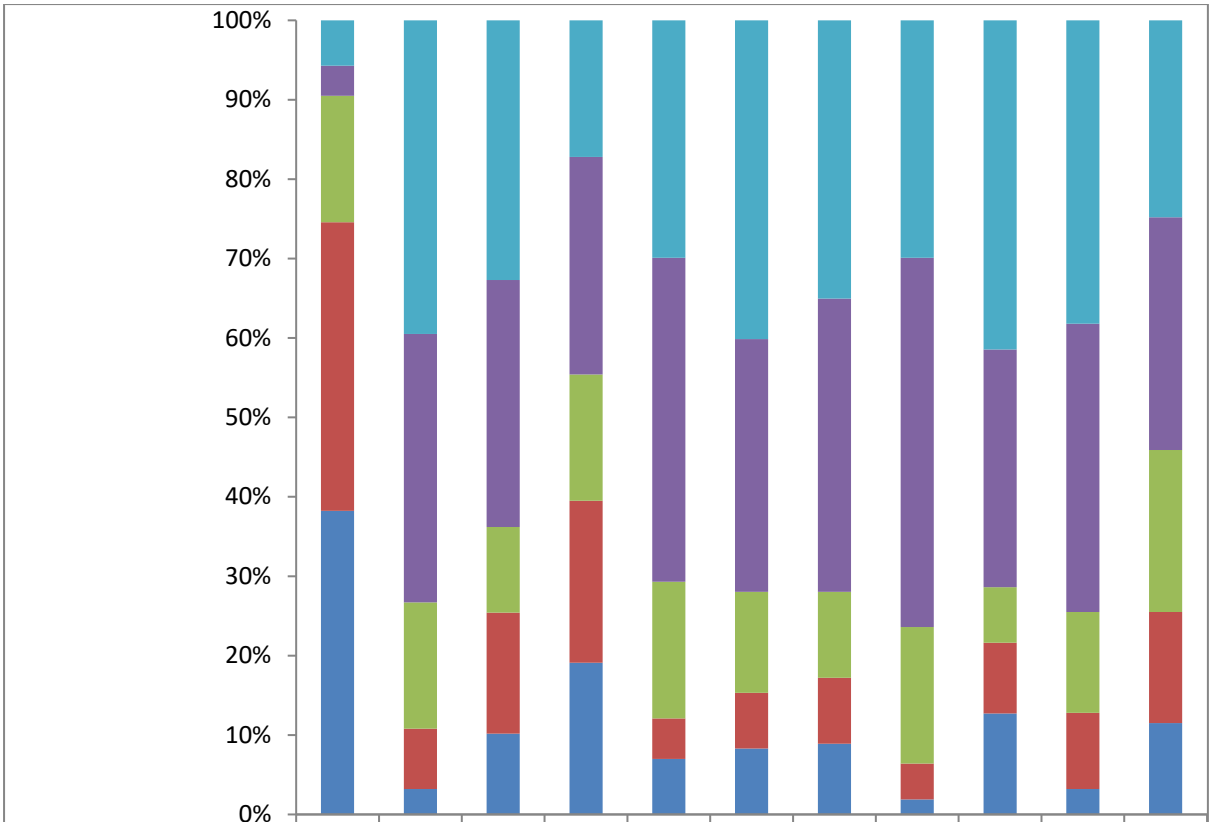
Table 3: Responses (in percentages) of the questionnaire based on the formalin fixed kidney specimen

Sr No	Questions	Disagree Responses [1+2]	Agree Responses [4+5]
1	I have heard about sheet plastination	74.5 %	9.5 %
2	The formalin specimen is clearly seen	10.8 %	73.3 %

3	The spillage & leakage of formalin is disturbing	25.5 %	64.0 %
4	There is difficulty in holding the formalin preserved kidney specimen	39.5 %	44.6 %
5	The internal structure is clearly distinguishable in formalin preserved kidney specimen	12.1 %	70.7 %
6	The fumes of formalin are causing irritation	15.3 %	71.9 %
7	The odor of formalin specimen is distressing	17.2 %	71.9 %
8	Spatial orientation of the organ in the body can be visualized	6.4 %	76.4 %
9	Formalin specimen is flexible	21.6 %	71.3 %
10	We can easily dissect the formalin specimen	12.8 %	74.5 %
11	Formalin specimen can be preserved for decades within jars	25.5 %	54.1 %

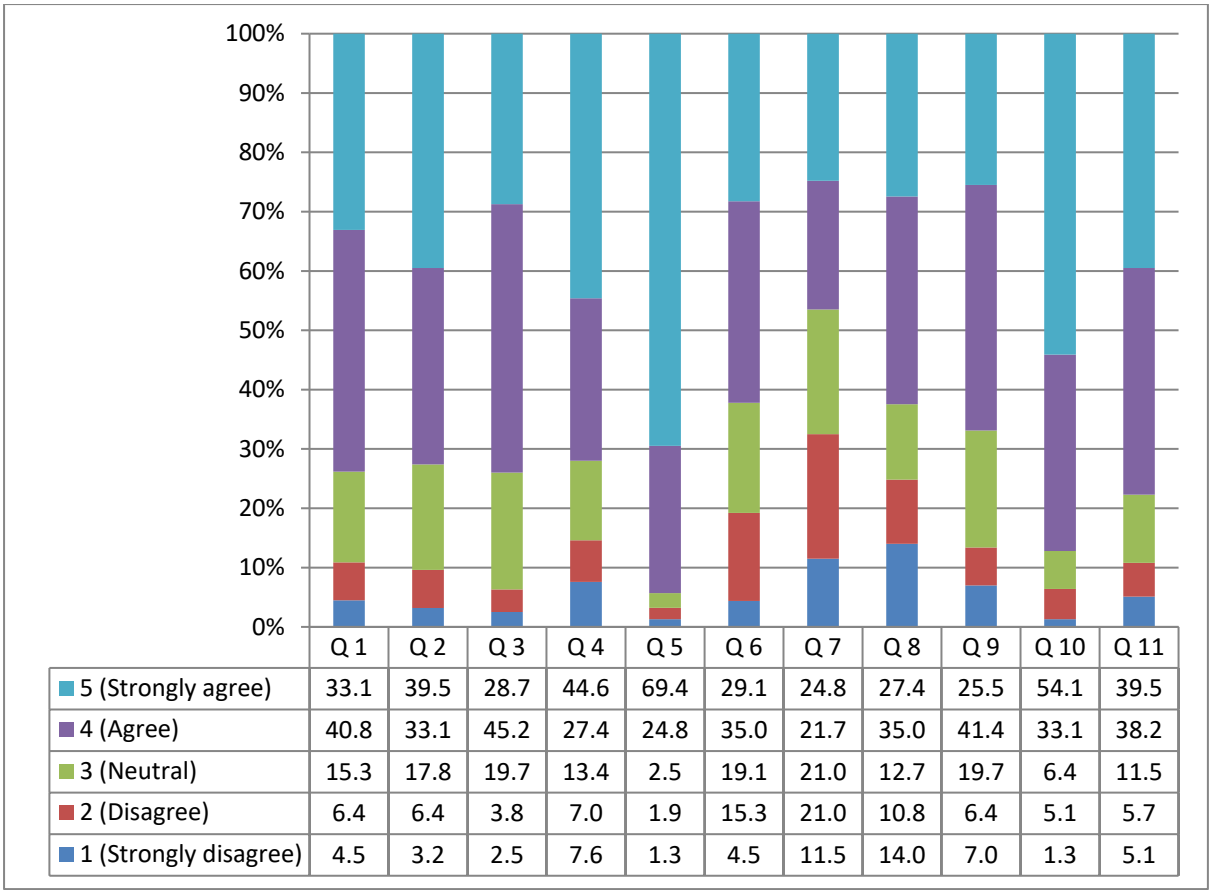
Table 4: Responses (in percentages) of the questionnaire based on the sheet plastinated kidney specimen

Sr No	Questions	Disagree Responses [1+2]	Agree Responses [4+5]
1	I know about sheet plastination	10.9 %	73.9 %
2	Sheet Plastinated specimen can be seen more clearly	9.6 %	72.6 %
3	Sheet Plastinated specimen is aesthetic	6.3 %	73.9 %
4	Sheet Plastinated specimen is not very much flexible	14.6 %	72.0 %
5	Sheet Plastinated specimen is easy to handle	3.2 %	94.2 %
6	In sheet plastinated specimen, internal structure of organ understood better	19.8 %	64.1 %
7	Sheet Plastinated specimen is more helpful in understanding of 3-D orientation of structure & its spatial relationship	32.5 %	46.5 %
8	Sheet Platinated specimen may replace wet cadaveric specimens in the future learning anatomy	24.8 %	62.4 %
9	Learning on sheet plastinated specimens has inspired me to study further anatomy	13.4 %	66.9 %
10	Sheet Plastinated specimens can be studied for several times	6.4 %	87.2 %
11	Would you prefer to use these sheet plastinated specimens in day to day demonstration?	10.8 %	77.7 %



	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10	Q 11
5 (Strongly agree)	5.7	39.5	32.8	17.2	29.9	40.1	35.0	29.9	41.4	38.2	24.8
4 (Agree)	3.8	33.8	31.2	27.4	40.8	31.8	36.9	46.5	29.9	36.3	29.3
3 (Neutral)	15.9	15.9	10.8	15.9	17.2	12.7	10.8	17.2	7.0	12.7	20.4
2 (Disagree)	36.3	7.6	15.3	20.4	5.1	7.0	8.3	4.5	8.9	9.6	14.0
1 (Strongly disagree)	38.2	3.2	10.2	19.1	7.0	8.3	8.9	1.9	12.7	3.2	11.5

Figure 1: Responses (in percentages) of the questionnaire based on the formalin fixed kidney specimen



	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10	Q 11
5 (Strongly agree)	33.1	39.5	28.7	44.6	69.4	29.1	24.8	27.4	25.5	54.1	39.5
4 (Agree)	40.8	33.1	45.2	27.4	24.8	35.0	21.7	35.0	41.4	33.1	38.2
3 (Neutral)	15.3	17.8	19.7	13.4	2.5	19.1	21.0	12.7	19.7	6.4	11.5
2 (Disagree)	6.4	6.4	3.8	7.0	1.9	15.3	21.0	10.8	6.4	5.1	5.7
1 (Strongly disagree)	4.5	3.2	2.5	7.6	1.3	4.5	11.5	14.0	7.0	1.3	5.1

Figure 2: Responses (in percentages) of the questionnaire based on the sheet plastinated kidney specimen

Table 3 & 4 as well as graph 1 & 2 are showing the final results after the statistical analysis of the medical students' feedback regarding formalin fixed specimen and sheet plastinated specimen.

According to the feedback obtained, many students have not heard about plastination technique before explaining the same by the faculties. Majority of students said that the spillage and leakage of the formalin fixed specimen is disturbing, fumes of formalin are causing irritation, odour of formalin specimen is distressing and to do fine dissection of formalin specimen for them is a difficult task. They have also agreed that the formalin fixed specimens are flexible and can be preserved for decades within the jar.

After demonstrating the sheet plastinated specimen, majority of students voted that the sheet plastinated specimen is more clearly seen, aesthetic, easy to handle, internal structure of the organ understood better, and it can be studied for several times. The study of sheet plastinated specimens inspires them to study further in anatomy as well as boosted their interest in studying anatomy. Most of the students said that the sheet plastinated specimen may replace the wet cadaveric specimen in the future learning of anatomy and they would prefer to use these sheet plastinated specimens in day-to-day demonstration classes.

Discussion:

Anatomy is a fundamental educational science in medical universities. In the study of anatomy, the use of gross specimens is mandatory. [22-23] Decay of this material is an impediment to all morphological studies, teaching and research. Thus, the preservation of biological materials becomes essential for them to be used as an educational tool. Their preservation is most commonly

achieved by using liquids such as formaldehyde, alcohol and glycerine. [24] A prolonged exposure to high concentrations of formalin can not only discolour the specimens, but it also makes them toxic, hazardous, fragile and unpleasant to use. The tissues which are fixed in formalin require periodic wetting to prevent them from drying. Inhaled formaldehyde is proven to cause carcinoma. Moreover, the repeated handling of these specimens may lead to a disturbance in the relationship of the structures, making them inappropriate for anatomy teaching. Specimens are unpleasant to work with due to formalin vapour emitted and require lots of maintenance as they rapidly deteriorate and dry out. [25]

In present study we used an alternative approach called "plastination" to study and teach gross anatomy specimens using silicone polymers. The process is simple, inexpensive, and can be carried out in any laboratory to produce dry, odourless, durable, life-like, maintenance-free, and nonhazardous specimens. In this study we used formalin fixed preserved specimen for plastination purpose. Plastinated specimen provides good visual appearance with clear surface detail. They exhibit an excellent contrast between adipose tissue which appears white and all other parenchyma. The plastinated section provides confirmation that the slices obtained by MRI are a true representation of that area of the body. Potential drawback of plastination is the possibility of shrinkage of the tissue during the processing. Sheet plastination is currently used in teaching and research to produce anatomical slices of many different body structures or anatomical regions. These kinds of anatomical specimens allow the undergraduate medical students to study in detail and faculties to teach with high precision, either easy or complex anatomical structures. The purpose of this work is to reveal the potential utility of sheet plastinated sections to learn and to interpret 3D topographical relationships of anatomical structures that exhibit a complex anatomic path. Using serial thin slices, either the physician or the medical student can represent the three-dimensional anatomy for better understanding of the topographical relationships.

Conclusion:

Plastinated specimens are an excellent alternative to formalin-fixed specimens for various teaching learning activities in Anatomy. The sheet plastinated specimens are dry, odorless, easy to demonstrate the gross morphological details over the formalin in which high concentrations of formalin can not only discolour the specimens, but it also makes them toxic, hazardous, fragile and unpleasant to use. The principle behind plastination is that the water and fat of the tissues are replaced by certain plastic materials, due to which specimens not only retain most properties of the original sample but also do not smell or decay. Plastination has a great future in all fields of teaching and research. Natural appearance of the specimens makes the plastination a boon for anatomy learners.

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