

Plastination in the teaching of Neuroanatomy

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SUMMARY

The development of plastination has allowed the introduction of novel tools into Anatomy teaching. The plastinated specimen is dry, odourless, durable and non-toxic. The aim of the present study was to compare the value of plastinated and formalin-preserved specimens in the teaching of Neuroanatomy. A survey was conducted of Neuroanatomy students concerning the use of plastinated and formalin-preserved specimens, investigating which technique preserved better, which allowed longer use of the specimen, and which produced specimens that were more faithful to reality and easier to handle, and also which technique was preferred by the students, establishing the degree of satisfaction obtained with each. The results were subjected to statistical analysis.

Plastination was considered to preserve specimens better by 88% of the study population, and 99% reported that the plastinated specimens were faithful to reality. They were considered equally realistic by 46%, whereas 37% thought plastinated specimens were more realistic. Plastinated specimens were considered by 99% of the students to offer easier handling by 99% of the students and were preferred to formalin-preserved ones by 92%

of the study population, providing a higher degree of satisfaction. Plastination is a highly valuable tool for the teaching of Neuroanatomy.

Key words: Plastination techniques – Teaching – Neuroanatomy

INTRODUCTION

For many years, the most widely used technique to obtain human specimens for anatomy teaching has been formalin preservation. However, evaporation from these specimens produces high exposure of students and professors to formaldehyde. Many studies have been conducted on daily formalin emission rates in anatomy labs and on strategies to control such exposure (Keil et al., 2001; Ryan et al., 2003). Exposure to formalin has adverse health effects, including ocular, nasal, throat, and skin irritation (Mizuki and Tsuda, 2001; Tanaka et al., 2003; Kunujita et al., 2004). Occupational exposure to formalin has also been reported to be a causative agent of asthma (Kim et al., 2001), multiple chemical sensitivity (Kunujita, 2003), nasal mucosal disorders (Burgaz et al., 2001), and respiratory disorders (Kriebel et al., 2001).

All the above underlines the need for protective measures to be taken in the anatomy lab, and several studies have reported the efficacy of wearing specific masks and goggles to reduce exposure to formalin (Akbar-Khanzadeh and Pulido, 2003; Tanaka et al., 2003). Another approach is to seek alternative preservation techniques, among which plastination developed by Von Hagens in the 1980s, is the most recent (Saeed et al., 2001). In plastination, water and lipids are replaced by a curable polymer that hardens to provide a dry, odourless, durable and non-toxic specimen (Von Hagens et al., 1987).

Plastination has enabled the range of human specimens available for anatomic teaching to be broadened (Jones, 2002). Moreover, some authors have reported a student preference for plastinated specimens (Mansor, 1996) and others have concluded that the educational value of plastinated specimens is equivalent to or greater than that of formalin-preserved specimens and that they offer improved handling (Bickley et al., 1981; Bickley et al., 1987; Ibegbu et al., 2003). The use of plastinated specimens has been proposed for the teaching of other disciplines, including pathology, radiology, and surgery (Dawson et al., 1990).

In Human Neuroanatomy, the low availability of human brains for practical classes coupled with their fragility adds importance

to the search for more durable specimens that can be easily handled by students. The use of silicon (e.g., S-10) plastination has produced durable and life-like specimens that correctly identify brain structures, among other advantages (Ulfig and Wuttke, 1990; Wu and Haase, 1996; Baeres and Moller, 2001; Wadood et al., 2001). The present study was designed to compare the degree of satisfaction of neuroanatomy students between plastinated and formalin-preserved specimens.

METHODS

The study population comprised all 179 2nd-year students of Medicine attending Neuroanatomy classes at our School of Medicine. A 13-item questionnaire (see Annex) was developed and administered to the students, and the results were analyzed using the SPSS (VERSION) software package. Outlier values were not considered in the analyses. Formalin-preserved specimens and plastinated specimens (S-10 technique) were used in the study.

Following a descriptive statistical analysis, predictive multivariate analysis was performed, simultaneously analyzing two or more variables. Since qualitative (degree of satisfaction) and quantitative (the plastination or formalin preservation techniques) variables were considered, they were analyzed by means of ANOVA.

ANNEX: QUESTIONNAIRE

1. **Sex:** Male Female

2. **What importance do you consider Anatomy to have in your course?**

Very little	Little	Average	Important	Very Important
1	2	3	4	5

3. **What importance do you consider practical classes have for understanding Neuroanatomy?**

Very little	Little	Average	Important	Very Important
1	2	3	4	5

4. **Indicate the effects you have noted from the prolonged handling of formalin-preserved specimens in Neuroanatomy practical classes:**

- Irritation of eyes
- Dizziness
- Breathing difficulties
- Unpleasant odour

5. **Have you worked with plastinated specimens?**

Yes No

6. Which specimens are better preserved after handling by students?

Formalin-preserved Plastinated

7. Are plastinated specimens faithful to reality?

Yes No

8. What degree of realism, with regard to structural details, is shown by plastinated versus formalin-preserved specimens?

Plastinated specimens are more realistic
 The two techniques are equally realistic
 Plastinated specimens are less realistic

9. Which samples were easier for you to handle?

Formalin-preserved Plastinated

10. List the advantages of:

Formalin-preservation	Plastination
_____	_____
_____	_____

11. If you could choose to work with a plastinated or formalin-preserved specimen in your Practical class, which would you prefer?

Formalin-preservation	Plastination
Why? _____	_____
_____	_____

12. Express your degree of satisfaction with the two techniques:

	Very little	Little	Average	Important	Very Important
Formalin	1	2	3	4	5
Plastination	1	2	3	4	5

RESULTS

One hundred-seventy nine students were included in the study, 74% women and 26% men. Anatomy was described as an important or very important subject in their degree course by 85% of the students, and practical classes were considered by 94% of them to be important or very important for understanding neuroanatomy.

Plastination was considered to preserve specimens better as compared with formalin preservation by 88% of the students (Fig. 1); 99% of them described plastinated specimens as realistic (Fig. 2), with 46% considering both types equally realistic and 37% describing plastinated specimens as more so; 99% found that plastinated specimens offered better handling (Fig. 3); and 92% of the study

Figure 1.

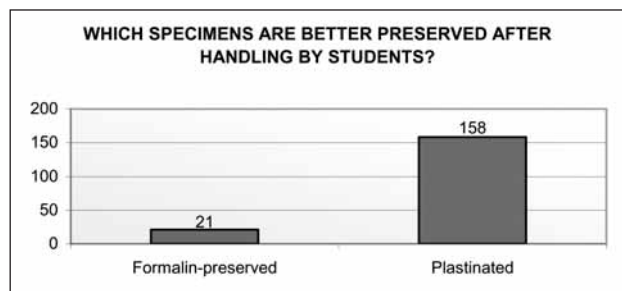


Figure 2.

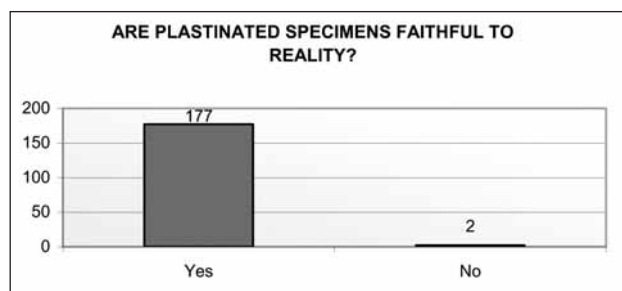


Figure 3.

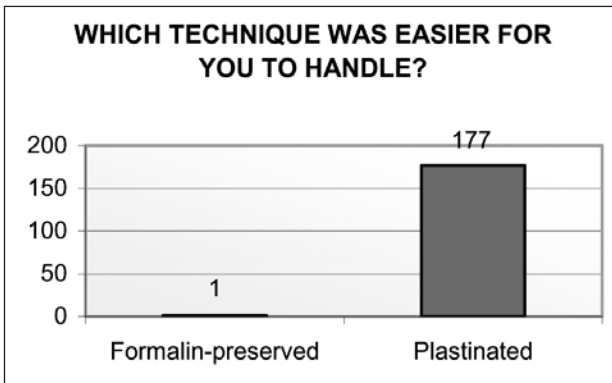


Figure 4.

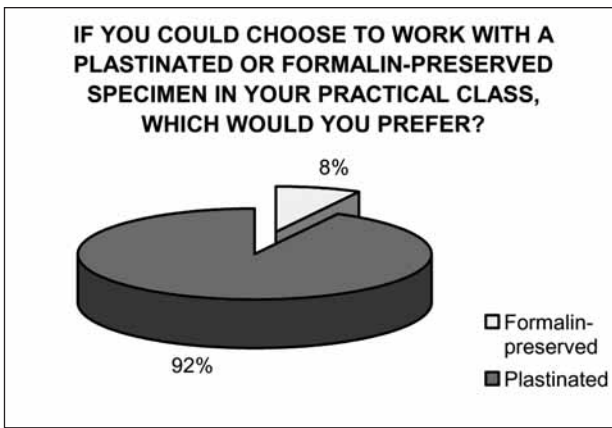
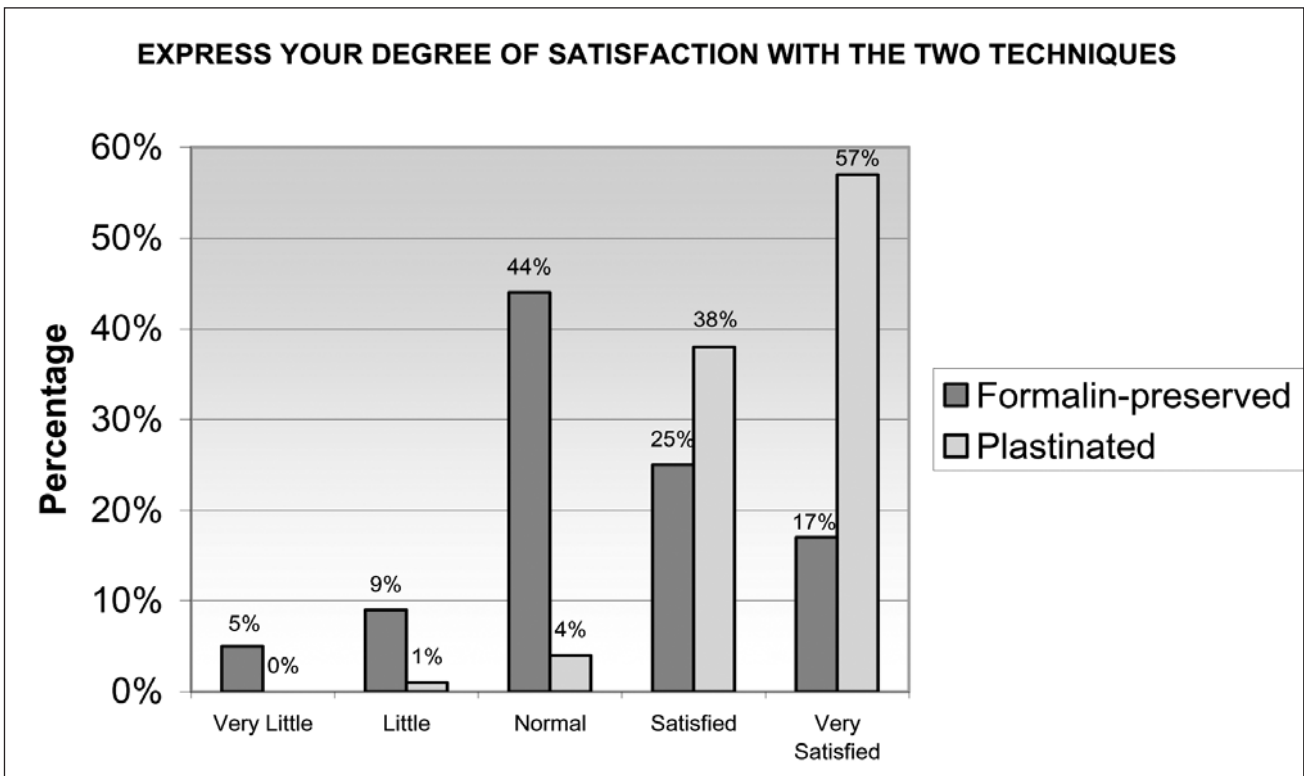


Figure 5.



population preferred plastinated to formalin-preserved specimens (Fig. 4).

The use of plastinated or formalin-preserved specimens had a significant influence on the degree of satisfaction expressed by the students, the analysis of means revealing that plastination offered the higher degree of satisfaction (Fig. 5).

DISCUSSION

Human Anatomy is an essential pillar of medical education and practical classes are an important part of the course, as confirmed by the students of Neuroanatomy in the present study. These students reported ocular and nasal irritation and a disagreeable odour when formalin-preserved specimens were handled in the anatomy lab; i.e., negative effects widely associated with exposure to formalin (Kunujita et al., 2004; Tanaka et al., 2003; Mizuki and Tsuda, 2001). Plastination avoids these problems, producing odourless, non-toxic specimens that are also easy to handle (Von Hagens et al., 1987; Weiglein, 1997), virtually all (99%) of the students in our study considering them easier to handle as compared with formalin-preserved specimens. A vast majority of them (88%) also believed that plastinated specimens were better preserved

after handling. Almost all (92%) of the students expressed a preference for plastinated versus formalin-preserved specimens, confirming the results of Dawson et al. (1990) and Mansor (1996).

Nearly every students (99%) considered the plastinated specimens to be faithful to reality. Only 17% of the students believed the formalin-preserved specimens were more realistic, whereas 83% considered the plastinated specimens to be equally or more realistic. Mansor (1996) published similar results, concluding that plastination is preferred by students but that, in his view, ideally both techniques should be used in the lab. There have been previous reports of the major advantages offered by plastination in the specific field of neuroanatomy (Weiglein, 1997). Moreover, the students in the present study expressed a significantly higher degree of satisfaction with plastinated versus formalin-preserved specimens.

These results contribute to the body of evidence supporting the great usefulness of plastination in medical education.

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