Bangladesh Journal of Anatomy January 2019, Vol. 17, No. 1, pp. 21-24

Comparison of Changes in Flexibility of Goat Livers Using Silicone (S10) Plastination

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Abstract

Introduction: *Plastination is a process intended to preserve the biological specimens in the field of educational and research purposes. The plastinates are natural looking, dry, odourless and highly durable. But during dealing with plastination in research, there are some other problems that may arise such as shrinkage, changes in flexibility and colour. So for getting good quality plastinates, it should be tried to minimise the shrinkage, changes in flexibility and colour. This research is designed to compare the effect of temperature on the changes in the flexibility of goat livers. Objective of this study is to compare the percentage of change in flexibility of goat liver in different stages of silicone (S10) plastination at cold temperature with those at room temperature.*

Methods: *A total of twelve (12) goat livers were collected from two government authorised slaughter houses of Dhaka. The percentages of changes in flexibility were calculated for different stages of plastination at cold temperature and at room temperature. This experimental study was carried out in the department of Anatomy, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.*

Result: *The overall mean (± SD) percentage change in flexibility was 95.90+1.74% at cold temperature group and it was 96.86+1.29% in room temperature group.*

Conclusion: *The concept of plastination is new in Bangladesh. So to produce good quality plastinates, it is essential to find out some techniques that are feasible in Bangladesh.*

Key words: *Forced impregnation, formalin, silicone plastination, acetone, dehydration, cold temperature*

Introduction

Plastination is a modern method of biological specimen preservation. Whole specimens, dissected specimens and cross-sectional slices can be preserved permanently into materials that are clean, dry and practical to use, without the irritation and potentially harmful effects of older preservative liquids such as formaldehyde.[1] Moreover, the storage and transportation of the plastinated specimens are much easier and cheaper than those preserved by other methods. This technique yields most delicate specimens with great surface detail and little flexibility.[2]

As various factors may contribute to the determination of the quality of the plastinates, sometimes the results are not as satisfactory as expected. Changes in the shape, bulk, colour, flexibility and other visible defects (e.g., deformations and spots on the organ surfaces) are produced during plastination. The common reasons for these defects depend on different factors which include temperature, dehydration medium, tissue quality, durations of fixation, dehydration, forced impregnation and curing as well as use of old formalin-fixed specimens.[3] The aim of the study is to compare the percentage of change in the flexibility of goat liver at different stages of silicone (S10) plastination at cold temperature with those at room temperature.

Materials and methods

A total of 12 livers from approximately 1 year-old goats were collected from two government authorised slaughter houses of Bangladesh. Six (06) goat livers were taken for each temperature group (room temperature group and cold temperature group). Of the six (06) livers, three (3) were kept

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whole and three (3) were sectioned longitudinally into three (3) pieces each. Both a whole and sectioned goat livers was considered as individual sampling unit. Each of these units was numbered with a tag. The change in flexibility was measured from each sampling unit. At the fresh stage and after every stage of plastination the percentages of change in flexibility were calculated. The overall changes in flexibility was also measured (i.e., from the fresh stage to the end of plastination).

In this study, the flexibility was measured using a locally built measuring instrument. The instrument has different parts including circular plate, scale, metallic indicator, wooden frame and screw (Figure 1). After placing the organ on a platform, it was compressed with the circular plate vertically. The linear downward movement of the plate down was measured on a scale attached to it. The first value was taken when the circular plate just touched the organ. Each organ yielded a value from the first to the last value on the scale beyond which no compression was possible.At first fixation was done. The procedures were same for both temperature groups. All the goat livers (whole and sectioned) were placed inside a plastic bucket containing 10% formalin for 5 days.[4] The bucket should be covered with a plastic lid. After fixation, the organs (whole and sectioned) were rinsed in running tap water for over night to remove excess formalin. Then a plastic container was filled with acetone for dehydration.

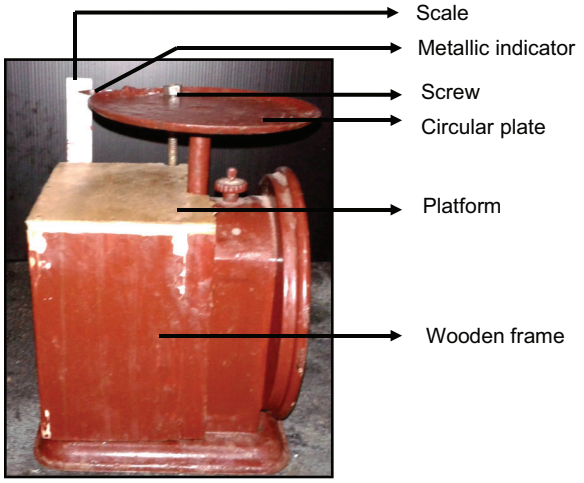

Fig.-1: *The specially constructed flexibility measuring instrument.*

The amount of acetone was five times more than the volume of all the goat livers. Then the goat livers (whole and sectioned) were kept in acetone.

Fig.- 2: *Plastination kettle.*

For gas-curing, the organs were placed in the curing chamber on absorbent papers (Figure 3). The cross linker BIODUR® S6 (20 cc) and some amount of the desiccant ($CaCl_2$) were put in the curing chamber. Then the chamber was closed and S6 was helped to vapourise using a small ventilator fan for twenty (20) minutes two times a day. Every day the surfaces of whole and sectioned organs were manicured and whole and sectioned goat livers were exposed to gas-curing agent (S6) until the surface remained dry.

Fig.- 3 *Gas-curing chamber.*

Results

After fixation, the mean percentage of change in flexibility was significantly greater at cold temperature (yielding lesser flexibility) than at room temperature but it was significantly lesser at cold temperature (yielding greater flexibility) after dehydration (Table 1).

Table I

Comparison of percentage change in flexibility goat liver in the different stages of plastination at cold temperature with that at room temperature

Stage of plastination	No. of organs (for each group)		No. of pieces (for each group)	Percentage of gross shrinkage by volume Mean ± SD Median (25th and 75th percentile) Room temperature	Cold temperature	Probability (p) and significance	
Fixation	Whole	3	3	16.51 ± 6.47	30.22 ± 12.64		
	Sectioned	3	9	16.19 (10.51, 21.46)	30.14 (16.55, 39.82)	0.009	S
Dehydration	Whole	3	3	71.35 ± 8.34	45.41 ± 16.96		
	Sectioned	3	9	70.34 (64.89, 79.59)	47.22 (35.18, 60.73)	0.00	S
Forced	Whole	3	3	61.07 ± 17.97	56.93 ± 12.34		
impregnation	Sectioned	3	9	65.15 (47.62, 78.18)	55.83 (46.59, 68.84)	0.33	NS
Curing	Whole	3	3	58.19 ± 13.24	71.39 ± 13.73		
	Sectioned	3	9	55.00 (50.00, 66.67)	75.00 (60.00, 85.12)	0.04	S
Overall changes	Whole	3	3	95.90±1.74	96.43±1.68	0.45	NS
changes(from fresh stage to the end of plastination	Sectioned	3	9	96.05 (94.90,97.44)	97.41 (94.69, 97.60)		

S: Significant (Pd"0.05); NS: Non-significant

The mean percentage of change in flexibility was lesser (giving greater flexibility) at cold temperature after forced impregnation. But the differences between the two temperature groups were not statistically significant (Table I). After gas-curing, the mean percentage of change in flexibility was significantly greater at cold temperature (yielding lesser flexibility) (Table I). The overall mean (± SD) percentage change in flexibility was 95.90+1.74 at cold temperature and it was 96.86+1.68 in room temperature (Table I).

Discussion

On fixation stage, the percentage of change in flexibility was significantly greater at cold temperature (showing lesser flexibility) than room temperature. Akhter[6] also observed in her study that the percentage of change was significantly greater at cold temperature (depicting lesser flexibility) for the pig lung. In this study, the percentage of change in flexibility was significantly lesser at cold temperature suggesting greater flexibility on dehydration stage, whereas Akhter[6] found it significantly greater in pig lungs at cold temperature than at room temperature. The percentage of change in flexibility was lesser (depicting greater flexibility) on forced impregnation at cold temperature than at room temperature but was not statistically significant. On gas-curing stage, the percentage was significantly greater at cold temperature (showing lesser flexibility). But Akhter[6] found it significantly lesser (showing greater flexibility) at cold temperature for the pig lungs. The overall mean (± SD) percentage change in flexibility was lesser (95.90+1.74) at cold temperature group and greater (96.86+1.29) in room temperature group, but was not statistically significant.

Conclusion

Plastinated specimens are being increasingly appreciated not only as training tools but also as research means throughout the different medical

institutions. Through the plastination method, good quality and cost effective plastinates may be obtained that can be used as effective teaching-learning tools in Bangladesh.

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