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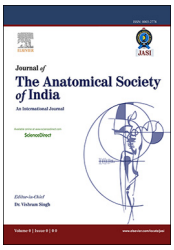

Original Article

Colour plastination – A valuable tool for medical education

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ABSTRACT

Introduction: Plastination is the process in which water and lipids in biological tissues are replaced with curable polymers. Colouring of structures of the specimen adds beauty and clarity. The aim of present study is to obtain coloured plastinates using chemical reagents which give colour to biological tissues that withstand the steps of plastination and use them for teaching purpose.

Materials and methods: Colouring of arteries, veins, nerves, aponeurosis and tendons was done by applying the reagents sequentially on tissues and then plastinated using the Standard S10 technique.

Results: The colours withstood the process of plastination. The colour remained stable over the years.

Discussion: Colour plastination adds value to the plastinates as a teaching tool, by highlighting regions of interest, thereby forming an important adjunct in anatomical education.

1. Introduction

Plastination is the process by which the biological tissues are preserved with curable polymers.[1] In this process, water and lipids in biological tissues are replaced by curable polymers (silicone, epoxy, polyester).[2] These polymers are subsequently hardened within the specimen, resulting in dry, odourless and durable specimens which allow easy handling and storing.[2] Plastination aids to preserve natural anatomical specimens in a durable, realistic and aesthetic manner for teaching and research purposes.[3]

It is a common practice to colour the anatomical specimens for aesthetic values. The coloured specimens are displayed in Anatomy museum. Here, an attempt has been made to obtain coloured plastinates according to Steinke and Spanel, 2006, and use it for teaching purpose.[4]

2. Materials and methods

The specimens selected for the colour plastination were obtained from cadavers donated to the Dept. of Anatomy of our institution for the purpose of teaching and research. Embalming was done in the routine manner using

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formalin-based preservatives. The specimens selected for colour plastination included

Heart	fibrous skeleton, coronary arteries
Cubital fossa	artery, vein, nerve and aponeurosis
Foot	ligaments
Lung	bronchial tree
Kidneys and spleen	artery and vein

The specimens were dissected meticulously. Various anatomical structures like artery, vein, nerve and fibrous rings/aponeurosis/ligaments were coloured with red, blue, yellow and green respectively using different chemical reagents as described by Steinke and Spanel.[4]

Reagent I	Ferric chloride 3 ml + 15 ml H_2O
Reagent II	Potassium hexacyanoferrate 1.5 g + 40 ml H_2O
Reagent III	Lead nitrate 4 g + 20 ml H_2O
Reagent IV	Potassium bichromate 4 g + 20 ml H_2O (hot)
Reagent V	Tannic acid 3 g + 20 ml H_2O (air proof)
Reagent VI	Ammonium carmine 2 g + 20 ml ammonia
Reagent VII	Alum potassium 5 g + 20 ml H_2O (hot)

In order to obtain the required colour, the following reagents were used in a sequential manner on the tissue:

Chrome yellow	reagents III + IV
Blue	reagents II + I
Red	reagents IV + V + VI + VII
Orange	reagents III + IV + VI + VII
Green	reagents III + IV + II + I

After colouring the specimens, plastination was done using the Standard S-10 technique. The specimens were dehydrated in acetone bath at −25 °C, vacuum impregnated in S10/S3 mixture (100:1) and gas cured using S6 (Biodur, Germany).

3. Results

The colour penetrated into the specimen and withstood the process of plastination including dehydration, vacuum impregnation and curing. Coloured plastinates obtained were stable and permanent even after 3–4 years after plastination despite exposure to light and heat (Fig. 1).

4. Discussion

Plastination has revolutionised the way in which the human body can be presented to students.[5] Complicated anatomical structures can be demonstrated using plastinates. These plastinates overcome the disadvantage of formalin-fixed specimens which are wet and irritating to eyes and the airways. Plastinated organs show better preservation of morphology and structure than those preserved in formalin.[6] They also facilitate 'out of the dissection hall' teaching because they are dry and odourless. Plastination has established itself as an essential contributor to the teaching armamentarium of clinical anatomists.[5] Plastinates are superior to the synthetic models, because of their ability to reflect anatomical variations.[7] Although not a replacement for traditional dissections, plastination provides an additional learning tool for long-term preservation and for teaching complex human anatomy.[8]

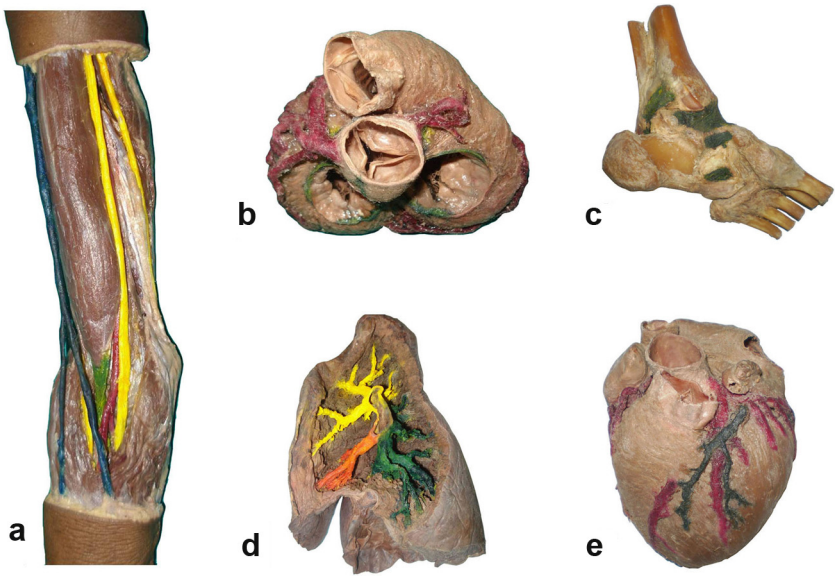

Fig. 1 – Colour plastinates prepared in our Department using appropriate colour codes. a, cubital fossa showing contents; b, fibrous ring of the heart and coronary arteries; c, ligaments of the foot; d, bronchial tree; e, coronary arteries and cardiac veins.

Plastination is a lengthy process and one of the problems of plastination is tissue discolouration.[9] Hence, colouration of the plastinates is desired for the revitalisation of the tissues, for better differentiation. Colouring of plastinates has been tried by different researchers.[4,9–11] Plastinates can be coloured before or after plastination. While Steinke and Spanel coloured the specimens before plastination,[4] Sakamoto et al. mixed imidazole in the impregnation bath during vacuum impregnation.[10] Marchese et al. and McCreary et al. coloured the plastinates after curing using acrylic paint and silicone-based colouring respectively.[9,11] If imidazole is added in the impregnation mix, the entire specimen is introduced to colouration and plastinates lose their educational value.[9] Direct application of acrylic paint on the plastinates was done by Marchese.[11] The drawback of using acrylic paint in plastinates is that it leads to patchy colouring.[9] Repeated handling by students leads to peeling of the paint needing lacquer application or reapplication of paint.

The colour plastination technique used in this study was as described by Steinke and Spanel in 2006.[4] It was the modified version of the colouring technique described by Gyermek in 1908.[12] However, while Steinke and Spanel did the colour plastination on alcohol-fixed specimens, we used the technique on formalin-fixed specimens. The coloured plastinates thus obtained are permanent and easy to maintain. They have been routinely used for teaching. The colours remained stable during dehydration, vacuum impregnation and curing of specimen and also following repeated handling of the specimens by the students.

5. Conclusion

In our experience, colouring the specimen before plastination is simple, less laborious and permanent. Colour plastination adds value to the plastinates as a teaching tool, by highlighting regions of interest, thereby forming an important adjunct in anatomical education.

Conflicts of interest

The authors have none to declare.

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