

An Aesthetic Analysis of the Color Applied to Plastinated Human Anatomical Specimens

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Disclose and conflicts of interest: none to be declared by all authors

ABSTRACT

Introduction: aesthetics is a branch of philosophy that deals with the principles of beauty and artistic taste. The plastinated specimen offers both the student and the spectator a feeling that permeates the teaching-learning capacity of anatomy, but also offers an aesthetic appeal, whereby color becomes a fundamental element in the presentation. It is noted that the use of industrial paints or unsuitable materials sometimes does not correspond to the ideal natural color, and although they show the differences of the tissues in their anatomical constitution, they end up flaking and fading. This study analyzes, from the point of view of the senses, the “artistic or not” production of human sensitivity and the ability to provoke an aesthetic response. The objective of this study is to promote an aesthetic analysis on the use of color in plastinated products from the application of pigments in human anatomical specimens. An easy-to-apply paint was formulated, based on natural inorganic pigments and a binder, which was applied with an artistic brush on human specimens plastinated in the room temperature method for analysis of adhesion, integration and drying of the paint, before and after curing. It was noticed that the pigment layer of the paint remained inert after drying, and the maintenance of the color was shown to be permanent over 16 months. It is concluded that even without matching the natural color, the shade achieved, and the presentation mode of the plastinated anatomical specimen contribute to an improvement for the aesthetic appreciation of Anatomy.

Keywords: Art; Paint; Color; Anatomy.

Introduction

Aesthetics is a branch of philosophy that analyzes, from the point of view of the senses, the “artistic or not” aspect of human sensitivity and, therefore, the ability to provoke these aesthetic responses. In line with the concept of art-anatomy, there is an overlapping relationship between Renaissance and contemporary times, between body, art, anatomy, death and, subsequently, the exposure of the cadaver.

Although it is essential to bring a philosophical discourse to this reflection, it is necessary to understand a little about the concept of art-anatomy (Janeiro and Pechula, 2016). Art and anatomy traced paths that are sometimes independent and sometimes intertwined when we talk about the experience of the anatomical, human, and animal bodies.

The conjunction between art and anatomy includes an aesthetic breadth of anatomy, which has been recently reinforced by the technique of plastination, when Gunther von Hagens reproduces, in the imagery of plastinated anatomical specimens, representations that, before, were widely discussed and illustrated in the works of Jacopo Berengario of Carpi (1460-1530), Leonardo da Vinci (1452-1519), Michelangelo

Buonarotti Simoni (1475-1564), Juan Valverde de Amusco (1525-1588), among many others, over the centuries and up to the present day.

Between the anatomical iconography and the imagery constructed by the various anatomical authors, anatomists, and artists, as well as the evolution of scientific anatomical knowledge itself, it is impossible to disregard the aesthetic debate that reaches the present day, including the scientific exhibitions and their spectacular display. These images can also be accessed in digital form, which allows us to reflect on the aesthetic properties to which these images are subjected, and the way in which the aesthetic appeal is fundamental to the make-up of the image.

Among the various philosophical discourses about Aesthetics, Socrates (470-399 a.C.) is credited with giving legitimacy to the idea that it is possible to list three aesthetic categories: ideal beauty, spiritual beauty, and useful beauty (apud Eco, 2013). Plato (424-423 b.C.), in turn, would have made two elaborations about Beauty, one that manifests itself from harmony and proportion, and beauty as a splendor (apud ECO, 2013).

Since antiquity, beauty has been associated with the proportion and delicacy of color (and light), according to Isidoro de Sevilla (560-636 b.C.). For Tomás de Aquino (1225-1274), in the medieval period, the existence of beauty should be submitted not only to proportion, but also to its integrity, in this way, a mutilated body would be considered ugly (apud ECO, 2013).

Over the centuries, the presentation of the corpse in public and / or in private dissections has aroused repulsion, horror and discomfort as well as curiosity and fascination in its audiences (Talamoni, 2012). For Berleant (2011), one cannot ignore the aesthetic dimension that occurs in different instances of human experience, such as: religious, social, mystical, practical and / or cognitive.

And in this way, it is understood that, in addition to the impressions of the artist-anatomists and anatomist-artists, the spectator's appreciation contributes to the imagery construction of the plastinated specimen exposed physically or virtually, in the same way that it allows the understanding of the educational, symbolic, and spectacular function of the image.

The improvement of coloration in plastination has been the reason for several studies and publications about the attempts to verify the compatibility of industrialized artistic materials used in plastination painting.

The objective of this study is to apply staining to anatomical specimens plastinated with an appropriate ink and to discuss the relationship between aesthetics and anatomy from the specimens produced.

Materials and Methods

A deltoid muscle, a gastrocnemius and two upper limbs, belong to the collection of the Plastination Laboratory of the Life Sciences Museum of Federal University of Espírito Santo/Brazil were used in this study. These specimens were plastinated by the room temperature method (RT) (Starchik and Henry, 2019), fixed in 10% formalin, dissected, dehydrated in pure acetone, impregnated with silicone, and cured with TEOS (tetraethyl orthosilicate) crosslinker. The deltoid muscle was cured before painting, and the other specimens were cured after painting.

Two paints formulations were made, which were designated as Paint A and Paint B, according to their tonality. Paint A was composed by a binder and the inorganic pigment iron oxide red PR101, from which we obtained a dark brownish-red tint, and Paint B was composed by the same binder and the synthetic inorganic pigments dark cadmium red PR108 (Pintkor®, Brazil) and dark cadmium yellow PY35 (Pintkor®, Brazil). For comparison purposes, Paint A was darker and less luminous, and Paint B presented a brighter luminosity (Table 1). The binder was not specified because it is the object of studies under development with the possibility of patenting.

Table 1. Composition of inks and anatomical specimens used in the research.

Materials	Paint A	Paint B
Binder	Not specified	Not specified
Inorganic pigment	Iron oxide red PR101	Dark cadmium red PR108 and yellow cadmium dark PY35
Specimen(s) painted	Deltoid muscle Left upper limb Right upper limb	Gastrocnemius muscle

The choice of Paint A or B depended on the original color of the anatomical specimen at the beginning of the painting process. Specimens were not bleached with hydrogen peroxide prior to plastination and presented different shades due to formalin fixation. Thus, the specimens that presented a darker hue after plastination were painted with Paint A and those with a lighter hue were painted with Paint B (Table 1).

For the painting of the upper limbs with paint A, a support structure was created to assist in the process of observation and painting. The suspension of the specimen avoided contact between the moistened paint and a support, that could have interfered with the uniformity of the application and drying of the paint. As already mentioned, these specimens had already gone through all the stages of plastination, except for curing.

In order to verify whether before or after curing is more appropriate for painting, the deltoid muscle was painted after the curing step and the other specimens were worked on before curing (after impregnation and extensive drainage excess silicone). Before and after photographs of specimens were taken for comparison and discussion of results.

The study was approved by the Ethics Committee for Research with Human Beings at Ufes under number 67632223.8.0000.5060.

The proposed analysis is based on a qualitative assessment between the shades of paint A and paint B and before and after painting, related to the perceptive aspects and the aesthetic appeal that painting promotes in anatomical specimens. It was also verified the ideal time for applying the paint, whether before or after curing. Based on the considerations, the interface anatomy, plastination and aesthetics applied to the specimens produced will be discussed.

Results

The deltoid muscle received an application of Paint A (Figure 1), after completed all the stages of plastination process, to investigate the possibility of a good covering of the pigment layer, as well as the adhesion of the ink after curing.



Figure 1. Deltoid muscle impregnated with S10 and cured, before (A) and after (B) the application of paint A.

The gastrocnemius muscle went through all stages of plastination except for curing (Figure 1a). This specimen received the application of Paint B (Figure 2b), due to the lighter staining of the musculature. After painting, the specimen was cured, according to the protocol already described. The comparison between an unpainted and a painted specimen can be seen in Figure 2.

Figures 3 and 4 shows the meticulous stages of process of painting a pair of upper limb specimen with Paint A.

In a general manner, it was observed that the formulation of Paint A and B allowed, during and after the painting process, the recognition of the quality of the paint in relation to its viscosity, compatibility, adherence, and drying, before and after curing. It was also noted that the pigment layer after total drying, as well as the color saturation, remained inert over the last 16 months.

Regarding the best moment for painting to be before or after curing, it was observed that, in the case of striated muscle tissue, there is no objectively best



Figure 2. Comparison between two Gastrocnemius specimens plastinated, unpainted (a) and painted (b) with application of Paint B.



Figure 3. Process of paint application with brush by an experient artist.



Figure 4. Comparison between painted and unpainted parts.

moment. If there is a good dissection, the painting can be done before or after curing.

In more specific terms, we can reinforce the interpretation that the use of the red tone under two values of luminosity maintained the opacity and the covering power of the visual material. Immediately after applying the paint, the covering layer appeared shiny, due to the wetness of the paint, which changed after the complete drying of the paint, and finally, the curing of the specimen. Under physical criteria, it was noted that five months after the application of the ink, the pigment layer remained adherent, and on rubbing with a paper tissue there was little transfer of the red color. Currently, the specimens are permanently colored, without color transfer on contact.

Discussion

The formulation of an ink compatible with the substrate to be painted is justified because the common use of industrial paint or other inadequate materials do not correspond to the ideal and natural color of a plastinated specimen, and, although they can evidence the differences among tissues, they end up flaking and fading. These aspects have been a constant stimulus, so that several researchers stopped analyzing the mode and quality of staining of plastinated specimens (Steinke and Spanel-Borowski, 2005; Sakamoto *et al.*, 2006; Mendez *et al.*, 2008; McCreary *et al.*, 2013; Raof *et al.*, 2013; Iliff *et al.*, 2015; Steinke *et al.*, 2017; Bolyard *et al.*, 2020).

It can be confirmed that the application of the paint with the use of an artistic brush with soft bristles occurred in a fluid manner and with good spread and coverage, without complications between the properties of the brush and the substrate (the anatomical part).

In addition to other aspects that may be involved, an aesthetic debate generated from scientific exhibitions cannot be ignored today. This scenario also requires due sensitivity, on the part of those involved, to take into consideration, in addition to anatomical aspects, issues such as: color, visual presentation, and the

possible perceptions from both experts and the lay public.

We defend that plastination promotes a new aesthetic experience, whose fundamental aspect of color reinforces the scientific and artistic appeal of the plastinated specimen, having as reference the imagery related to the anatomical iconography established over time. We observed that the great challenge of reproducing a natural color remains, therefore, it is inevitable that a limit between what is real and what is representational still exists.

Considering the visual aspects of color, and the relationship of the red color with anatomical pieces for a better visual and symbolic identification, it is necessary to note that, in nature, there are an average of 105 shades of red.

Thus, it is proposed here that the union between art and anatomy during the process of plastination and coloring of an anatomical specimen, leading to its final presentation, should maintain an intrinsic and interlinked relationship, where the experience of each area can allow an exchange of knowledge and of procedures that can, finally, promote an aesthetic reflection, beyond the appreciation of a plastinated specimen.

Thus, the red tone resulting from the formulated paint will hold in its aspects the ambiguity of meanings characteristic to the interpretation and association to which the viewer will attribute in his fruition and perception. The aesthetic appeal arouses interest, curiosity, the affective association of the red color in its various symbolic conceptions between pleasure and disgust, the edification of life and terror, and corroborate the aesthetic, cultural, scientific, and social experience of the viewer.

In our experience, the knowledge and artistic experience related to the painting contributed to the process of application of the ink in these cases, since it is a thorough and selective process, whose result aims to maintain the fundamental anatomical characteristics to enhance accurate visual reading and interpretation. Just as the plastination process requires

an adequate duration of time in each of its steps, the painting/coloring also requires an understanding of its properties and its application and drying times.

Conclusion

It was found that the use of a binder and the mineral pigments in the paint formulation created a durable-colored pictorial layer on the surface of the plastinated specimen. In addition, it contributes significantly to the final appearance and aesthetic experience of the viewer.

It is concluded with this study that the use of color in plastination, already observed and practiced by plastinators is essential to add artistic principles and techniques in the field of plastination, in order

to promote an analysis of the aesthetic dimension of plastination anatomical parts in educational presentations and in exhibitions to large audiences. We believe that this research can contribute to the development of accessible and replicable painting protocols.

Ethics Statement

For studies with human donors and/or cadaveric tissue, it is mandatory to state the following paragraph "The authors state that every effort was made to follow all local and international ethical guidelines and laws that pertain to the use of human cadaveric donors in anatomical research (Iwanaga *et al.*, 2022).

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Mini Curriculum and Author's Contribution

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Received: October 27, 2023
Accepted: December 10, 2023

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