



IDENTIFICATION OF ORBITAL ARTERIES BY MEANS OF STAMP-PAD INK ON EMBALMED CADAVERS.

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ABSTRACT

Vascular identification is an effective way of analysing the vascular system from large to very small blood vessels in cadaveric studies. A variety of vascular injection products have been utilised over the past decades to facilitate and demonstrate dissection of the blood vessels. The coloured dye used to demonstrate the branching patterns of the vascular system was introduced by Jean Riolan (1580 to 1657) (Doomernik et al., 2016). Although different identification techniques are available, only a few can be used on the specimens during dissections. A total of 118 human eyes from 59 bodies were dissected and all blood vessels were exposed. The ophthalmic artery (OA) and its branches were identified by means of fine dissections. The aid of a lighted magnifying glass made fine dissections of small blood vessels possible. After removing the orbital fat around the blood vessels, the arteries were then smoothly painted with the red stamp-pad ink and a paintbrush. Specimens were then allowed to dry at room temperature before photographic capturing and recording of the OA and its branches in each of the specimens were made. An accurate identification of the arterial system was possible as the arteries were followed intra-orbitally from the point where the OA emerged from the optic canal on course with the optic nerve. All branches of the OA that were present were identified and recorded. The application of stamp-pad ink as a dye is useful in the marking and identification of anatomical structures and can be used in the anatomy training for both undergraduate and postgraduate students.

Keywords: Vascular, blood vessels, orbital arterial, cadaver, dissections, identification

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INTRODUCTION

Cadaveric dissections have been extensively used and made a major contribution to the knowledge of anatomy for many years and still remains the best available method for understanding the human anatomical structures (Limpastan et al., 2013; Doomernik et al., 2016). Definitive dissection is demanding and requires precision, experience, knowledge and skill to reveal, learn and understand the structures of a human body (Galvarez et al., 2017). Doomernik et al., (2016) states that vascular dissection and especially of the smaller blood vessels, can best be achieved with aid of

labelling and staining techniques. A number of vascular injection products such as latex, silicon, coloured dye and resin have been utilised over the past decades to facilitate identification and dissection of blood vessels. The use of coloured dye to demonstrate the branching patterns of the vascular system was already introduced by Jean Riolan in the early seventeenth century (Doomernik et al., 2016). Although different techniques are available, some are used prior to embalming and dissection while others are suitable for use on specimens during or after dissection. The latex, silicon, coloured dye, and resin

need to be injected into the arterial system prior to dissection. Data on available identification techniques used on specimens or bodies during and after dissection is lacking. A summary of staining and identification techniques used in vascular dissections is given in Table 1.

Vascular anatomy history

Dissections of vascular anatomy were first obtained from those by anatomists and Herophilus (circa 340 BC). They contributed to the early knowledge of vascular anatomy; Herophilus furthermore introduced the term "artery". Galen (circa 129 to 200 AD) established the basis of modern anatomy after his animal dissection and Andreas Vesalius performed extensive human dissections in the years 1537 to 1564. Marchello Malpighi and Antoni van Leeuwenhoek independently made the discovery of capillaries in 1661 to 1668 (Galvez et al., 2017).

Facilitation of vascular dissection is best achieved when guided by colour staining. Vascular staining or labeling techniques have been used since the sixteenth century to describe the vascular structures (Galvez et

al., 2017). Jean Riolan (1580 to 1657) was the first anatomist to inject the dyes intra-arterially to demonstrate the branching of the vascular tree (Bergeron et al., 2006).

Of the many staining and labeling techniques available for use, the coloured latex remains to be widely used as a visual guide during dissections (Bergeron et al., 2006), however, the identification procedure involves latex being injected at least two weeks post-embalming in order for it to penetrate and settle well in the arterial system after flushing the blood out (Alverina et al., 2010). In many cases the latex injection procedure poses problems, because bodies are not prepared and injected within the prescribed time frame. Furthermore, small blood vessels such as the orbital arteries make it technically difficult to inject the latex because of their size.

This study aims to introduce a vascular identification technique that can be used on a specimen after dissection, also highlights the advantages and limitations of the technique.

MATERIALS AND METHODS

Fifty-nine bodies were used and a total of 118 eyes were dissected. All eyes were exenterated, and further dissections were performed on a dissection tray. The ophthalmic artery (OA) and all its branches were exposed by means of fine dissections. A round size 16.6 mm artistic paintbrush was used to colour the OA and all its identifiable branches with the *dala* red stamp-pad ink (30m1) (Figure 1). This is a concentrated dye-based ink and was painted on the blood vessels until it was clearly visible on the specimen.

Following this, the specimens were then left on the surface table to air-dry before recording all the observations. All the arteries that were observed were recorded on a

datasheet form. Additionally, digital photographs were taken with a cellphone camera (LG G4) in the dissection room with lights switched off for best photographic quality. Several photographs were taken per specimen and the best ones among all these were selected and used for the study. Ethical approval for this study was granted by the Human Research Ethics Committee of the University of Free State with reference: HREC33/2016.

RESULTS

The correct identification of blood vessels was possible, and all dissected eyes were used because all the arteries that were exposed during dissection were visible. Figure 1 shows an example of the left eye when the OA was seen crossing superior to the optic nerve (ON).

The ophthalmic artery gives off several branches and the lacrimal artery is shown in the figure 3 indicated by the black arrow at point bifurcation. Figure 2 shows the ophthalmic artery crossing superior to the optic nerve and its orientation as it further gives off its branches.

Advantages of using the stamp-pad ink

One of the advantages of the use of the stamp-pad ink as colouring technique is that it can be corrected if the wrong structures

were painted. In our experience with one of the specimens in this study, the veins were mistakenly painted was noted when analysis was done on the specimen. The specimen was then placed in prepared formalin water for a period of five days to assist washing off the ink. The correct blood vessels were then identified, and the specimen was repainted. It is therefore very important to note the correct arterial vessels upfront before applying ink to the specimen. This colouring technique method was seen as better suited for this kind of dissection and identification. Although the ink is durable, one major limitation is that the coloured specimens may not be immersed in liquids for preservation as the dye may be affected and wear off. Moreover, the best preservation technique is plastination for longevity.

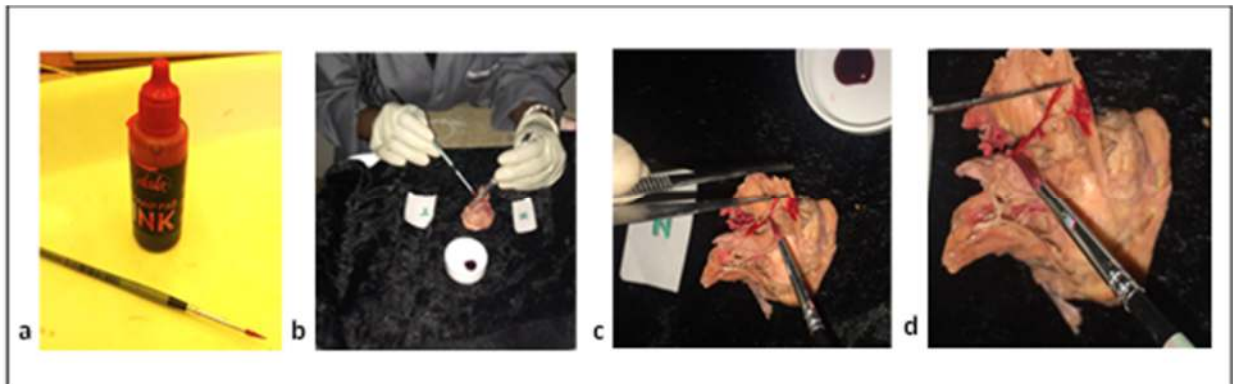


Figure 1: Colouring technique being performed on the dissected eye. a) The red stamp- pad ink and artistic paintbrush use to apply colour on the eye specimen. b, c, d)

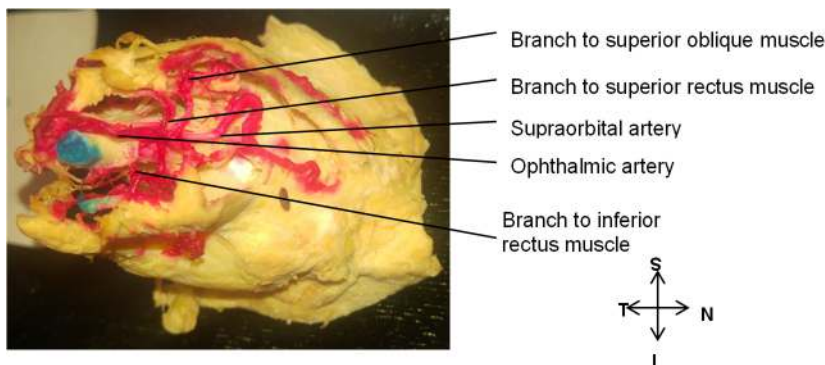


Figure 2: The ophthalmic artery crossing superior to the optic nerve with all its branches. S= superior, T= temporal, N= nasal, I= inferior.

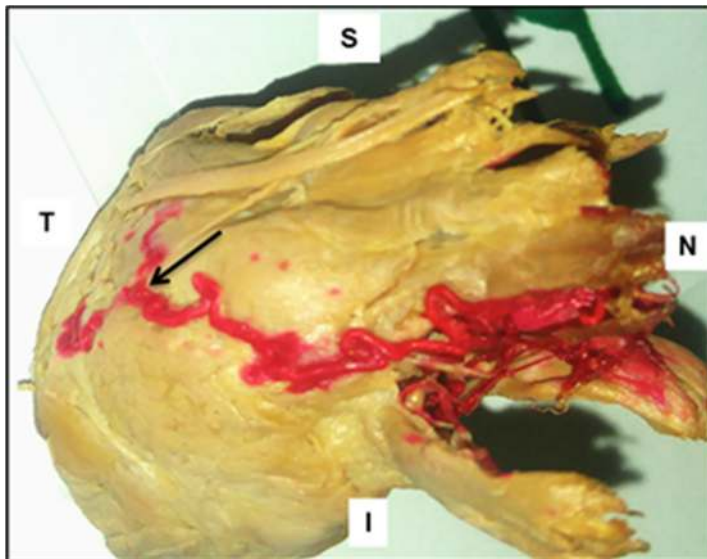


Figure 3: The lacrimal artery bifurcates (black arrow).

DISCUSSION

It is vitally important to explore the vascular anatomy and surgeons should know the vascular anatomy before contemplating any surgical procedure. Surgeons should familiarise themselves with any variations that maybe found in the area or that relating to the intended surgery. It is for this reason that vascular identification technique is useful and should be applied in the training of undergraduate and postgraduate students (Galvarez et al., 2017).

Many vascular staining techniques that have been in use since the 16th century to describe the vascular structures and were mainly based on fixing and filling of the vascular structures through a step-by-step preparation of the cadaveric material. These available conventional injection techniques: coloured dye, latex, resin, and silicon, requires an essential amount of time to prepare the specimens as the preparation may take a lot of effort for intra-arterial colour filling. More so the filling of the small blood vessels such as the OA and its branches. The step-by-step preparations involve a process of irrigation of the arterial system with water over a few minutes that could last from between 30 minutes up to one-hour pre-injection with the colouring

fluid; when this step is complete, it will then be followed by vascular cannulation and injection of the solution intra-arterially (Limpastan et al., 2013; Urgan et al., 2016; Galvarez et al., 2017). The stamp-pad ink colouring technique takes a few minutes to apply the dye with the paint brushes over the exposed blood vessels post dissection. This is the most convenient and effective method as it is less time consuming and can therefore be used for training purposes directly after dissection and it is also affordable in resource constrained environments.

The vascular system comprises of very large blood vessels to small capillaries (Standing, 2016). Several blood vessels would not be reached by the solution because of their size, and some might rupture through a continuous applied pressure of the solution intra-arterially. The stamp-pad ink staining technique allows for a fine dissection procedure enabling all arterial branches and small capillaries to be exposed and traced to the anatomical structures which they supply. The silicon, resin and latex involve a use of toxic and highly corrosive chemicals and substances that may be inhaled (Limpastan

et al., 2013), however, the use of stamp-pad ink painting is safe and non-toxic.

Some of the advantages and limitations from the stamp pad ink staining method is that it is best used for facilitation of dissections in identifying the arteries from veins and can be applied on the ready embalmed specimens. This method is less time consuming and very affordable.

Table 1: A summary of staining techniques used in vascular dissections.

Used for	Technique used	Authors	Material used
Identify branching patterns in the vascular system	Coloured dye	Doomernik et al., 2016	Formalin fixed cadavers
Identification of arterial supply	Silicon injection	Limpastan et al., 2016	Fresh defrosted cadaver heads
Identification of arterial supply	Latex injection	Galvarez et al., 2017	Fresh and non-fresh (formalin fixed) cadaver heads
Identification of arterial supply	Stamp-pad ink	Current study 2019	Formalin fixed cadavers

Conclusion

Studying anatomy with guided dissection needs accurate identification of the anatomical structures. The application of stamp-pad ink as a dye is useful in the marking and identification of anatomical structures and can be used in the training of undergraduate and postgraduate students. The stamp-pad ink is a viable option to use for painting of dissected structures during training sessions, but there are disadvantages if specimens have to be kept for later use.

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