



## Research Article

### Viewing Three-Dimensional Structure of the Cadaveric Brain Arteries Running Head: Three-Dimensional Structure of the Brain Arteries

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## Summary

**Aim:** The aim of this study was to expose three-dimensional anatomy and projection of brain arteries used by injection-corrosion cast's technique. Although corrosion method previously was used to expose coronary and testicular arteries, this is the first study that was applied to human brain arteries in details.

**Methods:** Internal carotid arteries and basilar artery of fresh human brain cannulised and irrigated with warm water, after that filled with colored polyester mixture. For corrosion process, brains were kept in diluted sulphuric acid and then carefully cleaned with water. By this way tree-dimensional anatomy of brain arteries were exposed.

**Results:** Injection-corrosion cast's technique resulted in deeper penetration of colored solutions into small cerebral vessels and provided good three-dimensional vision.

**Conclusion:** Vascular structures are usually discovered by cadaveric dissection method. By cadaveric dissection method, could obtain information about the origin of vascular structure but it is not possible for the anatomic position and projection. With the method of injection-corrosion, vascular structure could be exposed as tree-dimensional projection, even in the smallest branch look like it is in cranium position. From our point of view this technique will provide significant contribution to neurosurgery training and subsequent studies.

**Key words:** Aneurysm, cadaver, neuroanatomy, surgical planning

### Adavra Beyin Damarları Üç Boyutlu Yapısının görüntülenmesi Kafa Çalışması: Beyin Damar Üç Boyutlu Yapısı

## Özet

**Amaç:** Bu çalışmanın amacı beyin arterlerinin üç boyutlu yapısını koruyarak korozyon tekniği kullanarak ortaya çıkarmak. Korozyon yöntemi daha önce koroner ve testiküler arterleri göstermede kullanılmış olmasına rağmen beyin arterlerini göstermede ilk defa kullanılmıştır.

**Metod:** Taze insan beyni her iki internal karotid ve baziller arterlerinden kanülize edilerek irriye edildi. Ardından renklendirilmiş polyester ile dolduruldu. Korozyon işlemi için dilüe sülfirik asit ile dolu kabın içinde bekledikten sonra su ile geride kalan küçük atıklar dikkatlice temizlendi. Bu şekilde beynin üç boyutlu yapısı ortaya çıkarıldı.

**Sonuçlar:** Enjeksiyon-korozyon yöntemi en derin yerleşimdeki vasküler yapıları dahi üç boyutlu yapısı ile ortaya çıkarabilen yeni bir ekspozisyon yöntemidir.

**Tartışma:** Vasküler yapılar normalde kadaverik diseksiyon yöntemi ile ortaya çıkarılmaktadır. Bu şekilde yapılan diseksiyonlarda vasküler yapıların orjinleri hakkında bilgi edinilebilirken anatomic pozisyonları ve projeksiyonları hakkında bilgi edinebilmek mümkün olmamaktadır. Enjeksiyon-korozyon yöntemi vasküler yapıları kraniumdaki normal duruş pozisyonlarında, en ufak bir dal dahi zarar görmeden, en ince ayrıntısına kadar üç boyutlu olarak ortaya çıkarabilmemizi sağlamıştır. Serebral arteriyel yapıların projeksiyonları da korunarak bu şekilde ortaya çıkarılabilmemesinin nöroşirürji eğitimine ve bundan sonraki vasküler çalışmalara çok önemli katkıları olacağına inanmaktayız.

**Anahtar Kelimeler:** Anevrizma, kadavra, nöroanatomi, cerrahi planlama

## INTRODUCTION

Knowledge of anatomy is indispensable part of the neurosurgical operations, training, and discovering new neurosurgical techniques. Cadaveric specimens are very important in the education and the teaching of anatomy. William Harvey summarized this very nice. He said that "I profess both to learn and to teach anatomy, not from books but from dissections, not from positions of philosophers but from the fabric of nature". In the neurosurgical training microvascular anatomy is especially important (1-4).

When choosing preoperative surgical approach, determination of head position, and the calculation of dissection planning usually considering position of the arteries. Up to now, the vascular and microvascular architecture of the human brain was investigated mostly in injected and cleared preparations. To demonstrate the vascular tree on the cadaveric specimens, materials were done fixation protocols and substitution of in vivo coloration and flow characteristics. Then those arteries were dissected properly and carefully from brain parenchyma. The three-dimensional structure of the arterial tree is so important and there is not enough study in the literature.

To our knowledge, there is no published article about corrosion-cast technique of the human brain vascular anatomy so far. The objectives of this study were applying a new technique to reveal the three-dimensional structures of the brain vascular tree.

## MATERIAL AND METHODS

For this study fresh adult human brain was obtained. Cadavers with the signs of central nervous system trauma or disease were excluded from the study.

### Irrigation of the Arterial Systems

Basilar and common carotid arteries were identified and dissected to isolate each vessel from the surrounding soft tissue. Intravenous catheters were placed in basilar artery and common carotid arteries. The arterial system was irrigated with warm water using a syringe. Irrigation was done until the water flow is clear. Venous structures were not filling.

### Colored Polyester Injection of the Arterial Systems

Following irrigation vessels were filled with colored polyester blend. For this purpose, polyester (50 ml), pigments and catalyst (2.5 ml) were mixed in a bottle at room temperature and an accelerator (2.5 ml) was added. Then, this mixture was injected through the cannulae within a period not exceeding 7 minutes.

### Corrosion Process

The brains were stored in containers filled with diluted sulphuric acid for the corrosion process and debris removed with water carefully.

## RESULTS

One injected specimen had optimal results. Injection-corrosion cast's technique resulted in deeper penetration of colored solutions into small cerebral arteries and perforating branches.

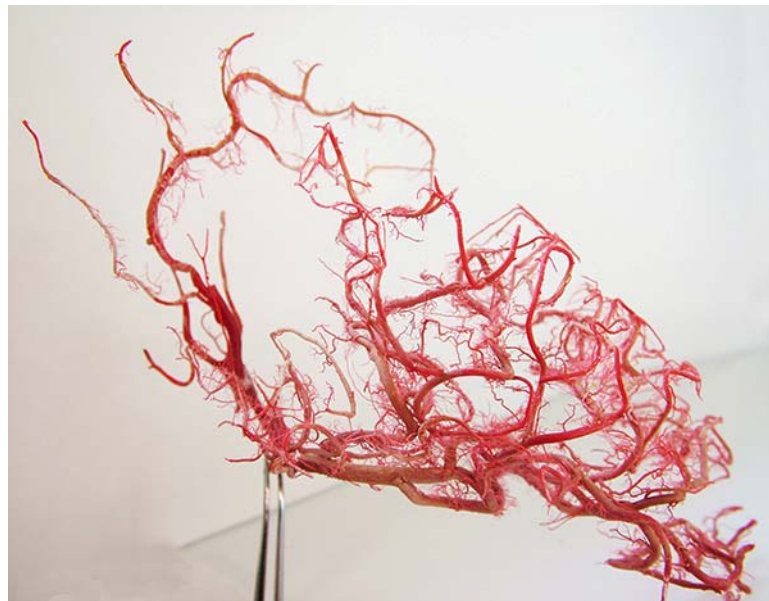
## DISCUSSION

Corrosion technique is a new and effective method for viewing of cadaveric vascular tree. With this technique all vascular structures also small distal vessels can be exposed in three-dimensional vision (2,7). During normal cadaveric dissection, smaller branches of vascular structures can

be damaged. Usually only large vessels can be exposed. But in corrosion technique, brain parenchym self-melted in sulfuric acid so that none of vascular tree is damaged. Also small perforating branches can be showed up (Figure 1-2).



*Figure 1: Three-dimensional viewing of the brain vascular tree*



*Figure 2: Three-dimensional viewing of the brain vascular tree*

Cadaveric specimens were always at the center of education in anatomy. Since the ancient Egyptians, different methods were applied for prevention of cadaver's putrefaction. Oldest evidence of the applications for the protection of lifeless bodies is based on 2000 BC (7). After that, in order to prevent brain putrefaction, used different substances such as sodium or heavy metal salts. The use of formaldehyde began in the 19th century. Formaldehyde, as well as alcohol, phenol, polyethylene glycol, and phenoxyethanol such as materials were used for preservation (2,8).

Selective injection of the cerebral vasculature was first documented by Thomas Willis in the 17th century (9). Different substances used for colouring of cerebral vascular structures. In practice, most used substances are colored silicone and latex (10). In all applications, except corrosion technique, the brain parenchyma dissection is necessary for the appearing of vascular structures. During dissection, the small veins and the perforating branches are usually sacrificed and only the large vascular structures can be displayed. Corrosion technique doesn't require dissection and this is the most important advantage of the technique. With this technique without dissection, the vascular structures can be viewed without any damage. In addition the most important advantage of this technique is the providing the view of three dimensional visions.

## CONCLUSION

Corrosion-cast technique is a new technique, revealing the brain vasculatures. This technique doesn't require any dissection and all vascular trees can be shown as three-dimensional. Well knowing of brain arterial structures leads decreased postoperative morbidity and mortality rates and increase the success rate of surgery. This paper is only preliminary report about a new vascular demonstration technique. After this important notification the new

studies will be published using this new technique.

## Conflict of Interest

The authors declare no potential conflicts of interest.

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