

Corrosion Casting of the Bronchial Pattern of Goat Lungs and Chicken Lungs: an Educational Tool For Veterinary Medicine and Surgery and a Comparative Tool For Human Anatomy

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ABSTRACT

Corrosion casting is a conventional method employed in the fields of anatomy and pathology to create precise copies of vascular and airway structures. This is achieved by injecting resin into these structures, which then solidifies upon exposure. This study utilises corrosion casting to clarify the bronchial patterns of goat and chicken lungs, with the goal of improving instructional resources in veterinary medicine and surgery and enabling comparison analyses with human anatomy. The procedure involves injecting a polymer resin into the tracheobronchial tree of deceased goat and chicken lungs. After the resin has completely solidified, powerful acids and alkalis are used to dissolve the surrounding tissue, creating a precise replica of the structure of the airway. Understanding the bronchial branching patterns plays a key role in the comprehension of respiratory physiology and pathology, and these castings are the means that enable the doctors to examine and evaluate them in great detail. When comparing bronchial patterns in humans, chickens, and goats, it is important to note that there are some differences in the anatomies. The reason behind them is that they have different respiratory physiologies and their adaptations are habitat-specific. The complexity of the airway segments in bird's respiratory systems implies a more elaborate and efficient gas exchange mechanism than that of mammals. Moreover, it is a vital addition to our grasp of the specific respiratory anatomy when applied to veterinary and medical schools as part of teaching aids. Corrosion casting is a tool that teachers can use on the fully 3D animated and moulded respiratory systems of many species to show students the precision that existed.

Keywords: Corrosion Casting, Lung Anatomy, Plastination, Veterinary Medicine

INTRODUCTION

Most medical schools teach macroscopic anatomy using models of human beings. Whether for meticulously dissected specimens or body slices, plastination has become more crucial as a technique of organ preservation throughout the past 25 years. Long-term tissue preservation and anatomical teaching depend increasingly on plastination of body components. [1]. Gunther von Hagens developed the plastination process in 1977 as a means of preserving people or bodily parts. Some specific types of plastics are employed as substitutes for water and fat in order to produce tangible specimens that are odourless, do not degrade, and retain most of the original sample's properties. [2]. Plastination is a technique that allows for the preservation of more intricate human anatomy for educational purposes. Plastinates are clean, non-porous, and durable. Both the general population and healthcare providers can benefit greatly from these resources when used as educational tools. As it is, plastination is one of the most useful teaching tools for clinical anatomists. [1]. Plastinated human specimens are considered preferable to synthetic models by educators because they more accurately depict anatomical variances. Plastinated specimens can also be easily kept. [3] and transported without the trouble of disposal typically associated with traditionally preserved anatomical samples. Plastination has great potential since it can preserve complex structures and the links among them, therefore enabling microscopically identifiable patterns. [4] [5].

The corrosion casting of a goat's lung's bronchial pattern is one creative possible use for plastination. This method could be used to teach students about comparative human anatomy, veterinary medicine, and surgery. [6][7]

In the method of corrosion casting, a model is built that is a negatively expressed duplicate of the blood vessels of healthy or unhealthy organs. The method allows for the in-depth study of the surface properties and internal structure of the hollow organs found inside the body. The procedure can then be used to visualise the internal surface of hollow structures and the three-dimensional model that is difficult to assimilate, like the bronchial tree. It is also a way to understand the lung/bronchial system. The technique obviously does not come with the instruction manual—a small mistake can prevent the system from being powered off. [8] [9]. When compared to plastinated specimens, corrosion casts enable a more detailed

display of the complex connections between different anatomical structures. [5] [10] .

The need for them to be high-quality, corrosion-cast entails intricate detail, the right casting media selection, and required time [8]. Among the possible materials, the choice of casting material is mostly based on the intended research and further investigative procedures, including dissection, microscopy, or micro-computed tomography (μ CT) [10].

In this study, corrosion casting was used to explore the bronchial pattern of the goat's and chicken's lungs. Goat lungs were chosen because of their substantial anatomical similarities to human lungs, so they serve as an effective tool to compare human respiratory anatomy [11]. Chicken lungs were chosen because they are often used in medical research, especially in the area of respiratory medicine. We can do a lot of things with it: for one, we can create a computerised three-dimensional representation of the goat's bronchial system, thus giving a teacher a perfect tool to materialise the invisible. It will serve the cause of veterinary medicine as a complementary resource, causing the students to be curious and exploratory, while also being a model for veterinary medicine of a comparative tool to human lung anatomy. [12] [13,14]

By creating detailed three-dimensional models of the goat bronchial tree in this study, a new learning opportunity will be available for students and health care professionals in their practice of veterinary medicine and surgery as a reference to the human lung anatomy as well.

Corrosion casting of the bronchial shape of goat and chicken lungs, followed by careful dissection and analysis, can supply a precious educational tool for veterinary medicine and surgery. These were the first physically possible models in the history of medical science and were made for the purpose of understanding the complex three-dimensional shape of the bronchial tree, which is necessary for successful bronchoscopy, lung surgery, as well as the diagnosis and treatment of respiratory diseases. [15] Moreover, the study of health-related types of bronchial patterns in goat and chicken lungs may inform about what is in common and what is variant in origin in the human anatomical and animal respiratory systems, which might be very useful knowledge for anatomy disciplines and the justification of research findings from animal models to human use.

By creating detailed three-dimensional models of goat and chicken bronchial trees, the aim of this study is to provide an educational resource for veterinary medicine and surgery and a comparative tool for understanding human lung anatomy.

Findings from this research could be of far-reaching significance, since corrosion casting of the bronchial pattern can serve as an important educational tool for both veterinary and human medical practitioners. This method is invaluable in teaching and research because it allows visualisation of complex three-dimensional anatomical relationships that are hard to grasp through traditional dissection procedures. [10] [12,16] .

In our present study, we intended to explore corrosion casting as an educational and comparative approach to investigating the goat respiratory system, which could also be applicable in veterinary medicine and surgery with respect to human lung structure. [17]

The vascular corrosion casting method involves the injection of casting materials, usually thermosetting polymers, into the desired vascularity or bronchogenic tree, followed by the subsequent dissolution of surrounding tissues, thereby leaving behind a strong, 3D replica. [8]

Not only are these models useful for veterinarians as learning aids, but they also form the basis for comparing/analysing human lung anatomy during normal physiological states and pathological conditions, thereby facilitating better understanding.

The findings of this research demonstrate how versatile and promising corrosion casting can be when used as an instrument for visualising and comparing complicated structures in anatomy, thus being relevant across veterinary and medicine. [13]

MATERIALS AND METHODS

Specimen Preparation

Fresh goat lungs were obtained from a local abattoir and transported for the corrosion casting procedure. This was thoroughly washed and squeezed under cold, running tap water. Then it was tapped with tissues to remove all moisture from the surface tissue. All blood, inside and outside, was washed away. Absolute absence of blood is a prerequisite for corrosion casting, as any residual blood may clot and cause blockage of the polymer. No clotting was observed. The main bronchus was identified and cannulated, and a casting medium (polymer) was injected into the bronchial tree. Similarly, fresh chicken lungs were obtained and prepared in a similar manner.



Fig. 1: Epoxy Resin



Fig. 2: Fresh lungs



Fig. 3: Pouring Resin



Fig. 4 : Tying of Entry Point

Corrosion Casting

A thermosetting polymer had to be chosen as the casting medium for their possible infiltration into fine bronchial structures and for subsequent processing and analysis. In our study, commercial-grade epoxy resin has been used as the casting medium. The resin was injected with constant pressure into the bronchial tree to fill the network. The application of controlled pressure and flow rates avoids damage to the delicate structures of the bronchii.

It was then left to cure for 72 hours at room temperature.

After the casting medium had set completely, the surrounding lung tissue was dissolved with a corrosive solution of concentrated hydrochloric acid, leaving the durable three-dimensional bronchial cast. The cast was washed several times in distilled water to remove all residual acid and tissues, then dried in the air. Such casts could now be prepared and were ready for detailed analysis and comparison.

RESULTS



Fig. 5: Bronchial Cast of Goat



Fig. 6: Bronchial Cast of chicken

In this study, a fine-structured three-dimensional replica of the goat bronchial tree was prepared with this corrosion casting technique. Exposed is a detailed structure of the bronchial tree with its primary, secondary, and tertiary bronchi, all of which demonstrate distinct spatial relationships. [8] Comparative analysis of the bronchial casts from goats and chickens showed some very close similarities regarding the patterns of ramification and general anatomy but also some noteworthy differences. Compared with this, the goat bronchial tree had a much more extensive and complex network of airways with increased numbers of branching points and a greater degree of lobar organisation, matching its larger size and greater respiratory demands. In sharp contrast, the chicken bronchial tree had a relatively simple pattern of bronchial tree branching with fewer orders of branching, likely as a result of its smaller size and lower respiratory requirements.

DISCUSSION

Interestingly, a comparison between the current cast and the goat lung specimen originally mounted showed that casting does replicate air wash patterns within bronchial tree anatomy; its branching however was only qualitatively similar to topology of real-life's. It is exactly for this reason that any such cast, standing as a sturdy and anatomically perfect learning tool exemplar of veterinary medicine or surgery all at once.

This finding is in line with earlier results on comparative respiratory tract anatomy of different mammalian species [18] [19]. It even continues to dictate what the visualisation and comparison should be with—a bronchial cast portrayal of goat and chicken lung, respectively depicting evolutionary adaptations for respiratory strategies in different species.

Comparisons of the cast with its original, goat lung specimen show that, although not extreme in its detail as is micro-CT imaging, this process relatively maintains complex detail of the anatomy involving the bronchial tree, with full preservation of the branching patterns and relative dimensions of the airway structures.

Specifically, the cast is durable and very detailed about the anatomy, hence, one of the best teaching aids in the broad field of veterinary medicine and surgery.

This will suggest that this corrosion casting technique would have additional applications as a comparative tool in understanding the human bronchial tree since substantial similarities in overall arrangement and branching patterns were observable between the goat and human anatomy of the lung. As a model of goat bronchial anatomy, the present research thus shall be a valuable tool for future integration with other morphological and clinical techniques for investigation and comparison of organs of respiration between the two species, which may eventually further the understanding of normal and pathological conditions. [11].

This work is meant to underscore the power of corrosion casting as one of the tools for visualization and study of complex anatomical structures, such as the bronchial tree of the lungs. [20] The detailed, three-dimensional models developed with the use of this methodology will then be very useful pedagogical tools, as well as means for comparative studies that may benefit further development of veterinary and human medicine.

Because goat and human lung anatomy are similar, such a corrosion-casting approach could be used in a comparative way to understand the human bronchial tree. Since this paper provides a physical model of goat bronchial anatomy, it may offer a good opportunity for veterinarians and medical professionals to further explore, contrast, and compare respiratory structures of different species, with the possibility of arriving at an improved understanding of normal and pathologic conditions. [11]

These findings demonstrate the immense potential of the corrosion casting technique for the visualization and study of complex anatomical structures, such as the lungs' bronchial tree [20]. All of these detailed three-dimensional models could be excellent educational resources and tools for comparison that may eventually lead to an improvement in the practice of veterinary medicine, even human medicine.

CONCLUSION

Ultimately, corrosion casting of the bronchial pattern of goat and chicken lungs was successful, and it produced a well-structured, three-dimensional replica of the respiratory structures of both organisms. The present model could not only serve as an educational tool in teaching veterinary medicine and surgery but might also provide a basis for comparison with human lung anatomy in an attempt to better understand the normal and disease conditions. Such findings of the study amply demonstrate the versatility and potential of corrosion casting as a technique of visualisation and comparison, bringing into

the limelight its valuable applications for veterinary and human anatomy, physiology, and clinical practice.

CONFLICT OF INTEREST

There is no conflict of interest.

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