

REVIEW ARTICLE

Cadaver Preservation for Display in Malaysian Anatomy Museums: Methods, Challenges, and Cultural Considerations

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ABSTRACT

The preservation of cadaveric specimens in anatomy museums is a cornerstone of medical education and research. This review examines the unique practices of cadaver preservation in Malaysian anatomy museums, addressing the following research question: What are the current methods, challenges, and cultural considerations in cadaver preservation in Malaysian anatomy museums? The review provides a detailed exploration of locally developed preservation methods, ethical and cultural influences, and a comparative analysis of traditional and modern techniques, such as formalin-based embalming and plastination. Furthermore, it evaluates the sustainability and future trends in cadaver preservation, ensuring these museums continue to serve as educational resources for future generations. *Malaysian Journal of Medicine and Health Sciences* (2025) 21(3): 474-480. doi:10.47836/mjmhs.21.3.55

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INTRODUCTION

The historical evolution of preservation techniques in anatomy museums is a fascinating journey that spans centuries and reflects the relentless pursuit of knowledge in the field of human anatomy. The roots of cadaver preservation can be traced back to ancient civilizations where early anatomists and physicians sought to unravel the mysteries of the human body. In ancient Egypt, for example, the art of mummification was not limited to preserving the bodies of pharaohs but also extended to those who contributed to medical knowledge (1). However, it was the ancient Greeks who made significant strides in the systematic study of anatomy, paving the way for advancements in preservation techniques (2).

During the Renaissance, a period marked by a revival of interest in classical learning, anatomists such as Andreas Vesalius challenged traditional beliefs and conducted detailed dissections to enhance their understanding of human anatomy (3). Preservation methods during this era often involved the use of various substances, including spices, herbs, and oils, to slow down decomposition (4). The quest for anatomical knowledge led to the establishment of anatomical theaters and the widespread use of formalin, a solution containing formaldehyde, in the 19th century (5). Formalin became a standard preservative, offering a practical and relatively long-

lasting solution for maintaining anatomical specimens (5).

As the 20th century unfolded, advancements in technology and scientific understanding further transformed cadaver preservation techniques. The development of plastination by Dr. Gunther von Hagens in the late 20th century revolutionized the field (6). Plastination involves replacing bodily fluids and lipids with reactive polymers, resulting in remarkably lifelike and durable specimens. This breakthrough not only extended the longevity of anatomical specimens but also allowed for the creation of dynamic and interactive exhibits, enhancing the educational experience in anatomy museums (7).

In the Malaysian context, the historical evolution of cadaver preservation techniques reflects a confluence of global influences and local innovations. The adoption of modern preservation methods in Malaysian anatomy museums aligns with international standards while catering to the specific needs and cultural sensitivities of the region (8). The ongoing evolution of preservation techniques in anatomy museums continues to be driven by a commitment to scientific rigor, ethical considerations, and a dedication to fostering anatomical education and research.

COMPARATIVE ANALYSIS WITH ALTERNATIVE PRESERVATION METHODS

In the realm of anatomy museums, the preservation of cadavers is a critical aspect that directly influences the

quality and longevity of exhibits. This subchapter delves into a comparative analysis of cadaver preservation methods, exploring alternatives to traditional techniques and their relevance within the Malaysian context.

Traditional methods of cadaver preservation, such as formaldehyde fixation, have long been the backbone of anatomical specimen preparation. However, concerns regarding the environmental and health impacts of formaldehyde have prompted the exploration of alternative preservation methods (9). One such alternative is plastination, a technique that replaces bodily fluids with polymers, resulting in odorless and durable specimens. The effectiveness of plastination in comparison to formaldehyde fixation, considering factors such as cost, ease of maintenance, and ethical considerations, is considerably beneficial (10).

Furthermore, the emerging field of digital preservation is presented as a novel alternative. Advancements in technology have enabled the creation of detailed three-dimensional virtual models of anatomical specimens, providing an immersive and non-invasive means of study (11). The analysis considers the potential advantages and limitations of digital preservation, including accessibility, educational value, and the integration of virtual exhibits into anatomy museums.

In the Malaysian context, where environmental conditions and resource availability may differ from Western counterparts, the adaptability of alternative preservation methods is important. Factors such as climate, cultural considerations, and cost-effectiveness play a crucial role in determining the most suitable method for cadaver preservation in Malaysian anatomy museums (12).

Preserving cadaveric specimens is influenced by both the choice of preservation technique and the specific environmental conditions under which they are stored. In Malaysia, where tropical humidity and temperature differ significantly from Western countries, these conditions can impact the longevity and quality of preserved specimens. For example, plastination, while offering durable and lifelike preservation, requires precise environmental controls during the polymerization process, which may be more resource-intensive in Malaysian settings compared to formalin-based fixation, which has been widely used despite the toxic nature of formaldehyde (10).

A detailed comparison between plastination and formalin fixation reveals significant differences in terms of cost, labor intensity, skill requirements, and time (6). Plastination is a costly process that requires specialized equipment and highly trained personnel, making it less accessible for smaller institutions in Malaysia. On the other hand, formalin fixation, while less expensive and widely practiced, poses health risks to staff and visitors

due to the use of toxic chemicals (10). Labor intensity also varies, with plastination demanding a higher initial investment of time but offering specimens that require minimal ongoing maintenance. Formalin-fixed cadavers, in contrast, require constant monitoring to prevent decay and maintain specimen quality.

In this review, we have examined the key preservation methods used in anatomy museums, focusing on their development and adaptation within the Malaysian context. However, a critical evaluation of the cited studies reveals varying degrees of rigor in the methodologies employed. For instance, studies advocating for formalin-based preservation often fail to address the long-term health risks associated with formaldehyde exposure (13), while others promoting plastination overlook its high cost and resource demands, particularly in developing regions (14). Moreover, studies from Western contexts, where climate conditions differ significantly, may not fully capture the challenges faced by Malaysian museums in maintaining specimen quality under tropical conditions (15). While plastination offers a highly durable and non-toxic alternative to formalin, its high setup costs and need for skilled personnel limit its accessibility in Malaysia. This discrepancy between the studies highlights the importance of considering both the methodological strengths and limitations when applying these preservation techniques locally.

The comparative analysis of formalin fixation and plastination techniques underscores the need for a nuanced understanding of their respective advantages and limitations. Studies advocating for formalin fixation emphasize its lower cost and widespread use in anatomy museums worldwide (13). However, the harmful effects of formaldehyde exposure to both museum staff and visitors present a serious concern that is inadequately addressed in some literature (13). In contrast, plastination, despite its higher initial costs, offers a safer and more durable method of preservation, particularly in educational settings where long-term specimen use is crucial (14). While research from developed countries suggests that plastination is the superior method, the feasibility of its implementation in Malaysia is less straightforward due to financial and environmental constraints. The studies reviewed provide valuable insights into these techniques, but a deeper evaluation of the specific costs, labor requirements, and cultural adaptability within Malaysia is necessary for a more accurate comparison.

MALAYSIAN ANATOMY MUSEUMS: AN OVERVIEW

Malaysia boasts a rich cultural tapestry, and within its borders lie some of the most comprehensive anatomy museums in Southeast Asia. These repositories of human anatomy serve as invaluable educational resources for students, healthcare professionals, and curious visitors alike. An overview of Malaysian anatomy

museums reveals a diverse landscape where traditional preservation methods blend seamlessly with modern technologies, offering unique insights into the intricacies of the human body.

At the forefront of Malaysia's anatomy museums is the Anatomy Museum, located within the University of Malaya (UM) in Kuala Lumpur (16). Established in 1963, this institution houses a vast collection of meticulously preserved cadavers, anatomical specimens, and models (16). The museum's exhibits cover a wide array of medical disciplines, including gross anatomy, histology, embryology, and pathology. Through innovative displays and interactive learning experiences, visitors gain a deeper understanding of human anatomy and its relevance to medical practice (16).

Another notable anatomy museum is situated at Universiti Kebangsaan Malaysia (UKM) and, Universiti Teknologi MARA (UiTM) and Universiti Putra Malaysia (UPM) in Klang Valley (17, 18). These facilities features a comprehensive collection of anatomical specimens acquired through meticulous dissection and preservation techniques. With a focus on anatomical variations and pathological conditions, the museum provides invaluable insights for medical students and researchers studying human anatomy and pathology. Through collaborations with healthcare institutions and academic partners, they continues to expand its collection and enhance its educational programs.

The following table provides a comparison of preservation methods, the number of preserved specimens, and other relevant factors across key anatomy museums in Malaysia, including those at the UM, UKM, UPM, and UiTM.

Table 1: The comparative analysis highlights differences in resource availability, preservation approaches, and educational applications across Malaysian anatomy museums.

Institution	Preservation Methods	Number of Preserved Specimens	Key Features	Challenges
UM	10% mixed-formalin fixation	200+	Plastinated specimens available	-
UKM	10% mixed-formalin fixation, plastination	150+	Strong focus on dissection-based teaching	Health risks from formaldehyde exposure
UPM	10% mixed-formalin fixation	60+	Emphasise on exhaust fan ventilation	Limited access to plastinated specimens
UiTM	4% mixed-formalin fixation	180+	Emphasise on reduced formalin exposure	Limited cadaveric supplies

Furthermore, the World Anatomy Day (WAD) celebration was established in 2019 to highlight the importance of anatomy knowledge, particularly in the medical field. Organized by the Department of Anatomy at Universiti Sains Malaysia, WAD events aimed to raise awareness about anatomy literacy among both medical professionals and the general public (19).

In addition to these prominent institutions, several other anatomy museums can be found across Malaysia, each offering its own unique perspective on the human body. These include museums affiliated with medical schools, hospitals, and research centres, as well as private collections open to the public. While the preservation techniques may vary from one museum to another, they all share a common goal of promoting anatomical education and research in Malaysia.

As the field of anatomy continues to evolve, Malaysian anatomy museums play a crucial role in preserving anatomical specimens and advancing medical knowledge. Through ongoing research, collaboration, and educational outreach, these institutions ensure that future generations of healthcare professionals have access to the resources they need to excel in their fields. A review of cadaver preservation in anatomy museums from a Malaysian perspective underscores the importance of these institutions in fostering a deeper appreciation for the complexities of the human body and its role in health and disease.

The effectiveness of cadaver preservation is significantly influenced by the controlled environment in which specimens are stored (20). Malaysian anatomy museums, like their international counterparts, have implemented various measures to ensure that anatomical specimens are preserved under optimal conditions. Several key environmental parameters are crucial for maintaining the integrity of preserved specimens.

Proper specimen preservation relies on several key factors. First, maintaining a stable temperature between 16°C to 20°C slows decomposition, while avoiding condensation from lower temperatures and tissue breakdown from higher ones. Humidity should be kept below 60% to prevent mold and bacteria growth, as well as to avoid drying and cracking of specimens. Adequate ventilation is important for preventing the buildup of harmful chemicals, particularly in museums using formalin-fixed specimens, as it reduces exposure to formaldehyde vapors. Low-light or UV-filtered lighting helps prevent tissue discoloration, and proper storage containers, such as airtight jars or acrylic cases, protect specimens from contamination (21). Plastinated specimens, being more durable, require less stringent storage conditions.

These parameters are meticulously regulated in Malaysian anatomy museums to ensure the prolonged preservation of specimens. Ongoing research into improving these environmental controls continues to align with global best practices, ensuring that Malaysia's anatomy museums uphold their educational and research value for future generations.

PRESERVATION PRACTICES IN MALAYSIAN ANATOMY MUSEUMS

Preservation practices in Malaysia's anatomy museums play a vital role in maintaining the integrity and educational value of these institutions. These museums serve as repositories of anatomical specimens, showcasing the intricate structures of the human body for educational and research purposes. Given the delicate nature of anatomical specimens and the importance of ensuring their longevity, preservation techniques are meticulously employed.

One of the primary methods utilized in the preservation of anatomical specimens is the use of chemical agents such as formaldehyde or formalin. These substances act as fixatives, halting decomposition and preventing microbial growth. Before being showcased in museums, specimens undergo a meticulous preservation process involving immersion in these solutions. This step not only prevents decay but also helps maintain the structural integrity of the specimens over time.

Furthermore, proper storage conditions are crucial for preserving anatomical specimens. Malaysia's anatomy museums typically maintain controlled environments with regulated temperature and humidity levels to prevent degradation. Specialized storage containers, such as glass jars or acrylic cases, are utilized to protect specimens from physical damage and environmental factors. Additionally, regular inspections and maintenance routines ensure that storage facilities meet optimal preservation standards.

Another essential aspect of preservation practices in Malaysia's anatomy museums is documentation. Detailed records are maintained for each specimen, including information about its origin, preservation method, and any associated historical or medical significance. This documentation not only aids in the organization of museum collections but also serves as valuable educational resources for researchers and visitors.

Moreover, ongoing research and advancements in preservation technology contribute to the evolution of preservation practices in Malaysia's anatomy museums. Continuous efforts are made to explore innovative techniques that enhance the longevity and quality of anatomical specimens while minimizing the use of harmful chemicals.

In essence, preservation practices in Malaysia's anatomy museums are characterized by a commitment to maintaining the integrity, educational value, and ethical standards of these institutions. Through meticulous preservation techniques, proper storage conditions, documentation, and ongoing research, these museums ensure that anatomical specimens remain valuable resources for education, research, and public engagement for generations to come.

CULTURAL AND ETHICAL CONSIDERATIONS IN MALAYSIA

In the context of cadaver preservation within anatomy museums, the intricate tapestry of Malaysian culture and ethical values plays a pivotal role in shaping the approaches and practices employed (22). This subchapter delves into the nuanced interplay between cultural and ethical considerations, providing a comprehensive understanding of their impact on cadaver preservation in Malaysia.

Malaysia, with its diverse ethnic and religious communities, presents a mosaic of cultural beliefs that influence perceptions of death, the human body, and post-mortem practices. Understanding and respecting these cultural intricacies are fundamental to navigating the ethical landscape of cadaver preservation. For instance, Islamic beliefs emphasize the sanctity of the human body and advocate for dignified treatment even in death (23).

Ethical considerations extend beyond religious beliefs to encompass broader societal norms and expectations. Its investigates how Malaysian ethical standards shape decisions regarding the display, handling, and disposal of cadaveric specimens (24). Furthermore, it explores the balance between educational objectives and the ethical imperative to treat human remains with reverence, especially given the potential sensitivities surrounding the display of anatomical specimens in public spaces.

Anatomy holds a paramount role in medical education, being fundamental for examining patients, forming diagnoses, and communicating findings. Effective teaching methods, including the utilization of deceased bodies, are crucial for medical students to master anatomical knowledge. However, using cadavers is a sensitive issue, especially from an Islamic perspective where there is a clear prohibition against mutilating the bodies of the deceased. Despite arguments for the necessity of learning anatomy through human bodies, varying opinions persist, highlighting the influence of religious beliefs on medical practices (23).

Moreover, the subchapter delves into the regulatory framework governing cadaver preservation in Malaysia, highlighting the legal and ethical obligations that anatomy museums must adhere to. The Malaysian perspective on

informed consent, the respectful handling of cadavers, and the transparency of preservation practices within the bounds of ethical guidelines are examined to ensure that the preservation methods align with both legal requirements and cultural sensibilities (25).

By navigating the intricate web of cultural and ethical considerations, this subchapter aims to provide valuable insights into the complexities of cadaver preservation within the Malaysian context. Acknowledging and respecting these cultural and ethical nuances is essential for the sustainable and harmonious integration of anatomy museums within the diverse societal fabric of Malaysia.

Ethical and cultural considerations play a pivotal role in shaping cadaver preservation practices in Malaysian anatomy museums. The literature highlights the profound influence of religious and cultural beliefs, particularly within the Muslim-majority population, which places high importance on the respectful handling of human remains (26). While several international studies emphasize the need for ethical cadaver use in medical education, there is limited research on how these practices are adapted to align with Islamic principles. Studies on formalin-based methods and plastination often omit discussions of cultural sensitivities and religious guidelines, which are vital in ensuring the ethical use of cadaveric specimens in Malaysia. This gap in the literature underscores the need for further exploration of how Malaysian anatomy museums navigate these ethical complexities while maintaining high educational and research standards.

FUTURE TRENDS IN CADAVER PRESERVATION: INSIGHTS FROM A MALAYSIAN PERSPECTIVE

The landscape of cadaver preservation in anatomy museums is poised for evolution. As advancements in medical education and technology continue to shape the field, a holistic examination of future trends becomes imperative, considering the unique cultural, ethical, and practical considerations within Malaysia (27).

In Malaysia, the intersection of tradition and innovation plays a significant role in shaping the future of cadaver preservation (28). The historical and cultural tapestry of the nation influences how anatomical education is approached, necessitating an exploration of preservation techniques that align with the values and sensitivities of the local populace (23). The potential integration of sustainable and eco-friendly preservation methods, considering Malaysia's commitment to environmental conservation and its cultural reverence for the deceased (20).

Additionally, plastination has emerged as a valuable tool for anatomical education and research in Malaysia (29). This technique has been particularly beneficial in

enhancing the learning experience for medical students and healthcare professionals by providing access to high-quality anatomical specimens that retain their natural appearance and structure. The availability of plastination specimens in anatomy education has enriched practical learning opportunities, allowing students to explore complex anatomical structures in detail (29). Furthermore, plastination has facilitated the development of anatomical museums and exhibitions, offering the general public opportunities to engage with anatomy in a visually compelling and informative manner. The integration of plastination in anatomical education and public outreach efforts underscores its significance in advancing anatomical sciences in Malaysia (9).

The Silent Mentor Program at the University of Malaya is a unique initiative aimed at advancing medical education and fostering humanistic values among healthcare professionals (30). Established in 2012 collaborated with the Tzu Chi University, the program involves voluntary body donation by individuals during their lifetime, with the understanding that their bodies will be used for medical education and research after their passing. Participants, known as "silent mentors," generously contribute their bodies to help train future generations of doctors and healthcare professionals. Through this program, medical students have the opportunity to learn from real human cadavers, gaining invaluable hands-on experience that enhances their understanding of anatomy and medical procedures. Additionally, the program emphasizes the importance of empathy, respect, and gratitude towards donors, instilling ethical values in medical education.

Furthermore, the advent of three-dimensional virtual models and augmented reality offers novel avenues for engaging and immersive learning experiences (31). As technology becomes increasingly integrated into medical education globally, this examines the readiness of the Malaysian anatomy museum landscape to embrace these advancements and explores potential challenges and benefits.

The prospect of interdisciplinary collaboration in shaping the future of cadaver preservation has also been considered (11). The synergy between anatomists, preservation experts, technologists, and ethicists are explored as a means to develop innovative and culturally sensitive preservation solutions. The Malaysian perspective on these collaborative efforts is crucial in ensuring the seamless integration of emerging trends into the local anatomy museum scene.

The quality of cadaver specimens is closely tied to the precision and finesse applied during dissection. In Malaysia, meticulous dissection techniques are pivotal in preserving the anatomical integrity of specimens, enabling extended educational use. These techniques

focus on minimizing damage to delicate structures such as nerves, blood vessels, and organs, ensuring that the specimens remain viable for detailed anatomical study (9). Properly executed dissections enhance the clarity of anatomical landmarks, improve student engagement, and support more in-depth learning. This emphasis on finesse aligns with modern preservation methods, including plastination, where high-quality dissection contributes to the overall educational value of cadaveric specimens (6). Continuous training in dissection techniques can thus play a crucial role in maintaining the quality of specimens, reflecting a future trend in Malaysian anatomy education.

CONCLUSION

In conclusion, the historical evolution of preservation techniques in anatomy museums reflects a journey marked by relentless pursuit of knowledge and innovation in understanding the human body. From ancient civilizations to modern times, the preservation of cadavers has been a cornerstone of anatomical education and research. The adoption of traditional and modern preservation methods in Malaysian anatomy museums underscores a commitment to maintaining international standards while respecting local cultural sensitivities. The comparative analysis of preservation methods highlights the importance of considering factors such as cost, environmental impact, and ethical considerations. Furthermore, the overview of Malaysian anatomy museums reveals their vital role as repositories of anatomical knowledge, fostering education, research, and public engagement. Looking ahead, future trends in cadaver preservation, including the adoption of sustainable practices, technological advancements, and interdisciplinary collaboration, promise to shape the landscape of anatomical sciences in Malaysia. By navigating cultural and ethical considerations and embracing innovative approaches, Malaysian anatomy museums are poised to continue their legacy of promoting anatomical education and advancing medical knowledge for generations to come.

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