ABSTRACTS PRESENTED AT THE 13th INTERNATIONAL INTERIM MEETING OF THE ISP,

TEMUCO, CHILE, DECEMBER 1-5, 2025

SHEDDING LIGHT ON THE DETAILED ANATOMY OF THE HUMAN ORBIT WITH EPOXY E12

Adds PJ
St George's, University of London, London, UK

Introduction: The human orbit is a region of complex anatomy. The orbit is susceptible to damage from trauma and pathology, and is a site of surgical interest. Retrobulbar anatomy is complex, varies between individuals, and is not well described in standard anatomy textbooks. The aim of these studies was to elucidate the detailed structure of the retrobulbar vasculature, ethmoidal arteries, and fat septa. **Materials and Methods:** Human orbits were sectioned from cadaveric heads donated with consent for anatomical education and research. Three sets of orbits were used. For investigations into the ethmoidal arteries, the internal carotid artery was injected with red silicone, and the medial orbital wall was isolated before further processing; for investigations into the vasculature and the fat septa, the orbits were decalcified in 10% formic acid. All specimens were dehydrated in acetone at -20 °C before impregnation with Biodur® E12. Sections of 0.3 mm thickness were cut with a slow-speed diamond saw. The medial wall sections were stained with Miller's stain for elastin. Three-dimensional reconstructions were carried out using WinSURF software. For the orbital fat septa, different staining methods were trialed. Stained sections were photographed, and 3D reconstructions were carried out using 'Reconstruct' software. To visualize the retrobulbar vasculature, sections were stained with Gomori's trichrome and Miller's stain, imaged, and reconstructed using BioVis software. **Results:** The optical qualities of the epoxy resin blocks were excellent. In the stained sections, the ethmoidal arteries were clearly visible, and a 3D model was created. For the orbital fat septa, Gomori's trichrome stain provided the clearest visualization, and a 3D model was created from the stained sections. For the vasculature, a 3D model of the arterial system was reconstructed; the superior ophthalmic vein and the central retinal vein were visualized, though the venous system could not be fully reconstructed. **Conclusions:** E12 plastination was effective for analyzing the structure of the orbital vasculature, retrobulbar fat septa, and ethmoidal arteries at a macroscopic level; however, anatomical topology was not fully preserved at the microscopic level. Gomori's trichrome stain gave good results in highlighting axial sections of the arteries. Detailed anatomical models of the retrobulbar orbital vascular system, the ethmoidal arteries, and the retrobulbar fat septa were created. The 3D models obtained may be used for teaching and surgery planning.

THE JOURNAL OF PLASTINATION

Adds PJ
St George's, University of London, London, UK

The "Journal of the International Society for Plastination" was first published in January 1987, edited by Harmon Bickley. The cover of Volume 1(1) featured an axial image of the human abdomen, although there were no images inside. Five papers were published in Issue 1, mostly describing technical aspects of tissue preservation and plastination; however, one paper (with Gunther von Hagens as a co-author) recognized plastination's potential for research. Other notable authors from Volume 1 include Dr Robert Henry, who was appointed Editor in 1989. All the contributing authors in Volume 1 were from the early centers of plastination: Utrecht, Vienna, Heidelberg, and the USA, reflecting the limited reach of plastination at that time. In Volume 3 (1989) abstracts from meetings of the ISP were included. Volume 3 included the first publications from Dr Carlos Baptista. Volume 4 (1990) listed an Editorial Board. In Volume 8 (1994), Dale Ulmer took over as Editor, and in Volume 9 (1995) the official founding of the International Society for Plastination was recorded. Volume 9 also carried letters from the newly elected President, Bob Henry, and the Editor. The Journal continued to develop over its first two decades, culminating in the publication of the plastination 'cookbook' in 2007 (Volume 22). The Editor from 1987-2000 was Gilles Grondin; Bob Henry was Interim Editor for Volume 16 (2001), Robert Reed took over as Editor from 2002. A glossy cover with a coloured photograph was added, and print and image quality improved, with coloured images. In its 20th year, Volume 22 (2007), the cover featured a photograph of von Hagens' plastinated 'Rearing Horse with Rider'. The Journal struggled to survive during its third decade, with the number of submissions falling. It was not published between 2009 and 2011, then was re-launched in 2012 as "The Journal of Plastination", with Carlos Baptista as Editor. I took over in 2014. The Journal became online only in 2020. The latest issue, Volume 37(1) (2025), fittingly contained two papers celebrating the achievements of Gunther von Hagens in his 80th birthday year, nearly 40 years after his contribution to the first issue of the journal.

PRELIMINARY RESULTS ON THE COMBINATION OF S10 PLASTINATION AND THE CHILEAN FIXATIVE SOLUTION

Álvarez-Ricartes N[1], del Sol M[1,2], Ottone NE[1,2,3,4,] Masuko TS,[5] Maranillo E[6], Veuthey C[7]
1 Doctoral Program in Morphological Sciences, Universidad de La Frontera, Temuco, Chile
[2]Center of Excellence in Morphological and Surgical Studies (CEMyQ), Universidad de La Frontera, Temuco, Chile
[3]Laboratory of Plastination and Anatomical Techniques, Universidad de La Frontera, Temuco, Chile
[4]Adults Integral Dentistry Department, Center for Research in Dental Sciences (CICO), Faculty of Dentistry, Universidad de La Frontera, Temuco, Chile
[5]Department of Biomorphology, Institute of Health Sciences, Bahia Federal University (ICS-UFBA), Salvador, Bahia, Brazil
[6]Unit of Human Anatomy and Embryology, Medical Basic Sciences Department, Universitat Rovira I Virgili, Reus, Spain
[7]Postgraduate and Research Direction, Faculty of Dentistry, Universidad de La Frontera, Temuco, Chile

Introduction: This study presents preliminary findings on the combined use of the traditional S10 silicone plastination method, originally developed by Gunther von Hagens in 1977, with a Chilean-developed fixative solution, to evaluate its compatibility,

effectiveness, and potential benefits for anatomical preservation. The Chilean fixative solution, formulated to enhance tissue stability, reduce toxic exposure, and improve long-term handling characteristics, has been widely implemented in educational settings. However, its integration into downstream plastination workflows has not been thoroughly explored. Understanding this interaction is crucial, as fixation quality directly influences dehydration, forced impregnation, and the final characteristics of plastinated specimens. **Materials and Methods:** The research involved preparing anatomical samples fixed exclusively with the Chilean fixative solution, composed of sodium chloride, sodium nitrate, glycerin, ethyl alcohol, benzalkonium chloride, formaldehyde (2%), and eucalyptus essence, and subsequently submitting them to the standard S10 plastination protocol, including cold acetone dehydration, vacuum impregnation with silicone polymer (Biodur®, S10:S3, 100:1), and gas curing (Biodur® S6). Throughout the process, we monitored macroscopic and microscopic parameters, with special attention to tissue shrinkage, acetone exchange efficiency, polymer penetration, and the visual and tactile qualities of the final plastinates. **Results:** Early results indicate that tissues fixed with the Chilean solution maintain structural cohesion comparable to specimens fixed with classical formaldehyde-based formulas. During dehydration, samples exhibited predictable acetone diffusion kinetics, without excessive lipid retention or abnormal tissue rigidity. Forced impregnation proceeded effectively, and polymer uptake was consistent, suggesting that the fixative does not chemically interfere with silicone bonding. The cured specimens demonstrated good dimensional stability, clear anatomical definition, and appropriate mechanical resistance, making them suitable for repeated manipulation in teaching environments. **Conclusion:** These preliminary observations support the feasibility of integrating the Chilean fixative solution into the S10 plastination workflow. Potential advantages include improved occupational safety, reduced chemical odor, and better preservation of tissue color and texture. In addition, future work will focus on reformulating the Chilean solution to completely eliminate formalin, aiming to further enhance biosafety while maintaining fixation quality. Further studies involving larger sample sizes, histological validation, and long-term durability assessments are needed to confirm these initial outcomes and optimize the protocol for broader application.

Grant support: Partially funded by Dirección de Investigación, Universidad de La Frontera, supports PP24-0030, PP25-0031, DI24-0039 and DI25-0092.

References

Ottone NE. 2023: Advances in Plastination Techniques. Cham, Springer Nature

Ottone NE, Cirigliano V, Bianchi HF, Medan CD, Algieri RD, Borges Brum G, Fuentes R. 2015: New contributions to the development of a plastination technique at room temperature with silicone. Anat Sci Int 90(2):126-35. DOI: 10.1007/s12565-014-0258-6

Rojas Oviedo JD, Ruiz Díaz SS. 2010: Empleo de solución fijadora conservadora chilena como alternativa al uso del formaldehído para la preservación de tejidos [Use of conservative Chilean fixative solution as an alternative to formaldehyde for tissue preservation]. In: V Congreso Colombiano de Morfología. Int J Morph 28(1):337-340. https://dx.doi.org/10.4067/S0717-95022010000100050

Skopnik-Chicago M, Poblete-Cordero K, Zamora N, et al. 2021: Comparison of haptic and biometric properties, bacterial load, and student perception of fixative solutions: formaldehyde versus Chilean conservative fixative solution with and without formaldehyde in pig kidneys. Anat Sci Educ 14:836-846

von Hagens G. 1986: Heidelberg Plastination Folder. Collection of all technical leaflets for

plastination. 2nd ed. Heidelberg: Anatomisches Institut 1, Universität Heidelberg
von Hagens G, Tiedemann K, Kriz W. 19897: The current potential of plastination. Anat Embryol (Berl) 175(4):411–21. DOI: 10.1007/BF00309677.

INCINERATION OF PLASTINATED SPECIMENS

Antill J[1], Schill VK[2]
[1]*City St George's, University of London, London, UK*
[2]*BIODUR® Products GmbH, Heidelberg, Germany*

Introduction: Plastination is a preservation technique of human and animal tissue that creates highly durable specimens, which, with appropriate care, last indefinitely [1]. However, because of their durability, only a few crematoriums/incineration plants have experience disposing of them. This paper aims to determine if cremation is an appropriate and safe disposition method for plastinates through investigating the thermal disposability of three silicone- or epoxy-impregnated specimens. Investigations also included legal compliance within the UK [2, 3] and Germany [4]. **Materials and Methods:** Three plastinated specimens were used for incineration experiments: silicone goat lung tissue, silicone human shoulder joint tissue, and epoxy resin giraffe pelvis joint slice. After incineration, the thermal disposability of each specimen was investigated, primarily its calorific value and ash melting behavior. Additionally, the UK waste management company Stericycle and the German crematorium Krematorium am Limes were interviewed about compliance and regulatory standards to ensure the technical data fell within appropriate remits. **Results:** Thermal disposability testing showed that both silicone and epoxy resin specimens produced expected results for incinerated plastic; most importantly, the calorific value, which positively correlates with overall energy output. All three specimens' calorific values fell within the expected range of plastics (21.90 - 43.20 MJ/kg)[5], with the epoxy specimen having the highest value of 26.23 MJ/kg. Combustion chambers of crematoriums are typically designed for content with a higher water content, thus lower calorific value. Therefore, to ensure they can withstand the higher calorific value of plastinates and, in turn, increased overall energy output, results were scaled up to simulate cremation of a whole body plastinate. Calculations show that cremation of a whole plastinated body with a pine coffin is completely appropriate and acceptable, as that total energy output (1138MJ) is still lower than the total energy output of an oak coffin alone (1208MJ). Interviews with Stericycle and a crematorium manager confirmed it is permissible to incinerate plastinated specimens as compliance regulations were upheld. **Conclusions:** Our findings demonstrate that crematorium combustion chambers are suitable and safe for the disposition of plastinated specimens as the relevant technical and legal standards for the UK and for Germany were met. Therefore, this paper can serve as a disposal guide for both crematorium and incineration plant operators and institutions housing plastinated specimens. However, as no investigations into the potential of flue gas pollutants were conducted, future chemical tests are required. These results would not influence the technical procedure for incineration but may affect the feasibility of plastination incineration, as regulations regarding potential environmental impact must be met.

References

1. von Hagens G, Tiedemann K, Kriz W 1987: The current potential of plastination. Anat Embryol 175:411-421. DOI: 10.1007/BF00309677

2. Industrial Emissions Directive (2020) Available from: https://www.gov.uk/guidance/industrial-emissions-standards-and-best-available-techniques
3. The Environmental Permitting (England and Wales) Regulations (2016) No. 1154. Available from: https://www.legislation.gov.uk/uksi/2016/1154/contents
4. Twenty-seventh Ordinance on the Implementation of the Federal Emission Control Act (1997). Available from: https://www.gesetze-im-internet.de/bimschv_27/BJNR054510997.html

ENGAGING THE NEXT GENERATION OF HEALTHCARE PROFESSIONALS AND THE PUBLIC: THE MUSEUM OF PLASTINATES AND THE STUDENT-LED TOURS

Baptista CAC
University of Toledo, Ohio, USA

The establishment of the Museum of Plastinates was a strategic institutional response to the shifting landscape of medical education, addressing the debate over dissection versus prosection. The construction, utilizing an original empty space, was made possible by revenue generated by the plastination lab. Opened in December 2013 and expanded in 2016, the Museum serves as the repository for specimens derived from the Body Donation Program, meticulously dissected by select 2nd-year medical students who receive stipends for their preceptorship. Museums of plastinates are a powerful resource for anatomical education, yet they must serve two distinct and critical audiences: future healthcare professionals, who require deep foundational knowledge, and the public, who benefit from improved health literacy. Engaging both groups effectively presents a significant pedagogical challenge. To address this, the University of Toledo's College of Medicine and Life Sciences implemented a student-led tour program (Student-to-Student) at its Museum of Plastinates. This initiative trains health science students to serve as docents, guiding tours for both their peers and the community. The program creates a symbiotic learning environment with dual benefits. For the student docents, it reinforces their own anatomical knowledge through the principle of "to teach is to learn twice," leading to deeper understanding and long-term retention. Furthermore, it serves as a practical workshop for developing critical communication skills as students learn to translate complex medical information into accessible language—a crucial competency for future clinicians. For the public, the student-led tours demystify medicine, provide an accessible forum for health-related questions, and increase community health literacy. These interactions also serve to inspire interest in STEM and healthcare careers among K-12 visitors. The University of Toledo’s program demonstrates a successful and sustainable model that leverages a single resource to simultaneously educate the next generation of healthcare professionals and engage the public.

AN 80TH BIRTHDAY TRIBUTE TO DR. GUNTHER VON HAGENS

Brewer R
von Hagens Plastination, Guben, Germany

Gunther von Hagens has never followed convention. This keynote offers an intimate exploration of the challenges he faced, the motivations that fuelled his relentless pursuit of innovation, and the passion that transformed him from a dedicated anatomist into a public

figure and speaker. It traces his journey from adversity to acclaim, revealing the personal battles behind his scientific triumphs. To many, he is the eccentric genius who transformed anatomical education, a man whose work straddles science and art, controversy and acclaim. But to those who know him beyond his revolutionary invention of plastination, he is something much more: a tireless dreamer, a defiant survivor, and a man who has spent a lifetime pushing the boundaries of what is possible.

PERSPECTIVES OF INTERNATIONAL ANATOMY EDUCATORS: PLASTINATION, CROSS-SECTIONAL TEACHING AND CHALLENGES IN CLINICAL ANATOMY EDUCATION

Brewer R[1], Ward P[2], Hammond L[1], Tunstall R[1]
[1]*Warwick Medical School, University of Warwick, Coventry, UK*
[2]*West Virginia School of Osteopathic Medicine, Lewisburg, WV, USA*

Introduction: E12 plastinated cross-sectional anatomy (PCA) offers high fidelity and correlation with medical imaging [6,7,8,10]. However, student exam performance, educator perceptions, pedagogical frameworks underpinning their application, and barriers to use are inadequately explored [2,4]. The aim of this study was to capture international educator perspectives on cross-sectional anatomy with a focus on PCA, and to compare three groups: (1) PCA users, (2) non-PCA cross-section users, (3) non-users, on learning challenges, resource use, curricular stage/frameworks, and barriers/facilitators to PCA adoption. **Materials and Methods:** A web-based (Qualtrics) CHERRIES3-aligned survey (Ethics BSREC 55/24-25) was used, 25 Feb-14 Apr 2025. Inclusion criteria: anatomy educators (any healthcare discipline). Exclusion criteria: no consent/teaching experience, <9% survey progress. We performed descriptive statistics and thematic analysis. **Results:** 372 educators (318 analyzed) across 62 countries responded. Top learning challenges were visuospatial ability (70%), medical-image interpretation (58%), positional relationships (53%), and spaces/regions/planes (48%). 315 use cross-sectional resources; 25% use PCA. Perceived performance gains: PCA 57%; non-PCA 59%. Supporting teaching frameworks were uncommon, and the leading barriers were insufficient curricular time (56–67%), limited faculty training/confidence (41–43%), and "too complicated" (22–32%). Curricular "fit" clustered in early and middle years. Non-users were largely familiar and willing to adopt PCA but constrained by time/training. **Conclusions:** Spatial and image interpretation skills were identified as the most common challenges. Globally, educators value cross-sections (particularly PCA) for spatial and imaging outcomes, yet adoption is impeded by multiple barriers.

References

1. Braun V, Clarke V. 2006: Using thematic analysis in psychology. Qual Res Psychol 3 (2): 77–101
2. Chytas D, Piagkou M, Johnson EO, Tsakotos G, Mazarakis A, et al. 2019: Outcomes of the use of plastination in anatomy education: current evidence. Surg Radiol Anat 41(10): 1181–1186
3. Eysenbach, G. 2004: Improving the quality of Web surveys: the checklist for reporting results of internet e-surveys (CHERRIES). J Med Internet Res 6(3): e34. doi: 10.2196/jmir.6.3.e34
4. Goh JSK, Chandrasekaran R, Sirasanagandla SR, Acharyya S, Mogali SR. 2024: Efficacy of plastinated specimens in anatomy education: A systematic review and meta-

analysis. Anat Sci Educ 14 (1): 1–10
5. Klaus RM, Royer DF, Stabio ME. 2018: Use and perceptions of plastination among medical anatomy educators in the United States. Clin Anat 31(2): 282–292
6. Latorre R, de Jong K, Sora MC, López-Albors O, Baptista C. 2019: E12 technique: Conventional epoxy resin sheet plastination. Anat Histol Embryol 48(6): 557–563
7. Ottone NE, Baptista CA, Latorre R, Bianchi HF, Del Sol M, Fuentes R. 2018: E12 sheet plastination: Techniques and applications. Clin Anat 31(5): 742–756
8. Ottone NE. 2023: Advances in Plastination Techniques. Springer Nature.
9. Sadler T, Zhang T, Taylor H, Brassett C. 2018: The role of radiology in anatomy teaching in UK medical schools: a national survey. Clini Radiol 73(2): 185–190
10. Sora MC, Cook P. 2007: Epoxy plastination of biological tissue: E12 technique. J Int Soc Plast 22:31-39.

PLASTINATES: BESPOKE DESIGNS

Chereminskiy, V
von Hagens Plastination, Guben, Germany

Plastination has long supported anatomical teaching, yet its fullest value emerges when specimens are purpose-built. This presentation charts the progression from historical/traditional displays to routine plastinates for education, clarifying where standard preparations excel and where they fall short. Bespoke designs are developed with explicit clinical endpoints and learning outcomes. Examples show how targeted dissections can preserve and foreground key fascial continuities, expose safe surgical access, and integrate neurovascular relationships often sacrificed in conventional approaches. Early feedback from learners and clinicians highlights improved transfer to clinical decision-making. With routine plastinates as a solid foundation, this presentation explores “bespoke designs” to ensure plastinates teach precisely what practice requires.

SETTING THE STANDARD: A COLLABORATIVE APPROACH TOWARD ETHICS IN HUMAN PLASTINATION

Patrick W. Frank[1], Wheelan, A.
[1]*Department of Neurobiology and Anatomy, Drexel University College of Medicine, West Reading Campus, Wyomissing, PA. 19610*

The ethics of human plastination has garnered significant discourse throughout the medical and social sciences. As plastination continues to evolve within a dynamic bioethical landscape, it is essential to establish and maintain rigorous standards. In this climate, the ISP is poised to make a significant impact by coming together to formulate a codified ethical framework and take positions on challenging topics. To address global ethical concerns about plastination, Dr. Bill Frank and Alexandra Wheelan, along with ISP members from diverse cultural contexts and academic backgrounds, are collaborating on a “Statement of Position” that aims to provide practical, necessary ethical guidance on human plastination for practitioners, institutions, and other essential stakeholders. We intend to draw on relevant theoretical frameworks to build toward practical applications that offer a new model of ethical practice with greater specificity. While core tenets such as informed consent, respect, dignity, transparency, and stewardship are all immensely important and faithfully implemented, the plastination community is still faced with challenges including

balancing education and public engagement, legal frameworks and institutional oversight, transportation, use of digital images, 3D prints, and virtual reality, care of legacy collections, and final disposition of plastinates. These are all critical topics that require positions from the ISP. We are deeply interested in the invaluable insights and opinions of other ISP members, and hope this presentation allows for productive and meaningful dialogue.

APPLICATION OF THE S10 SILICONE TECHNIQUE FOR PLASTINATION OF THE CARDIOPULMONARY BLOCK

Gómez-Barril R[1], Torres-Villar C[2,3], del Sol M[2,4], Ottone NE[2,4,5,6]
[1]*Faculty of Dentistry, Universidad de La Frontera, Temuco, Chile*
[2]*Doctoral Program in Morphological Sciences, Universidad de La Frontera, Temuco, Chile*
[3]*Departamento de Ciencias Morfológicas, Facultad de Ciencias, Universidad San Sebastián, Puerto Montt, Chile*
[4]*Center of Excellence in Morphological and Surgical Studies (CEMyQ), Universidad de La Frontera, Temuco, Chile*
[5]*Laboratory of Plastination and Anatomical Techniques, Universidad de La Frontera, Temuco, Chile*
[6]*Adults Integral Dentistry Department, Center for Research in Dental Sciences (CICO), Faculty of Dentistry, UFRO, Temuco, Chile*

Introduction: The S10 silicone plastination technique, invented by Gunther von Hagens in 1977 [1-3], represents one of the most reliable and widely adopted methods for preserving human anatomical specimens, offering durable, odorless, and dry-to-the-touch preparations suitable for both teaching and research. Its application to the cardiopulmonary block offers significant advantages for studying thoracic anatomy, as this region contains complex spatial relationships among the heart, lungs, great vessels, and mediastinal structures [4]. This work describes applying the S10 method to an en bloc cardiopulmonary specimen, highlighting methodological considerations, practical steps, and the educational value of the resulting plastinated preparation [5, 6]. **Materials and Methods:** The process begins with careful dissection and removal of the cardiopulmonary block, preserving the pericardium, major vascular connections, and bronchial structures. After fixation, dehydration is performed with cold acetone to ensure thorough removal of water and lipids while maintaining structural integrity. Forced impregnation at cold temperature (-25°C) with Biodur© S10 silicone polymer, combined with the catalyst (Biodur© S3) (100:1) under vacuum, constitutes the core of the technique, during which acetone is gradually replaced by polymer within the tissues [7, 8]. This step must be carefully monitored to avoid excessive shrinkage or distortion, particularly in delicate structures such as coronary vessels, lung parenchyma, and the heart's conduction pathways. Curing and gas-hardening (Biodur© S6) complete the process, yielding a robust and anatomically accurate specimen. **Results:** The resulting plastinated cardiopulmonary block demonstrates excellent morphological preservation, enabling detailed visualization of cardiac chambers, coronary circulation, bronchial tree, and mediastinal relationships. Compared with traditional wet specimens, S10 plastination offers superior long-term stability and improved accessibility for learners, allowing for repeated handling without degradation. This technique also facilitates integration of plastinated specimens into interactive and problem-based curricula,

enhancing students' understanding of three-dimensional thoracic anatomy. **Conclusions:** Finally, applying the S10 silicone technique to the cardiopulmonary block provides a high-quality educational resource that supports anatomical training in medicine, dentistry, nursing, and allied health sciences [9]. The method offers an effective approach to producing durable, realistic thoracic specimens while maintaining the anatomical fidelity essential for professional instruction.

Grant support: Partially funded by Dirección de Investigación, Universidad de La Frontera, Supports PP24-0030, PP25-0031, DI24-0039 and DI25-0092; ANID BECAS/DOCTORADO NACIONAL under grant number 21232217.

References

1. von Hagens G. 1979: Impregnation of soft biological specimens with thermosetting resins and elastomers. Anat Rec 194(2):247–55. DOI: 10.1002/ar.1091940206
2. von Hagens G. 1986: Heidelberg plastination folder. Collection of all technical leaflets for plastination. 2nd ed. Heidelberg: Anatomisches Institut 1, Universität Heidelberg
3. von Hagens G, Tiedemann K, Kriz W. 1987: The current potential of plastination. Anat Embryol (Berl) 175(4):411–21. DOI: 10.1007/BF00309677
4. Baptista CA, Conran PB. 1989: Plastination of the heart: preparation for the study of the cardiac valves. J Int Soc Plastination 3(1):3-7. DOI:10.56507/PEXL8984
5. Henry RW, Janick L, Henry C. 1997: Specimen preparation for silicone plastination. J Int Soc Plastination 12(1):13–17. DOI: 10.56507/HVSK9838
6. Tiedemann K, von Hagens G. 1982: The technique of heart plastination. Anat Rec 204(3):295-9. DOI: 10.1002/ar.1092040315
7. Starchik D, Henry RW. Comparison of cold and room temperature silicone plastination techniques using tissue core samples and a variety of plastinates. J Plast 2015;27(2). DOI: https://doi.org/10.56507/NTQJ7764
8. Ottone NE. 2023. Advances in Plastination Techniques. Cham, Springer Nature
9. Prieto-Gómez R, Rojas M, Koch C, Saint-Pierre G, Estrada J, Ottone NE. 2025: Plastination of Archival Human Fetuses: Anatomical Preservation, Microbiological Safety, 3D Reconstruction, Ethical Considerations and Educational Impact in Obstetrics and Childcare Career Students. Clin Anat 0:1-11 DOI: 10.1002/ca.70032.

PLASTINATION UNDER ECUADORIAN RESTRICTIONS: PROTOCOL USING ETHANOL AND PLATINUM SILICONE

Revelo-Cueva M[1], Luis López JL[2], Estevez R[3], Toaquiza A-B[3]
[1]Laboratorio de Anatomía Animal, Facultad de Medicina Veterinaria y Zootecnia, Universidad Central del Ecuador, Quito, Ecuador
[2]Facultad de Ingeniería Química, Universidad Central del Ecuador, Quito, Ecuador
[3]Carrera de Radiología e Imagenología, Facultad de Ciencias Médicas, Universidad Central del Ecuador, Quito, Ecuador

Introduction: Plastination is an anatomical technique that provides accuracy and durability (von Hagens et al., 1987). In Ecuador, implementation faces challenges due to the complex logistics of importing specialized polymers and government regulations on solvents such as acetone and isopropyl alcohol (Acevedo et al., 2018). To apply this technique without violating local regulations, the study used ethanol and food-grade silicone as alternative materials. **Materials and Methods:** The plastination protocol described by von Hagens et al. (1987) was applied to preserve organs of Gallus gallus domesticus (heart, gizzard, and

proventriculus), with adaptations to the dehydration–defatting and impregnation–curing phases. After fixation in 10% formaldehyde, two protocols were evaluated at −20 °C: (a) ethanol combined with acetone and (b) ethanol combined with thinner, selecting the former due to its lower shrinkage. Subsequently, the organs were impregnated and cured in two groups: (a) Biodur® silicones S10/S3 plus Biodur® S6 silicone and (b) platinum silicone with catalyst (MOLMA, 7000 cPs). **Results:** Using thinner caused severe volumetric shrinkage of 43.46% in the hearts. In contrast, the ethanol–acetone protocol maintained shrinkage at manageable levels across all organs (up to 12%). Regarding the use of platinum silicone, the plastinated organs exhibited characteristics similar to those obtained with specialized silicones (glossy appearance, absence of odor, and preserved anatomical shape), as well as comparable final shrinkage (10% to 32%). **Discussion:** The results showed that although thinner was used as a defatting agent, it caused severe shrinkage in hearts and moderate shrinkage in gizzards, a difference likely associated with the histological structure of the organs (Troup & Stein, 1995; Monteiro et al., 2022). In contrast, dehydration with ascending ethanol concentrations at −20 °C, followed by defatting with acetone, resulted in acceptable volumetric shrinkage, as previous studies have reported greater tissue shrinkage with ethanol than with acetone (Srisuwatanasagul et al., 2010; Singh et al., 2015). However, volumetric shrinkage occurs mainly during impregnation, and silicones with lower viscosity produce less tissue contraction (Monteiro et al., 2022; Delpupo et al., 2024). Therefore, the shrinkage observed in the organs (>30%) is likely related to the high viscosity (7000 cPs) of the platinum silicone, which limited deep capillary perfusion (Singh et al., 2015). **Conclusions:** The trial conducted using ethanol–acetone and platinum silicone provides a cost-effective solution for the dehydration–defatting process. However, the high viscosity of platinum silicone hinders reuse, which increases costs and creates significant operational challenges.

Grant support: Supported by the Research Directorate of the Central University of Ecuador through the senior research project coded DI-CONV-2023-003.

References

Delpupo F, Cassiano L, Monteiro Y, Júnior M, Soares K, Bittencourt A. 2024: Low viscosity silicone with less shrinkage for brain slices. Morphologie 108(360): 100726

Monteiro Y, Silva M, Bittencourt A, Bittencourt A. 2022: Plastination with low-viscosity silicone: strategy for less tissue shrinkage. Braz J Med Biol Res 55: e11962

Ottone NE. 2023: Advances in Plastination Techniques. Cham, Springer Nature

Singh N, Chaudhary A, Nair S, Kumar S. 2015: Non-perishable museum specimens: redefined plastination technique. J Plast 27(2): 1-9

Srisuwatanasagul K, Srisuwatanasagul S, Adirekthaworn A, Darawiroj D. 2010: Comparative study between using acetone and absolute alcohol for dehydration in plastination procedure. Thai J Vet Med 40(4): 437-440

Troup C, Stein F. 1995: Chicken plastination: its role in teaching avian anatomy. J Int Soc Plastination, 10(2):34-36

von Hagens G, Tiedemann K, Kriz W. 1987: The current potential of plastination. Anat Embryol 175(4): 411-421

BEYOND DISSECTION: INTEGRATING PLASTINATES WITH CLINICAL TRAINING AND IMAGING

Savoini E

A.T. Still University-School of Osteopathic Medicine in Arizona (ATSU-SOMA), USA

Traditional cadaveric dissection provides a foundation for understanding human anatomy, yet it often limits exposure to structural relationships, tissue texture, and the functional dynamics observed in living systems. This presentation explores an integrative approach that combines plastinated specimens, anatomical casts, and fresh animal tissue demonstrations to bridge the gap between anatomic form, radiologic imaging, and clinical application. Plastinated hearts, lungs, knees, and head sections—alongside corrosion casts of coronary and pulmonary vasculature—are incorporated into anatomy and clinical skills sessions to reinforce three-dimensional understanding and structural continuity. Head plastinates are paired with MRI slices to enhance spatial comprehension, while plastinated knees are utilized during cadaveric surgical demonstrations such as total knee replacement to reveal correlating structures. Fresh animal tissues provide a complementary perspective on the properties of living anatomy. Demonstrations of bone with intact periosteum illustrate tissue layering rarely appreciated in preserved specimens, while fresh lungs are inflated and deflated to visualize airway branching and pulmonary elasticity. Fresh hearts demonstrate valve function and highlight the delicate thinness of cardiac structures obscured by fixation. By integrating plastination, fresh-tissue dynamics, and imaging interpretation, this session presents a cohesive model for teaching anatomy that transcends traditional dissection. The approach fosters deeper understanding of form and function, enhances radiologic and procedural reasoning, and connects the static anatomy of the lab to the living anatomy of clinical practice.

PLASTINATION FOR CLINICAL RESEARCH

Starchik D
Department of Human Morphology, North-Western State Medical University, Saint Petersburg, Russian Federation

Plastination was originally developed to create anatomical specimens for educational purposes in medical training. Since 1988, plastination has also been applied in clinical research, leading to the emergence of a distinct field — clinical plastination. This approach has opened new possibilities for morphometry, investigation of pathological processes, and evaluation of surgical outcomes using various plastination techniques. The aim of our study was to summarize accumulated experience applying plastination in clinical practice. The study utilized standard silicone plastination (S10), room-temperature plastination (RT), epoxy plastination of slices (E12), and epoxy plastination of tissue blocks. The study used pathologically altered human organs and tissues obtained during autopsy or after surgical procedures. Some silicone plastinates were photographed from multiple angles to generate three-dimensional models using photogrammetry. We determined that epoxy resin with a refractive index between 1.45 and 1.51 provides high optical transparency, allowing clear visualization of stent components and their relationship to the arterial wall in sections. This method proved superior to conventional radiography for assessing stent wire positioning and its adherence to the vessel wall. Therefore, epoxy plastination currently represents the only morphological technique enabling detailed examination of the spatial relationships among metallic stents, vascular walls, and atherosclerotic plaques. Plastinates contribute significantly to clinical anatomy by facilitating the demonstration of pathological processes, assessment of surgical outcomes, and surgeon training. They are easy to handle, safe, and effectively engage practicing physicians. The specimens are convenient for use in lectures, seminars, and practical training. Epoxy sections are widely used in radiologist education

(by correlating plastinates with CT/MRI data), while silicone three-dimensional models are used for endoscopic skills training (bronchoscopy, gastroscopy) and for highly accurate morphometric analysis. The application of plastination in clinical education and research significantly enhances diagnostic capabilities, surgical planning, and morphological investigation. Further expansion of plastination use in clinical and laboratory practice will deepen the understanding of anatomo-clinical relationships and improve the quality of specialist training.

STUDY OF THE LAYERED STRUCTURE OF FACIAL SOFT TISSUES USING EPOXY PLASTINATION

Starchik DA, Khabibulaeva NA
Department of Human Morphology, North-Western State Medical University named after I.I. Mechnikov, Saint Petersburg, Russia

Introduction: Epoxy plastination allows the study of anatomical structures while preserving their topography and high optical transparency. The aim was to describe the layered anatomy of facial soft tissues on epoxy-plastinated slices and compare it with ultrasound and MRI data for injection and reconstructive procedures. Materials and Methods: Serial head slices were prepared in three planes using epoxy plastination (E12 protocol: dehydration, defatting, impregnation, curing; total duration ≈30 days). Morphometric assessments of the thickness of major layers (skin, subcutaneous tissue, SMAS/facial muscles, deep fat compartments, fasciae) were performed in key areas (frontal-temporal, buccal, parotid-masseteric, peri-orbital). Comparison with ultrasound and MRI of corresponding regions was made; descriptive statistics (mean±SD), Student's t-test, $p<0.05$. Results: Epoxy plastinated slices provided clear visualization of the layered organization of the face: skin, subcutaneous tissue, SMAS/facial muscles, deep fat compartments (including the buccal fat pad), buccopharyngeal/masseteric fascia, masseter muscle, periosteum. Slice transparency facilitated tracing of fascial transitions and inter-aponeurotic spaces, including the temporal region. Skin thickness was generally low (maximal in zygomatic and chin regions, minimal on nasal dorsum and eyelids); relative ratios of soft tissue layers were preserved across individuals. On ultrasound and MRI, layer boundaries corresponded to plastination, although fascia and periosteum were less distinct. We identified safe planes for filler injections and risk zones (variable subcutaneous thickness, proximity of neurovascular structures). Discussion: Epoxy plastination (E12) provides micro-topography comparable to sonography but with higher "reference" resolution for calibration of ultrasound/MRI. Combining these data improves accuracy of preoperative planning and training. Limitations: small sample size and preparation artifacts (shrinkage), requiring extension of the series and standardization of morphometry. Conclusions: Epoxy plastinated slices reproduce layered facial anatomy and validate radiological signs of clinically important layers; integration with ultrasound/MRI increases safety and predictability of injection and surgical procedures.

References

1. von Hagens G, Tiedemann K, Kriz W. 1987: The current potential of plastination. Anat Embryol (Berl) 175(4):411-421. doi:10.1007/BF00309677. PMID:3555158.
2. Sora M-C, Cook P. 2007: Epoxy plastination of biological tissue: E12 technique. J Int Soc Plast 22:31-39. doi:10.56507/FCTY3173
3. Adds PJ, McCarthy P, Uddin J, Gore S. 2017: 3-D reconstruction of the retrobulbar

orbital septa using Biodur E12®. J Plastination 29(1):8-14. doi:10.56507/CDAC7411
4. Latorre R, de Jong K, Sora M-C, López-Albors O, Baptista C. 2019: E12 technique: conventional epoxy resin sheet plastination. Anat Histol Embryol 48(6):557-563. doi:10.1111/ahe.12507. Epub 2019 Oct 15. PMID:31617253
5. Ottone NE, Baptista CAC, Latorre R, Bianchi HF, Del Sol M, Fuentes R. 2018. E12 sheet plastination: techniques and applications. Clin Anat 31(5):742-756. doi:10.1002/ca.23008. Epub 2017 Dec 4. PMID:29082560
6. Cotofana S, Alfertshofer M, Schenck TL, Bertucci V, Beleznay K, Ascher B, et al. 2020: Anatomy of the superior and inferior labial arteries revised: an ultrasound investigation and implication for lip volumization. Aesthet Surg J 40(12):1327-1335. doi:10.1093/asj/sjaa137. PMID:32469050
7. Chaimongkhol T, Mahakkanukrauh P. 2022: Facial soft tissue thickness-related facial reconstruction by ultrasonographic imaging: a review. Forensic Sci Int 337:111365. doi:10.1016/j.forsciint.2022.111365. Epub 2022 Jun 11. PMID:35752011

PLASTINATION AND HISTOLOGICAL RESEARCH METHODS IN A COMPARATIVE ASPECT

Starchik DA[1], Pavlov AV[2], Kazantseva EV[1], Andreev YA[1]
[1]*Mechnikov North-Western State Medical University, Saint Petersburg, Russia*
[2]*Yaroslavl State Medical University, Department of Histology, Embryology, and Cytology, Yaroslavl, Russia*

Introduction: Plastination is a relatively new technique that allows for the study of organ topography and their anatomical proportions [1]. However, its application in the histological study of human tissue, including in educational settings, remains limited. Microscopic examination of slides remains an integral part of training in the departments of histology and pathological anatomy. However, modern trends in medical development and physician training require improved approaches in educational disciplines. Undoubtedly, sheet plastination with epoxy resin could also be useful for studying the layered structure of organs. The aim of this study was to develop a method for combining epoxy plastinates and histological preparations for research and for teaching students in morphology departments. **Materials and Methods:** For the study, six preparations of a parenchymatous organ (liver), six preparations of a hollow organ (heart), 12 preparations of a gland (mammary gland), and six preparations of the head (frontal sections) were prepared. After standard fixation of the biological material with 7% formalin solution, epoxy plastinates were prepared using E-12 epoxy resin. The epoxy plastinates were then scanned using an office scanner at 2400 dpi. For histological examination, 30 liver sections, 35 heart sections, and 30 mammary gland sections were prepared. Staining was performed using standard hematoxylin and eosin. The resulting slides were photographed at high resolution. **Results:** Histological slides offer greater resolution and allow examination of an organ at the microscopic level, illustrating not only tissue but also cells. However, students with such classical training do not gain a holistic understanding of the organ. Epoxy plastination allows for the assessment of the overall structure of tissues and organs at the mesoscopic and macroscopic levels, providing an "intermediate link" or "bridge" between anatomical and microscopic examination. **Conclusions:** Thus, the epoxy plastination method significantly expands the capabilities of morphological studies and improves the effectiveness of student learning in disciplines such as anatomy and histology.

References
1. Ottone NE, Baptista CAC, Latorre R, Bianchi HF, Del Sol M, Fuentes R. 2018: E12 sheet plastination: Techniques and applications. Clin Anat 31(5):742-756

S10 SILICONE PRESERVATION OF HUMAN HEAD SECTIONS FOR ANATOMICAL EDUCATION AND RESEARCH

Torres-Villar C[1,2,] Gómez-Barril R[3], Rodríguez-Torrez VH[4], Fuentes R[5], del Sol M1,[6], Ottone NE[1,6,7]
[1]*Doctoral Program in Morphological Sciences, Universidad de La Frontera, Temuco, Chile*
[2]*Departamento de Ciencias Morfológicas, Facultad de Ciencias, Universidad San Sebastián, Puerto Montt, Chile*
[3]*Faculty of Dentistry, Universidad de La Frontera, Temuco, Chile*
[4]*Chair of Human Anatomy and Neuroanatomy, Medicine and Dentistry Department, Universidad Privada del Valle, La Paz, Bolivia*
[5]*Adults Integral Dentistry Department, Center for Research in Dental Sciences (CICO), Faculty of Dentistry, UFRO, Temuco, Chile*
[6]*Center of Excellence in Morphological and Surgical Studies (CEMyQ), Universidad de La Frontera, Temuco, Chile*
[7]*Laboratory of Plastination and Anatomical Techniques, Universidad de La Frontera, Temuco, Chile*

Introduction: The S10 silicone plastination technique, developed by Gunther von Hagens in 1977, has become a cornerstone method for preserving human anatomical specimens, yielding durable, odorless, and easy-to-handle materials well suited for both educational and research purposes. When applied to human head sections, S10 plastination, preceded by colored epoxy resin vascular injection, provides a highly informative and long-lasting resource that accurately preserves the complex spatial relationships among cranial bones, soft tissues, neurovascular structures, and components of the central nervous system. This overview summarizes the methodological approach and highlights the pedagogical value of S10 silicone plastination for preserving and studying human head sections. **Materials and Methods:** The process begins with careful preparation of the head specimen, including vascular fixation with 20% formalin, followed by immersion in the same solution for three months. After this period, the head was injected via the carotid artery and internal jugular vein with red and blue epoxy resin (Biodur® E20Plus) to selectively highlight the arterial and venous systems, respectively. Subsequently, the specimen was embedded in a polyurethane foam block to enable precise sectioning into 1.5-cm-thick horizontal slices. The resulting sections were then re-immersed in a fresh 20% formalin bath for an additional three months to further enhance fixation, particularly to ensure optimal preservation of brain tissue. Dehydration was subsequently performed using cold acetone to remove water and lipids while preserving structural integrity and minimizing tissue artifacts. This step is essential for achieving sharp anatomical definition in the final plastinate. The specimens were then immersed in a mixture of S10:S3 (100:1) (Biodur®: S10 silicone polymer; S3 catalyst) and subjected to forced impregnation under vacuum. As the acetone vaporizes, the polymer gradually replaces it, thoroughly infiltrates the tissues, and stabilizes their internal architecture. The final curing phase, typically performed using Biodur® S6, results in a dry, stable, and durable plastinate that closely preserves the specimen's natural morphology.

Results: Silicone-plastinated head sections offer several advantages over traditional cadaveric materials: they withstand repeated student handling, maintain natural coloration and structural relationships, and eliminate formaldehyde odor, thereby creating a safer and more comfortable learning environment. Notably, the fixation protocol used in this study allowed the brain to preserve its original volume and morphology, with no evident tissue shrinkage or deformation, which is critical for accurate neuroanatomical representation. These attributes make silicone-plastinated sections particularly valuable for teaching neuroanatomy, head and neck anatomy, radiological interpretation, and surgical planning. In research settings, plastinated head sections also provide reproducible and stable models suitable for morphometric analyses, three-dimensional reconstruction, and comparative anatomical studies. **Conclusions:** Overall, S10 silicone preservation of human head sections represents a powerful technique for producing high-quality, long-lasting specimens that greatly support anatomical education and scientific investigation across multiple disciplines.

Grant support: Partially funded by Dirección de Investigación, Universidad de La Frontera, Supports PP24-0030, PP25-0031, DI24-0039 and DI25-0092; ANID BECAS/DOCTORADO NACIONAL under grant number 21232217.

References

da Silva AF, Cerqueira EP, Baptista CAC. 2020: 3D Reconstruction of silicone (S10 Biodur®) plastinated specimens using computed tomography scanning. J Plastination 32(1). DOI:10.56507/HPHJ5119

Henry RW, Janick L, Henry C. 1997: Specimen preparation for silicone plastination. J Int Soc Plastination 12(1):13–17. DOI: 10.56507/HVSK9838

Henry RW, von Hagens G, Seamans G. 2019: Cold temperature/Biodur® /S10/von Hagens ' silicone plastination technique. Anat Histol Embryol 48(6):532-538. DOI: 10.1111/ahe.12472

Starchik D, Henry RW. 2015: Comparison of cold and room temperature silicone plastination techniques using tissue core samples and a variety of plastinates. J Plastination 27(2). DOI: 10.56507/NTQJ7764

Ottone NE. 2023: Advances in Plastination Techniques. Cham, Springer Nature.

von Hagens G. 1979: Impregnation of soft biological specimens with thermosetting resins and elastomers. Anat Rec 194(2):247–55. DOI: 10.1002/ar.1091940206.

von Hagens G. 1986: Heidelberg plastination folder. Collection of all technical leaflets for plastination. 2nd ed. Heidelberg: Anatomisches Institut 1, Universität Heidelberg

von Hagens G, Tiedemann K, Kriz W. 1987: The current potential of plastination. Anat Embryol (Berl) 175(4):411–21. DOI: 10.1007/BF00309677