Abstracts from the 10th Interim Meeting on Plastination Toledo, Ohio, 2011

Fungal infection of plastinated brain slices in high temperature storage rooms. *Alshehry, Murad A. and Alobeaci, Mahir M. Faculty of Medicine. King Fahad Medical City (KFMC), Riyadh, Kingdom of Saudi Arabia*

In desert conditions in Riyadh City in the Kingdom of Saudi Arabia, plastinated brain slices are regularly stored in dry, higher temperature environments of more than 30̊ C. Because of these conditions, a white crystal precipitate is seen in brain slices, particularly located in the white matter. The objective of this study is to determine the origin and type of contaminant, and solutions to prevent brain slice contamination. **Methods:** Several brain slices were used for this study. Feathery crystals were scraped from the brain slices surface and then swabbed onto two petri dishes containing broad range growth medium. Two types of growth medium were used for this experiment, that is, Sabouraud dextrose agar and Corn Meal dextrose agar. Crystals from the slices were swabbed onto both media types and incubated at 30°C in humid incubator. For the control sample, laboratory benches were swabbed in each of the media type stated previously. The media containing crystals was allowed to grow for a month. **Results:** Mycological growth was found on both media of Sabouraud dextrose agar and Corn Meal dextrose agar petri dishes after 1 month of incubation The petri dishes were positive for *Aspergillus fumigatus*. The control plates showed colonies of *Aspergillus niger* and *Aspergillus flavus*.
Conclusion: *Aspergillus fumigatus* is the contaminating agent of the plastinated brain slices. We conclude that the contamination of the plastinated brain slices with the airborn fungus was a result of storing the specimens in a dry, high temperature environment.

Use of plastinated camel brain as neuroanatomy teaching aids. *Basset Aly A.E*, Soliman K.Z., Selim A. , Abdel Aziz S.E., Nosiur H., Konsowa M.,Omar A., Hilal A., Atia A., Khairy S.and Elhadi E.* Plastination Laboratory, Faculty of Veterinary Medicine, Zagazig University, Zagazig , Egypt

Plastinated camel brains have been shown to be effective in teaching and research purposes, enhancing the quality of education in neuroanatomy.
Methods*:* Five camel brains were plastinated using the standard S10 technique. The brains were fixed by injection of cold 10% formalin for 4 weeks, dehydrated by freeze substitution in cold acetone, forced impregnated (Biodur S10&S3) and cured (Biodur S6).
Results: The plastinated camel brains were dry, easy to handle and durable. All structures on both ventral and dorsal surfaces were very clear. The brain slices showed contrast between grey and white matter. Also the deep origin of some cranial nerves and nuclei were distinguished, especially the spinal trigeminal nucleus, hypoglossal nucleus and dorsal nucleus of the vagus.
Conclusion: Plastinated camel brain specimens and slices are non-toxic and ideal for teaching purposes and research. Digital photos of the specimens were used for e-learning. This work is supported by a project from The Ministry of Higher Education (CIQAP, 2nd cycle 2009, code zag-vet-1).

Brief history of plastination in Kyrgyzstan. Belov Georgei*and Aidarova Dinara *Department of Pathologic Morphology of the Kyrgyz-Russian Slavonic University, Institute of Polymeric Technologies, Bishkek, Kyrgyzstan.*

The aim of this work is to analyze the legal, financial, technological and scientific documents of mass media articles about the Centre for Plastination in Kyrgyzstan since 1997 (Institute of Morphology and Polymer Technologies in 2002). The largest investment project in medicine in Kyrgyzstan included the newest technologies of sectional, 3-dimensional and corrosion anatomic specimens developed by Dr. Gunther von Hagens for teaching and research purposes. Students of the Kyrgyz State Medical Academy (KSMA) and Kyrgyz-Russian Slavonic University (KRSU) studied anatomy using unique specimens that had an aesthetic look, unlimited storage time, free of formalin odor, which contributed greatly to anatomy learning. Special tests of students' knowledge conducted by the Association of Central Asia Medical Schools showed

KSMA to be in the leading ranks. The Museum of Plastination established in Bishkek has more than 1500 plastinated specimens, including 15 whole anatomic bodies. The Museum became a place for training first year students, practicing physicians and surgeons. Mobile training sessions on several topics were organized for students of other universities. The Museum, the most visited among others, had many foreign guests, physicians and laypersons, people of different faiths who expressed their delight for the collection..Besides the Museum, the investments of G. von Hagens were directed to the repair of the building of The Morphology Department of KSMA, the Institute of Physiology and High-Altitude Pathology of the National Academy of Sciences, and the reconstruction of refrigeration and equipment of the Bureau of Pathologic Anatomy, Bureau of Forensic Medical Examination. Anatomical specimens have been made with the involvement of many specialists from the departments of general anatomy, topographic anatomy and operative surgery of KSMA and KRSU. Members of the students' scientific community, where many of them had training abroad also supported the project. The legal basis concerning anatomic specimens in Kyrgyzstan, as in other NIS countries has been deteriorating since 2000. Involvement of politicians in research and teaching disrupted all activity related to plastination. The use of human organs, including surgical amputated material and placenta, are restricted by legislation. As a result the quality of learning anatomy has declined, the sanitary and technical state of morgues has worsened, and problems of temporary storage and burial of unclaimed corpses remain unsolved. The problems of the past demand the resolve at the present. We developed proposals to amend some chapters, regulations and guidelines of the National Healthcare Law on anatomic specimens. Special attention was given to points concerning to body donation.

3D multidetector CT reconstructions of a heart and a diencephalon and brain stem, plastinated by Biodur S10 standard technique. *Cerqueira, Esem[1], Baptista, Carlos A. C.[3], Campi, Cláudio.C.[2],Silva, Adriano F [1]Dept. of Anatomy, University of São Paulo/ICB/USP, São Paulo, Brazil [2]Dept. of Radiology, Heart Institute, São Paulo, Brazil [3]Dept. of Neurosciences, University of Toledo, U.S.A.*

Computed Tomography (CT) and Magnetic Resonance (MR) examinations are normally used in clinical and anatomical practice. Imaging of plastinated specimens by CT, was used to evaluate its internal and external structures to ascertain their integrity.

Methods: A Toshiba Aquilion 64-multdetector CT scan, at Radiology Department of the Heart Institute – University of São Paulo - USP/Brazil, was used to evaluate plastinated secimens of the heart, a diencephalon and a brain stem. The specimens were plastinated in 1986 at The Department of Anatomy of the Institute of Biomedical Science - ICB/USP/Brazil, using Biodur S10 standard technique. Several images were obtained from the scanned specimen slices of cross-sections of 0.5-mm thickness and 0.5-mm reconstruction interval. Three-dimensional images were reconstructed through MIP (Maximum Intensity Projection) and VR (Volume Rendering) techniques at Aquarius Net Viewer Workstation of TeraRecon Company. Also, the rate of CT attenuation coefficient (UH) of the images was measured and compared with images obtained from myocardium and white/ grey matter of a living individual.

Results: The anatomical aspect of the heart, diencephalon and brain stem of the plastinated specimens were preserved. The internal structures of the heart, such as cardiac valves, ridges and bridges (trabeculae carneae), fibrous threads (chordae tendineae) and papillary muscles where remarkably preserved. The internal and external structures of the third ventricle and the midbrain were found to be preserved twenty-two years after being plastinated. The 3D reconstructions of anatomical structures of these specimens showed great detail and high spatial resolution. Radiological images showed increased attenuation rates, compared with the images of the myocardium of the living specimen. When images of the plastinated grey and white matter was compared with the living brain specimen images, they showed reduced attenuation but less than the attenuation values of any kind of calcification. CT images were not clear enough to recognize the layers of myocardium wall, or the grey/white matter of the nervous tissue of both specimens.

Conclusion: CT scanning is an excellent method for assessing plastinated specimens, especially to reveal and evaluate either inner or outer surfaces, but not to differentiate their wall structures because the silicone impregnation altered the CT attenuation rates of specimens.

Using the plastination facilities at the medical school to establish new research, education and communication with the local community. *Dall, Annette M and Chemnitz, John Department of Neurobiological Science, Institute of Molecular Medicine, University of Southern Denmark, Denmark, Europe*.

At the medical faculty at the University of Southern Denmark – Odense we have facilities for S10 plastination, which were established to prepare anatomical specimens. These facilities were used in a new co-operation with the local zoo, where incidentally a giraffe was necropsied. Because giraffes have extremely high blood pressure the heart and kidney were studied.

Methods: The heart, stomach and a segment of the giraffe neck were immersion-fixed in 4% formaldehyde, dissected and plastinated using the Biodur®. S10 technique. The two fresh kidneys were cast-injected with red epoxy-resin (Biodur® E20) via the renal artery, One kidney was immersion-fixed with 4% paraformaldehyde and plastinated with S10, while the other was macerated using NaOH.

Results: The weight of the heart was 4.2 kg. The left ventricle had a remarkable thick wall and a small lumen. The *ligamentum nuchae* of the neck extends from the seventh cervical vertebra to the head, where it widens before attachment. The arterial structure from the renal artery to the interlobular arteries was visualized.

Conclusion: The weight of the heart corresponded to 0.5% of the total body-weight, similar to other domestic animals. The thick wall of the left ventricle in combination with the small lumen is essential in creating the high blood pressure unique to the giraffe. The giraffe neck contains large neck muscles and an enormous elastic *ligamentum nuchae*, which are significant structures in the movement of the head and neck. Our reconstruction of the renal arterial system is in accordance with the description by Maluf (Anat Rec 267:94-111, 2002). This study is the beginning of co-operation between the medical faculty at the University and the local community.

Use of glycerine embedded specimens for teaching neuroanatomy for medical students. *Fazan, Valéria P. S.School of Medicine of Ribeirão Preto, University of São Paulo,Brazil*.

The neuroanatomy course for our medical students (MED-NEURO) is taught using whole and sectioned, formalin-fixed brains and spinal cords. In order to have enough good quality specimens available, a considerable amount of time has been needed to collect the brains and ensure proper and timely fixation.

Methods: Fixation was accomplished by arterial injection of 10% formalin. Additional tissue from autopsies was fixed by immersion. After several days in the fixative, the immersion-fixed or arterially-fixed tissues were then placed in 50% formalin/50% glycerine to start the embedding process. Three days later, the specimens were placed in 100% glycerine until they sank to the bottom of the container..

Results: The fixed specimens are wet and slippery to handle., Gloves must be worn for protection from the fixative. Differentiation of white and grey matter was difficult to appreciate on unstained, fixed cross sections. The glycerine-embedded specimens are more pleasant to touch, do not drip on the student's text or notes, and do not cause tearing, respiratory irritation, and topical allergic reactions that have been a problem in anatomy laboratories in the past.

Conclusion: We observed that students use glycerine-embedded brains more readily than formalin-fixed brains. An added advantage, in view of the dwindling availability of cadavers and increased cadaver costs, is that glycerine-embedded specimens are more durable, reducing the need to replace the collection so often. *Support: FAPESP, CAPES, CNPq

Comparing mechanical properties between pre and post-plastinated specimens. *Kim, Sang-Hyun *, Hong Byung-Ouk, Lee U-Young, Kwak Dai-Soon, Lee Mi-Sun, HAN Seung-Ho. Department of Anatomy, Catholic Institute for Applied Anatomy, College of Medicine, The Catholic University of Korea, Seoul, Korea.*

The Catholic Institute for Applied Anatomy first made plastinated specimens in 2003. Presently about 200 plastinated specimens of human organs and some whole body animal specimens are used for research and education. There are some advantages in making plastinated specimens which are elastic and able to move slightly. However there are no trials to assess the mechanical properties of our specimens. This research compared the elasticity between pre and post plastinated specimens using a Universal Test Machine.

Methods: Brain, lung, liver and kidney from one embalmed male cadaver were used. In order of decreasing stiffness values these are liver, brain, kidney and lung for pre-plastinated specimens and liver, kidney, brain and lung for post-plastinated specimens.

Results: We found the decrease in elasticity to be as follows: liver, 36%; brain, 24%; kidney, 62% and lung, 55%.

Conclusion: Based on these results, it is possible to predict how much elasticity would be reduced after plastination. The information would be helpful to prepare better plastinated specimens. If more samples are analyzed, procedures could be developed to maintain or improve elasticity of plastinates.

Injection-corrosion technique followed by Spalteholz clearing for the description of extra- and intra-osseous vascularization in the distal femur.

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We studied the feasibility of a convex vascularized osteochondral graft harvested from the medial femoral condyle and trochlea, from an anatomical and practical point of view. This work was mainly designed for a clinical outcome but the unprecedented combination of anatomical techniques used represented a real challenge.

Methods: An injection-corrosion technique was used on 16 fresh cadaver specimens, and completed by a modified Spalteholz clearing. Each step of the standard procedures was carefully watched and, if needed, adapted in real time. The extra- and intraosseous vascularization of the medial femoral condyle was systematized and the luminal diameter of the arteries was microscopically measured.

Results: The last steps of the Spalteholz clearing had to be customized due to corrosion of the cast itself. Nevertheless, a very precise visual mapping of the intraosseous vascularization could be obtained. The periosteal vessels of the medial condyle are responsible for the whole peripheral intraosseous vascularization, without any watershed region. Several constant vascular axes could be found, and may serve as a pedicle for a vascularized osteochondral graft from the medial femoral trochlea.

Conclusions: This combination of techniques is valuable for a fine definition of the intraosseous vascularization as well as extraosseous vascularization, even in a basic lab. Results are rewarding, but these demanding techniques have to be slightly customized.

Cross-sectional anatomy of the carpal tunnel in children. *Luz, Marcus A. M.[1]; Camilli, José A.[2]; Santo-Neto, H.[2]Paulista University (UNIP), São José do Rio Preto, SP, Brazil.[2] Department of Anatomy, Cell Biology and Physiology and Biophysics, Institute of Biology, State University of Campinas (UNICAMP), Campinas, SP, Brazil.*

Plastination is an excellent technique for impregnating anatomical materials that can then be used for teaching and research. Several studies have used this technique for obtaining sections of anatomic details, enabling morphometric and positional analyses. Despite the advantages offered by plastination, it remains a costly and complex technique which has undergone several changes in recent years. Due to the complex nature of the plastination process many researchers still have little or no knowledge of the technique. An alternative to the plastination technique for studying small anatomical material is embedding in paraffin wax.

Method: In the present study, carpal samples were taken from 12 children ranging from 2 to 11 years old. After fixation in a 10% solution of formalin, the samples were dehydrated in ethanol, embedded in paraffin and sectioned with a microtome to obtain cross sections of the carpal region. The sections were then stained with hematoxylin and eosin and Masson's trichome. In each section, images were obtained by a digital camera capture system that was coupled to a microscope and then analyzed using Image J Version 1.32 software. The main nervous, muscular and vascular structures of the carpal tunnel were analyzed.

Results: The position of the median nerve was in the central and lateral areas of the carpal tunnel and showed marked variability. In addition, variations in position of the flexor retinaculum and flexor muscle tendons in the carpal tunnel were found. Approximately 56% of the carpal tunnel was occupied by the tendons of the superficial and deep flexor muscles of the fingers. The median nerve occupied 11.9% of the area. In 16% of the samples a persistent median nerve satellite artery was observed that occupied 1.37% of the area of the carpal tunnel. The variation in size and position of the components of the carpal tunnel can explain the syndrome of non-traumatic compression in children. Our results showed that the technique of embedding small specimens in paraffin wax provided sections with anatomical details preserved for morphometric analyses.

Innovative preparation technique produces life-like specimens and delayed decomposition. *Mueller, Dean A.*, Wessels, Michael W., Akingbola, Bolaji A.*Division of Anatomical Sciences, Department of Medical Education, The University of Michigan Medical School, Ann Arbor, MI 48109, USA*

Over the past several years the embalmer at the University of Michigan has been approached by the Department of Surgery to embalm cadavers for an annual "boot camp" class. They have asked if it would be possible to preserve cadavers that would be more life-like than traditional formaldehyde-embalmed cadavers. Several solutions were tried, using chemicals including preservatives, fixatives and disinfectants with minimal success. All the attempts either failed because of rapid decomposition or the un-natural feel of the treated tissues.

Methods: We decided to contact Trinity Fluids, LLC., a Michigan-based company that we currently use to supply our customized embalming chemicals. They provided an arterial chemical they believed would make the cadavers have a life-like feel and last up to 5 days at room temperature without decomposition or putrefaction odors. We followed the protocol which was similar to common embalming practices on two whole body cadavers.

Results*:* The cadavers remained satisfactory for over 14 days. During the last 4 days a noticeable yet tolerable odor became distinct on the skin, but not noted on the organs or muscles. The results peeked many faculty and students' interests, wondering how this process could affect plastination. For this purpose we harvested an upper limb, piece of femoral artery, liver, lung and kidney. All specimens were plastinated in the room temperature method with success. Our hope was to find a final product that would be more flexible and life-like than traditional plastination. After plastination we found no difference than specimens prepared with common embalming chemicals. We did however, notice the skin on the arm specimen continued to express a slight odor while the other tissues still had no noticeable odor. This was interesting because all the specimens were processed in the same containers and chemicals at the same time.

Conclusion: Plastination of specimens preserved initially in this manner are similar to those preserved by common embalming chemicals. The faculty in the Department of Surgery were impressed with the life-like condition of the cadavers so much so that they have requested all future cadavers to be preserved in the same manner. They are also submitting recommendations to other universities for what is hopefully to become a national surgical boot camp curriculum with other medical schools. These successes and failures have encouraged us to continue to develop the protocol and chemicals to better learn how we can use it to expand and develop anatomical teaching. With minor improvements to the protocol and chemicals, we assume even greater success in the near future.

Integrated teaching of anatomy correlating with clinical anatomy with the help of plastinated specimens. *Nimmagadda, Haritha kumari*[1], Tyagi Kavita[1], Mathur Brij Kishore[2]. [1]Department of Anatomy, [2]Department of Radiology, Mahatma Gandhi Mission's Medical College, Mumbai, India.*

Anatomy is taught for all medical health science courses. Gross Anatomy is a fundamental basic course in virtually all medical training programs, and the methods used to teach it are under frequent scrutiny and revision. Students often struggle with the vast collection of new terms and complex relationship between structures they must learn. Teaching Anatomy in various modalities has been a topic of discussion for a very long time. Dissection has been the main focus in the anatomy curriculum requiring a constant flow of cadavers to be available to various courses. Since body donation is not uniform, the lack of cadavers for dissection in many institutions is making anatomists rely on plastination.

Methods: Plastination is a method where dissected specimens can be preserved in a plastic form which will be dry, odorless, life-like, non-hazardous, maintenance free and which do not deteriorate with time and even can be re-dissected if required. This technique consists of four main important steps, 1. Fixation, 2. Dehydration, 3. Forced impregnation and 4. Hardening. Fixation can be done by almost all conventional fixatives. Dehydration is achieved mainly by acetone because acetone also serves as the intermediary solvent during impregnation. Forced impregnation is the central step in plastination: vacuum forces the acetone out of and the polymer into the specimen. Finally the impregnated specimen is hardened by exposing it to a gaseous hardener. There are currently three methods of plastination which are followed frequently: whole organ plastination, sheet plastination and luminal cast plastination.

Results: We conducted a study to evaluate the use of plastinates for teaching anatomy from the perspective of teachers and students. The observations and results of our study show that with the help of these plastinated specimens, the anatomy of every organ can be well shown and easily understood. The observations and results of our study will be reviewed in detail along with problems faced by medical colleges. Problem-based learning is becoming an important tool in medical education. Plastination applied to normal and abnormal structures of the body can be well-reviewed, making it an excellent technique in medical institutions for better understanding of anatomy.

Does sucrose prevent shrinkage in silicone brain plastination? *Parsai, Shireen and Baptista, Carlos A.C., University of Toledo, College of Medicine, Department of Neurosciences, Toledo, Ohio, USA*

Sucrose has been advocated for use in plastination of brain tissue. Several researchers utilize sucrose in many different concentrations as a means of protection of the brain tissue against cold silicone impregnation. The purpose of this study was to determine whether sucrose treatment is an effective means of preventing shrinkage in the silicone plastination technique of brain tissue. Additionally, in order to design methods to decrease shrinkage the following questions were tested: (1) Which plastination step results in the greatest shrinkage? (2) Does impregnation length contribute to shrinkage.

Methods: Four brain samples were used to create 48 specimens. These were first divided into four groups according to concentration of sucrose: control, 4%, 6%, and 10%. Then each group was further divided according to impregnation length: 3 weeks, 4 weeks, and 5 weeks. The surface area of each specimen was measured after each step of plastination using image analysis software.

Results: Statistical analysis was conducted to determine correlation between fixation time, concentration of sucrose, impregnation length, plastination step, and shrinkage of tissue. No statistical significance was found among the variables. It was found that the impregnation step resulted in the greatest shrinkage. The specimen treated with 6% sucrose with an impregnation length of 5 weeks resulted in the least shrinkage during the dehydration and impregnation steps. However, the specimen treated with 10% sucrose with an impregnation length of 5 weeks resulted in the least shrinkage during the curing step. These data represent preliminary results.

Conclusion: The interpretation of our experiment results was challenging due to the large number of variables tested. Because the results were deemed inconclusive regarding the effect of sucrose in the shrinkage of the brain tissue, an experiment with more controlled variables is being performed.

Improved science education with exhibition of plastinated specimens for teachers and students of public high schools of Niterói, Rio de Janeiro, Brazil. *Pereira-Sampaio, Marco A[1]*; Chagas, Maurício A[1]; Holanda, Eloísa CO[1]; Bastos, Ana L[1], Babinski, Márcio A[1]; Henry, Robert W[2]. [1]Department of Morphology, Fluminense Federal University, Niterói, RJ, Brazil and [2]Department of Comparative Medicine, University of Tennessee, Knoxville, TN, USA.*

Test scores of the 2007 ENEM (Exame Nacional do Ensino Médio, the exam necessary to select students entering Brazilian universities) of students of public high school were significantly lower than those of students of private high schools of Niterói, Rio de

Janeiro. A difference of 17.27 points between scores of students from private and public schools shows that public high schools of Niteroi require more focal attention. Plastinated specimens were used as an exhibition to enhance science exposure to students of public high schools. The teachers could then improve learning and therefore increase performance of students of public high schools. The aim of this work was to improve the science education in Niterói public high schools.

Methods: All plastinated specimens used in the exhibitions were produced in the Plastination Laboratory of the Department of Comparative Medicine, University of Tennessee, Knoxville, USA. The exhibitions took place on Saturdays in the Anatomy Laboratory of the Department of Morphology of Fluminense Federal University. Teachers of public high schools attended training for teaching anatomy and physiology, using plastinated animal specimens. Students participated in demonstrations by their teachers, where topics of anatomy and physiology were addressed. Both teachers and students had the opportunity to handle the plastinated specimens during the exhibitions.

Results: Teachers of the public high schools of Niterói, at the end of the exhibitions, reported that the training activities were helpful and they would participate in other training. After the first year of exhibitions (2007), the ENEM results of Niterói public high school students improved from 32.18/100 (2007) to 46.08/100 (2008) and 49.20/100 (2009) This significant improvement suggests that the exhibitions did not only increase learning in science but also motivated the students in other subjects. When compared with the results of private school students, the difference decreased significantly after two years of exhibition from 17.27 to 9.28 points.

Conclusion: Using plastinated specimens as an aid to improve science teaching is a good way to motivate students and professors to improve learning. Grant Sponsor: Foundation for Research Support of Rio de Janeiro (FAPERJ), Brazil.

Volume changes in brain specimens with altered approaches to S10 plastination. *Pizzimenti, Marc Department of Anatomy and Cell Biology, Carver College of Medicine, University of Iowa, Iowa City, Iowa, 52240*

Volumetric changes in tissue during the plastination process are common and almost inevitable. However, the degree to which specimens will experience volumetric decreases through plastination has not been quantitatively assessed for intact brain specimens. If brain specimens are to serve educational purposes, they must reflect appropriate size and morphologic relationships after the plastination process.

Methods: Sixteen human brain specimens were used to investigate how alterations in the plastination process affect specimen volume. The brains were divided into hemispheres and assigned to one of four experimental conditions: standard room temperature (SRT); standard cold temperature (SCT); short standard cold temperature (SSCT); and SSCT with xylene (SSCTX). Standard protocols were followed for each of the experimental conditions, however in the SSCTX conditions, the impregnation time was reduced to only 36 hours. Also, in the SSCTX condition, 200 mL of xylene was added to the polymer bath. Volume and mass measures were made at specific stages during the plastination process. Volumetric changes were determined through water displacement.

Results: Specimens underwent a decrease in volume that varied with the experimental conditions. At the dehydration phase of the process, SRT specimens were affected most and measured 88.2% (±4.7) of their original volume. Specimens in the SSCTX conditions demonstrated the lowest decrease in volumetric change (98.2% ±5.0). Volumetric decreases were also observed in the STR (78.1% ±3.7) and SSCT (95.0% ±4.2) conditions. The major decrease in specimen volume occurred during the impregnation process. SRT specimens demonstrated the largest overall change, measuring only 43.3% (±6.7) of the original volume. Specimens in the SSCTX condition also demonstrated a large change in volume, but on average measured 47.4% (±1.3) of the original volume. Mass of the specimens was generally correlated with volume measures for each experimental condition. Specimen density prior to the dehydration process (e.g., SCT 1.06 g/mL (±0.01)) decreased through the dehydration process (0.91 g/mL (±0.03)). There was, however, no overall difference in specimen density once the specimens were cured.

Conclusion: The primary stage in which major volumetric changes in brain tissue occurs is during polymer impregnation. Cold temperature methods tend to minimize brain tissue volume loss, particularly if an additional intermediary solvent (e.g., xylene) is added to the polymer bath. However, additional methods for the S10 process must be determined to minimize volume loss in brain tissue.

Plastination and embedding technology used in teaching and researching on meridian human anatomy. *Qixiao, Ye[1];Chengjie Yang [2]; Jianhua Zhang[1]; Hui Wang[4]; Yang Zhou [3]; Xiaoxu Liu [1] Shanghai University of Traditional Chinese Medicine; [2]Qingdao Keyi Biological Technology Company; [3]Shanghai Putuo Medical school;. [4]Shanghai Public Safety Department.*

The research on Meridian Acupoints of Human Anatomy has been at the frontier of modern Chinese Medicine explorations. Since 2007, with cooperation between Shanghai University of TCM and Qingdao Keyi Biological Technology Company, plastination and embedding technologies have been applied in teaching and researching on structures of meridians and acupoints, which has aroused great interest in academic fields. This research will introduce the applications of plastic and embedding technologies to meridians and acupoints in specimens of human anatomy.

Methods: Five normal female cadavers whose properties accord with the average standard of Asian races were selected. According to the requirements of teaching and research, we divided human anatomic structures into the following four levels: skin, superficial fascia, superficial and deep muscle-vascular-nerve layers, and used four cadavers to exhibit each level. Another cadaver was used to review the dangerous acupoints which were closely related to body organs. Generally, the process of making plastinated specimens can be divided into five steps: dehydration; de-fatting in pure acetone; vacuum infiltration; positioning and gas curing. We then inserted needles into those acupoints following the principles layed down by authorities. The meridians were marked with different colors in the body and different names marked on the needles. One of the unique designs of these specimens was their gestures of playing Taiji, which manifests the vitality and aesthetic properties; another is that all specimens were exhibited in a three-dimensional way which successfully shows every details of their anatomical structures. Embedding technology was also used in horizontal slices to show human acupoints. The material of the slices was normal adult male. According to the horizontal sections of the acupoints, we selected 159 slices (less or equal to 2mm) from the corpse which could reflect the specific structures of 830 acupoints. The process includes: bleaching tissues by H_2O_2, dehydration, de-fatting in pure Acetone; vacuum infiltration; determining points and inserting needles; positioning with glass ptates, embedded with ester resin and finally shaping into slices with heat. After these processes, the thickness of slice could be limited to 3.7mm. These slices were transparent, bright and clear. We intend to connect these slices with a digital retrieval system in order to realize the communication between students and machine, to emphasize the anatomical structures of acupoints and to strengthen the ability to identify requested acupoints in clinical trials.

Conclusions: As the first two cases around the world, the creation of these two specimens will have a great influence on the field of medication, teaching and researching, especially in meridian and acupoints of human anatomy. *Supported by Shanghai China Municipal People's Government Education Funds **supported by Shanghai Municipal Education Commission Specific Discipline Construction Funds

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Intermediate solvents rectification unit in the plastination laboratory. *Starchik, Dmitry* and Kucher Fedor International Morphological Centre, Saint-Petersburg, Russia*

Rectification of acetone and other solvents from water and fats for recycling is one of the important tasks in plastination. The rectification unit must have high productivity but small size, provide a high degree purification of dehydration and degreasing agents and be easy to control. It should also meet explosion safety and reliability requirements.

Methods: We have designed a laboratory unit for rectification of intermediate solvents polluted by dehydration and degreasing of anatomical specimens. The unit consists of 4 parts: vaporizing tank, rectification column, reflux condenser and an electronic block. The vaporizing tank consists of external and internal containers, placed one inside another, each with capacity of about 100 liters. The external container

has three heating elements and a heat sensor. The internal container is designed for evaporation of solvents and has filling and draw-off taps, a temperature sensor and a thin metal tube for pumping air. The rectification column is 100 mm in diameter and 1950 mm high and is attached to the top aperture of the internal container. The column consists of two segments that have special spiral wire elements inside. The top segment is equipped with two temperature sensors. The reflux condenser is installed on the top of rectification column and has an adjusting valve and is cooled by water. The electronic block provides power for the heating elements, controls the process of rectification and prevents the unit from overheating. Before starting, the external container is filled with heat-resistant oil and the internal tank is filled with polluted solvent. Distillation is carried out in a semiautomatic mode. The rectification degree of solvents is adjusted by the valve of the reflux condenser. The volume of rectified solvent and its water content are measured every ten minutes.

Results: During the trial period the unit was used to rectify single-component and multicomponent mixtures, containing acetone, ethanol, methylene-chloride and isopropyl alcohol. For single-component mixtures the highest efficiency was registered when rectifying methylene-chloride (44 liters/hour) and the lowest one with ethanol (18 liters/hour). Separation of multicomponent mixes is also possible with strict temperature control. It is possible to adjust the water percentage in distilled solvent and obtain a minimal level by decreasing the rate of solvent by controlling the difference in temperatures between top and middle parts of the rectification column.

Conclusion: The experiments have proved that the productivity of the unit depends on the physical and chemical properties of the intermediate solvent and its water content. Achieving minimal water percentage solvent requires maximum time. Using spiral wire elements inside the rectification column helps to halve the unit height and makes it possible to install it in labs with floor-to-ceiling height up to 3 meter.

Plastinated Minke whale with silicone technique by Dalian Hoffen. *Sui, Hongjin[1,2]1 Department of Anatomy, Dalian Medical University, Dalian, China; [2]Dalian Hoffen Bio-technique Co., Ltd. No.36, Guangyuan Street, Lushunkou Economic Development Zone, Dalian, China*

A 6.2m minke whale preserved by Dalian Hoffen through silicone plastination technique, is currently the largest plastinated specimen currently in the world. This specimen displays the skin, muscles, nerves, vessels, and organs.

Methods: The plastination process of the minke whale was as follows: A male minke whale became stranded and died in the Dalian Wafangdian sea in February, 2009. It was found by local fishermen. After verified by the fishery sector, Dalian Hoffen was entrusted to preserve it through plastination. After injecting 1 ton of 10% formalin, perfusing 50,000 ml dye and immersion in 10% formalin purpose-made bath for 8 months, the specimen was dissected to display muscles, nerves, vessels and organs, and then bleached using 5% H_2O_2 until a uniform color was obtained. The process of dissection and bleaching took 2 months. Due to the large size of the minke whale, plastination was performed by cutting it into 4 parts. Meanwhile, special baths and cantilever cranes were designed and used for its dehydration and forced impregnation. The 4 parts were precooled in a 5ºC refrigerator, then dehydrated in cold acetone baths for 4 months, degreased in acetone baths at room temperature for 4 months, then impregnated in a cold vacuum bath for 2 months. After forced impregnation, the minke whale's 4 parts were reassembled through a reinforced steel framework fitted into its body. The whale was positioned into a diving posture. The process of modeling and anatomically repairing took 2 months. After modeling and repairing, the specimen was carried out for curing with gas and heat for 1 month.

Results: The process of the minke whale's plastination took 23 months. The flexibility of its skin, muscles, nerves, vessels, and organs tissues after plastination were easily discriminated. The minke whale specimen, with its vividly diving posture, clearly showed its dorsal and ventral structures.

Conclusion: Dalian Hoffen preserved a dry, odorless, resilient, and durable minke whale specimen used for not only science popularization but also anatomical learning.

Generating 3D computer models for educational delivery through personal mobile computer devices: an example using a plastinated heart.

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Computer-aided delivery of anatomical course content is becoming increasingly popular since instructional information can be tailored to specific learning objectives. With increasing availability of mobile computer devices such as iPads and iPhones, learning opportunities have become individualized and instantaneous for students. As well, sophisticated 3D images can be delivered within virtual learning environment facilitating understanding of complex spatial relationships. Design of anatomical course content deliverable through personal computer devices remains problematic when representative models do not exist. A potential solution for this issue is to utilize plastinated anatomical material enabling an instructor to generate anatomical models tailored for specific pedagogical objectives deliverable through personal mobile computer devices. The purpose of this study was to develop a method to generate computerized 3D anatomical models from plastinated material for use in electronic media.

Methods: A formalin-fixed cadaveric adult human heart was dissected free and injected with INR-seal (Dodge) so that the cavities remained expanded. The specimen was subsequently dehydrated in an acetone bath of increasing concentrations (90%-99.5%) for six weeks followed by degreasing for 2 weeks. Forced impregnation was accomplished with PR10 polymer and Cr20 cross-linker (4 days) and it was cured by applying sequential coats of Ct32 cross-linker. The resulting plastinated heart was digitized using a hand-held scanner (Polhemus), exported and edited in Maya (AutoDesk) and WinSURF (Akuaware), and finally saved in xdf format. Audio files (.wav) were recorded, based on the individual cardiac components. The model was incorporated into an electronic dissection guide (.pdf) and viewed with SURFviewer (Akuaware.com).

Results: Using the PDF file, students could call the heart model as they worked through the electronic dissection guide. The model can be viewed and interactively manipulated on a standard Dell computer stationed at each dissection table as well as personal mobile devices including an iPhone and iPad. **Conclusion:** Results from this study demonstrate how plastinated specimens can be generated and tailored for electronic dissections guides.