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TABLE OF CONTENTS

(continued on page 2)

COVER PAGE: Limbs plastinated at room temperature with Su Yi Chinese Silicone (see paper page 21)

TABLE OF CONTENTS

SURVEY

ANNOUNCEMENTS

MESSAGE FROM THE EDITOR

Dear readers,

As you will notice on the inside front cover of this issue, the number of reviewers has decreased. Dr Harmon Bickley has retired from teaching and decided to also retire from the editorial board of the journal. Harmon, in the name of all the members of the society, I want to thank you so much for all the work you have done for the Society and for our Journal, as the first editor and as a reviewer for many years. I want to wish you many very happy years by lake Michigan. Larry Janick also decided to quit the editorial board as he now occupies a new job that is not related to plastination. Larry, it has been a privilege for us to have you in our team for these years and I thank you for the excellent work you always did. Take care of yourself. I wish you a good health and all the best in your new job.

These departures add to our urgent needs for more reviewers. Some of the peoples present at the conference last summer talked to me about their possible interest to work as reviewer, I invite you to contact me as soon as possible and join the editorial board.

As a coincidence, you will find in the present issue 2 papers dedicated to the labelling of plastinated specimens. One from Dr James Arnold Baker particularly inexpensive and interesting for small labs with small number of specimens and the second from our friends from Brazil for labs with a large number of specimens that are used by many teachers.

I would like to take this opportunity to thank all the participants who attended the last conference at Trois-Rivières. It was a real pleasure and honour to welcome you all and I truly hope that you enjoyed your stay in our University and City. For the first time in plastination conferences, a prize was awarded for the best of the following categories: papers, exhibits and posters.

Peter Cook for his presentation entitled "Submacroscopic Interpretation of Human Sectional Anatomy using Plastinated E12 Sections", a work done in collaboration with ***S. Al-Ali,***

and ***Mircea Constantin Sora*** for his presentation entitled "Plastination of Three Dimensional Structures with P40", work done in collaboration with ***P. Brugger*** and ***H. Traxler*** were considered to be equally deserving of the award for the best presentation.

A special mention was also awarded to ***Mélanie Caron*** for "Elaboration of a three-Dimentional Identification Key for Microcheiropterans Species of Quebec with the S10 Plastination Technique", work done in collaboration with ***G. Grondin*** and ***J.P. Bourassa***.

The best poster award was presented to ***Rafael Latorre*** for "Macroscopic Interpretation of Horse Head Sectional Anatomy Using Plastinated S10 Sections", presented in collaboration with ***M. Orenes, J. M. Vazquez Autón, F. Gil Cano, G. Ramirez-Zarzosa, O. Lopez-Albors, A. Arencibia and F. Moreno Medina***.

The best specimens award was presented to ***Bob Parmelee*** for his exhibit. Visitors were particularly impressed by his elephant heart, slice of an elephant foot and dolphin foetus.

Finally, I again invite you to submit papers. We absolutely want to keep editing 2 issues per year and this will be only possible if we receive your papers. The next issue is already under preparation and I wish to have it published before the next interim conference. It could also be very interesting to include in it the answers to the survey that you will find on page 42 of the present issue.

I hope to meet many of you next July in Rochester.

Thank you,

Gilles Grondin

LETTERS TO THE EDITOR

ISP Secretrary's report

Hello to all ISP members,

Yet another great plastination meeting has concluded, and for those of you who, for numerous reasons were not in a position to attend, I'll attempt to outline the highlights so that you'll know what you missed and be certain to make provisions to attend the next conference in France in the year 2000.

The location of the ninth international conference on plastination was Trois-Rivières, Canada - a pleasant, friendly, laid back little slice of Europe around 2 hours north of Montreal, right in the heart of Quebec was our host town for 5 days of *'all things polymer'*. The people of Trois-Rivières were simply wonderful, and at all times we were all made to feel welcome, regardless of our linguistic capabilities (or lack thereof).

The final tally of registered participants was around 90, from 27 countries, representing a wide cross section of delegates from many different parts of the world. It was indeed reassuring to see so many new faces present at the meeting, which would clearly suggest that plastination is still generating as much interest today as it has for the past twenty years or so. Conference organisers, Dr Régis Olry and Mr Gilles Grondin took the reins as it were, and, with the assistance of a most engaging crew of *'plastinator wranglers'* treated us to five days of plenary sessions which included some 29 fascinating platform presentations and some 19 poster / specimen displays.

No stone was left unturned as all facets of conventional plastination were covered as papers or specimen displays, in addition to spectacular examples of the future of anatomical preservation demonstrated vividly with specimens produced with the new polymers developed by Dan Corcoran as well as some impressive new soft silicones developed in China by Dr Tianzhong Zheng who was never anything less than enthusiastic about his new polymers and their impressive applications.

Of the many excellent papers, Mircea Sora's presentation of the use of P40 for three dimensional brain specimens was a must see, not just for the outstanding educational potential of polyester co-polymer in a unique and exciting non sheet format, but as evidence that there is a bright future for P40 polyester in a whole new format.

It was also pleasing to see the polymerised emulsion technique, or P.E.M. as it is more commonly known, still being put to good educational use as a means of MRI correlation as vividly illustrated in Marisa Magiro's paper. Harmon Bickley presented his Chronology of Plastination for the benefit of those who had just joined us, and Wolfgang Weber provided the gathered delegates with a practical 'hands on' display of the E12 method of sheet plastination.

Among the presentations, from the newcomers to plastination were Mélanie Caron's examples of the application of silicone plastination as a three dimensional identification key for different species of cave-bats, a paper which achieved special commendation by the judging panel at the conclusion of the congress. This is to my memory the first and only 'Batpaper' ever presented.

A new and very exciting development in formaldehyde free embalming of cadavers was presented by Juan Collado and Rafael Pérez Bedox of Spain. The applications, not only for anatomical embalming but also in the preservation of human remains for standard funerals certainly appear to be far reaching. Gunther von Hagens treated us to a video journey through the Mannheim plastination expo together with fascinating behind the scenes coverage of the incredible amount of work which went into actually preparing the specimens for the roadshow.

The posters and specimen displays were an instant hit, with Quebec Television covering the plastinated exhibits in detail, resulting in a high level of public interest on the designated open day. Unforgettable specimens were a whole, delicately extracted, plastinated human nervous system which seemed to include every nerve branching known to man - as well as a few heretofore not known.

On the veterinary front, Richard Borg's plastinated colour injected Greyhound was popular as were the superb (as always) zoological specimens produced by Jorge Martinez-Galindo of Mexico, which have been a highlight at every plastination conference attended by this author.

The sixth biennial ISP meeting was the forum for a number of proposals and discussion to expand the resourses of our international plastination community. One of these being the possible coordination of instructional programs being offered between institutions primarily for the advancement of the science to those establishing new laboratories or initiating some of the newer and more complex sheet

plastination techniques. The experiences thus far at several institutions has indeed proven fruitful for all parties involved.

For the most part the weather was good with mild sunny days and almost as mild summer evenings, with only one day of treacherous weather where it rained so hard that we wondered if it were too late to add 'synchronised swimming' to the conference program.

The social program included several well planned events. A cocktail party and welcome by the Mayor of Trois-Rivières was a nice pre-curser to the official function which followed. A lovely moonlit cruise an one of the three rivers of Trois-Rivières which included a banquet, prize giving to our distinguished members Robert Henry and Harmon Bickley followed by a great disco was truly unforgettable. I think I can speak for all of those who were present when I say that a truly wonderful time was had by all.

The final few days saw the Trois-Rivières Jazz Festival which nicely coincided with our meeting. The streets were full and the best restaurants and cafés were crammed with locals and visitors alike. The ambiance, live music and great food were memorable on these pleasant Quebec summer evenings.

The choice of venue for the year 2000 meeting was, at the last minute, reduced from four initial interested parties to just two - Egypt and France. A secret ballot awarded the 2000 meeting to the University of St. Etienne, France. This will be a summer meeting and should give ample time for all members to make the necessary arrangements. I'm sure that we are all looking forward to this event, as two years isn't really very far away.

In closing I would like to take this opportunity to personally acknowledge Dr Régis Olry and Mr Gilles Grondin for hosting a first class international meeting. Merci beaucoup.

Peter Cook
Secretary to the International Society for Plastination

Dear Editor,

As an experiment, we had previously plastinated two red roses with COR-PR-10 silicone at room temperature. Both specimens were readily preserved, with unmeasurable shrinkage (as measured by pins inserted through the stems) and their color turned to a purplish hue. Both were dehydrated in acetone, one at -20°C, and the other at room temperature. There was little difference between them in color, however, both were extremely brittle. On discussing this with experienced plastinators, one suggestion was to dehydrate them in ethyl alcohol, rather than acetone.

We repeated the experiment with one red rose using ethyl alcohol for dehydration at room temperature (for both dehydration and impregnation), and, although the color was better preserved, significant fragility still exists. Although botanical specimens are not our primary interest, we would appreciate any comments from plastinators as to how plant material may retain flexibility when plastinated.

James Arnold Baker, D.C.
Director, Plastination Laboratory
National College of Chiropractic, Lombard, IL
USA

MINUTES

SIXTH BIENNIAL MEETING OF THE INTERNATIONAL SOCIETY FOR PLASTINATION

Trois-Rivières, Canada, July 9th 1998

I. Call to order, 10.20am

66 members were present at the ISP meeting. The quorum was established and the agenda was approved without alteration.

II. Reading and approval of the minutes of the 1996 conference

The minutes were approved as read/printed in ISP Journal volume 12 number 1, 1997. (Motion: Alex Lane, seconded: Robert Henry)

III. Reports of officers

President's report: Plastination, science or art.

*(In the absense of president Andreas Weiglein, the report was presented by vice president Régis Olry).

ISP Vice president, Régis Olry read a proposal based in part on provisions in article II of the ISP bylaws, whereas the society is a muti-disciplinary organisation and should neither encourage nor criticise the use of plastinated materials when unrelated to official society meetings. Furthermore it is proposed that the executive board of the ISP, ask organisers not to use the name or logo of our society in relation to promotion of such exhibitions.

Wolfgang Weber asked if the purpose of this proposal was to exclude museums. Robbie Boyes stated that the ISP should not be the judge or jury but should have an official statement on record to protect the society in the event of negative publicity.

Ronn Wade mentioned that the protection of the ISP trademark is not an issue. The prime responsibility is to protect the organisation. The term 'plastination' has a direct link to the society, making it appropriate that we adopt an official position as to how we see plastination and the use of plastinated material for the purposes of public information.

Ronn Wade proposed a motion that the newly elected executive board appoint 1 executive member and 2 members at large to draft a position statement relevant to the association according to the bylaws. The draft statement should be presented to the ISP membership for approval at the next biennial meeting. (motion seconded by Tim Barnes and carried unanimously)

Acknowledgement of international meeting host:

Meeting hosts/organisers, Régis Olry and Gilles Grondin were presented with certificates acknowledging their work in hosting the 9th International Conference on Plastination at Trois-Rivières, Canada.

Treasurer's report:

ISP Treasurer, Ronn Wade informed the society that membership was healthy and numbers of new members were increasing. This was reflected in the improvements to the ISP Journal with colour plates and improved printing quality. Membership dues payments by electronic transfer often presented a problem with the bank service fee deductions significantly reducing the net value of the US$75 renewal. A detailed financial statement to the year ending 3rd July 1998, was made available. On the question of ISP meeting sponsorship, Robbie Boyes pointed out that official sponsorship was sought for the 1996 meeting, but proved futile due to the small membership of the ISP. Ronn Wade made a motion to approve the treasurer's report, Robert Henry seconded the motion and the motion was carried unanimously.

IV. Reports of committees

Local committee:

For the local committee Régis Olry reported that 80 participants from 29 countries had registered for the 9th congress. Of the presenters, only 7 had supplied abstracts prior to the advertised deadline, with some 45 abstracts recieved after the deadline. Some abstracts arrived within just 5 days of the commencement of the congress.

Membership committee:

Ronn Wade reported that to date there were 232 financial members of the ISP, with some 17 new members signed up as a result of the congress. Approximately 50% of the overall membership consists of overseas members. Approximately twelve memberships were not renewed.

Journal committee:

For the journal committee, Gilles Grondin reported that in the interests of the society, the journal could be increased to at least two issues per year with an increase in page num-

bers of each issue. Régis Olry encouraged manuscript submissions from more ISP members. Gilles Grondin acknowledged the contributions of the editorial board of the journal committee. Peter Cook acknowledged the high international standard that the ISP journal has now achieved.

Nominations committee:

The following nominees for the officers' election introduced themselves as present, or were introduced by representatives from the ISP membership if not present. Voting was carried out by secret ballot.

President: Andreas Weiglein/Harmon Bickley

Vice President:Tim Barnes/Régis Olry

Secretary: Peter Cook/ David Griffiths /Pieter Nel

Treasurer: Wolfgang Weber/Ronn Wade

V. Host of the next international conference 2000

Both Giza, Egypt and Saint-Etienne, France applied for the 10th international conference on plastination to be held in 2000.

VI. Old business

VII. New business

Conference planning:

Gilles Grondin commented on the difficulties experienced in preparing an adequate mailing list to international universities, medical/veterinary schools and institutions potentially interested in plastination. To aid organisers of subsequent meetings, a guide schedule for early planning and a database aimed specifically at potential users of plastination would be desirable. Having outlined the need, Gilles suggested the activation of the Conference Planning Committee, as per article VIII, section 5 of the ISP bylaws. Positive support came from Robert Henry, who stated that such a committee was an essential, practical aspect for the preparation of the 2000 meeting. Gilles Grondin mentioned that he would be willing to be included on this committee, as did Cynthia Ryan.

Plastination training:

With interest among many new plastinators to train for a period in an overseas laboratory, Gilles Grondin reported on the positive experiences of sending a student to Graz, Austria for three months and made the suggestion that the ISP act in the form of coordinator for future exchanges. In response, Roy Glover commented that the idea was sound in principle but the logistics required further discussion. Robbie Boyes pointed out that such a posting need not neccessarily be for research, but could be for scientific or technical training. Pam Arnold asked whether or not a committee needed to be formed for this. In response to this, Ronn Wade suggested that the arrangements be undertaken on a one on one basis between the applicant and the plastination laboratory concerned, and that it really did not concern the ISP.

James Baker made the comment that it was an excellent idea, but should the laboratory be in some way certified as an established plastination laboratory? Georg Feigl reported that his experiences with a student exchange were indeed positive. The discussion closed with a comment by Ronn Wade that it could in fact be advantageous for a survey to be carried out of all plastination laboratories, with the results published in the ISP journal as a database.

Bylaws study and ammendment:

A discussion was raised by Ronn Wade in reference to the ISP bylaws in which a motion was made that the bylaws be reviewed and ammended if or where neccessary. The motion was seconded by Pam Arnold and carried unanimously.

Interim meeting:

Cynthia Ryan submitted a proposal to host the next Interim meeting/workshop in Rochester, New York in the summer of 1999.

Election of officers:

The results of the vote count for the election of ISP executive officers for the 1998-2000 term were as follows; President: Andreas Weiglein (Graz, Austria) Vice-President: Régis Olry (Trois-Rivières, Canada) Secretary: Peter Cook (Auckland, New Zealand) Treasurer: Ronald Wade (Baltimore, U.S.A)

Host of the next international conference:

Voting was carried out by secret ballot for the location for the 10th International Conference on Plastination, to be held in the summer of 2000, with the result being; Saint-Etienne, France.

VIII. Adjournment 12.25pm

Respectfully submitted
Peter Cook, Secretary

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Andreas Vesalius on the Preparation of Osteological Specimens

Regis Olry

Departement de chimie-biologie, Universite du Quebec a Trois-Rivieres, Trois-Rivieres, Quebec, Canada

(received October 23, accepted November 20) *Key words: Osteology, Prevesalian illustrations, Andreas Vesalius, Skeletal specimens*

Abstract

In 1543, Andreas Vesalius dissected and prepared the skeleton of a murderer called Jakob Karrer, and gave the specimen to the university of Basle. This specimen, now kept in the Vesalianum Museum of this university, is one of the most ancient anatomical specimens in the world. The analysis of the initials and capital letters of Vesalius' "Fabrica" enables us to understand the procedure used by this famous anatomist to prepare human skeletons.

Introduction

Osteology is at the root of our knowledge of human anatomy. Several thousand books or dissertations were chiefly, indeed even exclusively devoted to the description of the human bones in the last six centuries (Olry, in preparation). The reason is obvious: human (or animal) bones withstand putrefaction, and therefore might be found in nature. In the early sixteenth century, the French anatomist Pierre Barot used in his lectures "human bones which had been cast up by rivers in spate" (Beau, 1933). Carnivores and insects (Megnin, 1894) were unquestionably the first producers of skeletal specimens.

Some prevesalian plates of the human skeleton

In the early second millenium, bones had an important role in sacred art. However, it was not always easy to distinguish human bones from bones of animal origin in these illustrations (Saban, 1988). In the fifteenth century (ca. 1475), Martin Schongauer, the son of an Alsatian silversmith, published the first copperplate depicting some parts of the human skeleton (skull, femur, coxal bone) (figure 1). Ten years later, the Augsburg naturalist Johannes de Cuba included in the German first edition of his "Ortus sanitatis" the first woodcut of a human skeleton (1485) (figure 2). In 1493, an almost similar plate was published by Richard Helain (figure 3), and Michael Wolgemut and his son-in-law Wilheim Pleydenwurffmade a drawing of dancing skeletons

Figure 1. Human bones in a "Crucifixion" by Martin Schongauer, 1541 issue (taken from Saban, 1988).

to illustrate Harmann Schedel's Nuremberg Chronicles (figure 4). However, none of these illustrations had any claims to anatomical accuracy, and nothing is known about the dissection and preservation procedures.

The skeleton of a murderer prepared by Andreas Vesalius

During his stay in Basle (first five months of 1543), Andreas Vesalius gave many lectures and dissection courses, published his celebrated "De humani corporis fabrica libri septem", and prepared numerous anatomical specimens. One of them, a human skeleton, was given to the university by Vesalius himself: it has to be considered as one of the most ancient preserved anatomical specimens to date (Huard and

Address correspondence to: Dr. R. Olry, Departement de chimie-biologie, Universite du Quebec a Trois-Rivieres, C. P. 500, Trois-Rivieres, Quebec, Canada G9A 5H7. Telephone: 819 376 5053 / Fax: 819 376 5084. Email: Regis_Olry @uqtr.uquebec.ca

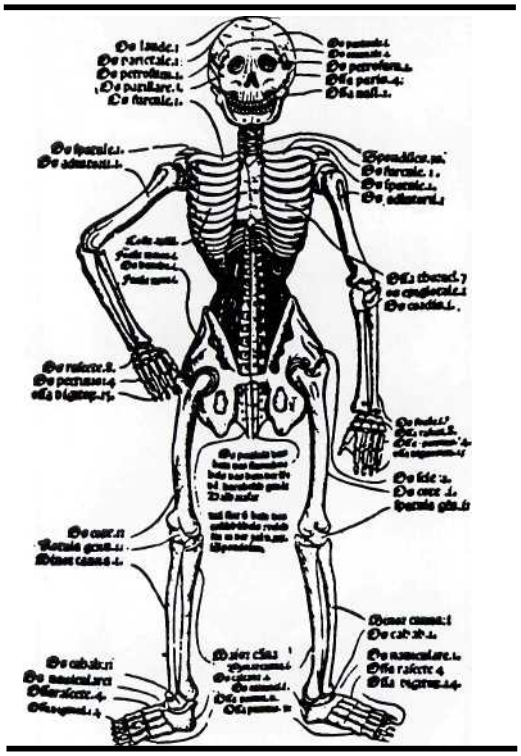

Figure 2. Human skeleton in Johannes de Cuba's "Ortus sanitatis", 1497 edition.

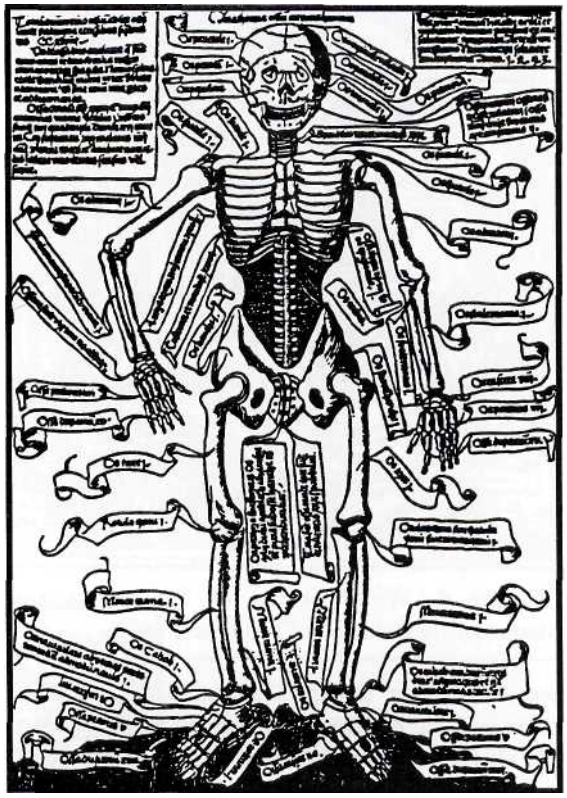

Figure 3. Anatomical plate of the human skeleton by Richard Helain, 1493 (taken from Saban, 1988).

Imbault-Huart, 1980; Kurz, 1992).

This skeleton was the one of Jakob Karrer, a notorious murderer of Alsatian origin who was beheaded on May 12, 1543 (Gast, 1548; Wurstisen, 1580). It was prepared by Vesalius in the same year, and restored in 1985 (Kurz, 1992): the mandible, both hands with carpal bones, some ribs, both patellae, the left foot and the phalanges of the right foot are lacking (figure 5). It has however to be regarded as a fine specimen of the human skeleton, showing that Vesalius was skilled in the art of dissecting and assembling the human bones. His procedures are illustrated around some of the capital letters and initials used in his famous treatise of anatomy.

The initials and capital letters of Vesalius' **Fabrica**

The capital letters and initials of Vesalius' Fabrica are very helpful in understanding the procedures used to prepare osteological specimens at that time (Metzger, 1935; Anson, 1944, 1949; Lambert et al., 1952; Monteiro, 1952). We will describe here the initials "C" and "P", and the capital letter "O" in both 1543 and 1555 editions of Vesalius' masterpiece (Huard and Imbault-Huart, 1980).

In both 1543 and 1555 editions, the capital letter "O" shows five cherubs who bustle about boiling human bones in a pot which is suspended with a trammel (figure 6). Two cherubs are preparing to plunge a skull and a long bone into the pot, while a third one stirs up the fire. This illustration depicts the first step in skeletal specimen preparation. The bones were placed in a pot, and boiled until it became easy to remove the majority of the soft structures. It is noteworthy that some of the human bones (sternum, hyoid, sesamoids) and related structures (teeth, nails, laryngeal cartilages) did not have to be macerated, but needed only to be scraped and dried. The habit of macerating and boiling dead bodies in order to preserve only the bones had spread at the time of the crusades (Paladilhe, 1979). It was the simplest way to repatriate the corpses of the victims who wished to be burried in their native country. This procedure, called "sepultura more teutonico" became so common that Pope Boniface VIII, Benoit Caietan, decided to proscribe it in his bull "Extravagantes communium" on February 18, 1300 (Wickersheimer, 1926). Though this bull was not directed at human dissections, it influenced the famous Mondino dei Luzzi who decided therefore not to boil some parts of the skull (Olry, 1997).

In the 1543 edition, the initial "C" shows three bearded men who carry a casket, from which hangs a human fleshless hand (figure 7). The casket is full of holes, and is about to be

Figure 4. Woodcut by M. Wolgemut and W. Pleydenwurff for Schedel's Chronicles, 1493.

immersed in a river. In the 1555 edition, this initial depicts the same subject, but the three bearded men were replaced by four cherubs (figure 8). This initial illustrates the second step of skeletal specimen preparation. After having removed the majority of the soft tissues, the anatomist covered the specimens with lime and placed it in a perforated wooden casket for a time. Subsequently, the casket was firmly tied down at the bottom of a river, where the current gradually removed the remaining soft tissues as it flowed through the casket.

In the 1543 edition, the initial "P" shows three cherubs who put together some bones to reconstruct a skeleton which is partly visible at the right border of the illustration (figure 9). In the 1555 edition, the same scene is depicted, but the cherubs are now four in number (figure 10). This illustration shows the last step of skeletal specimens preparation. The lower and upper limbs were first assembled with copper wire, and the vertebral column was then fastened to a metal rod (Monteiro, 1942; Brocas, 1958).

Discussion

Andreas Vesalius is unanimously regarded as one of the pivotal figures in the history of anatomy. The very new English translation of the first two books of his famous "Fabrica" by William Frank Richardson and John B. Carman (1998) attests to the outstanding importance of this treatise. Vesalius broke new ground compared to his predecessors: he dared criticize Galen's hegemony, and entrusted artists with the task of illustrating his treatise. Both of these points were revolutionary in anatomy at that time. To my knowledge, Vesalius was also the first anatomist to illustrate some of the

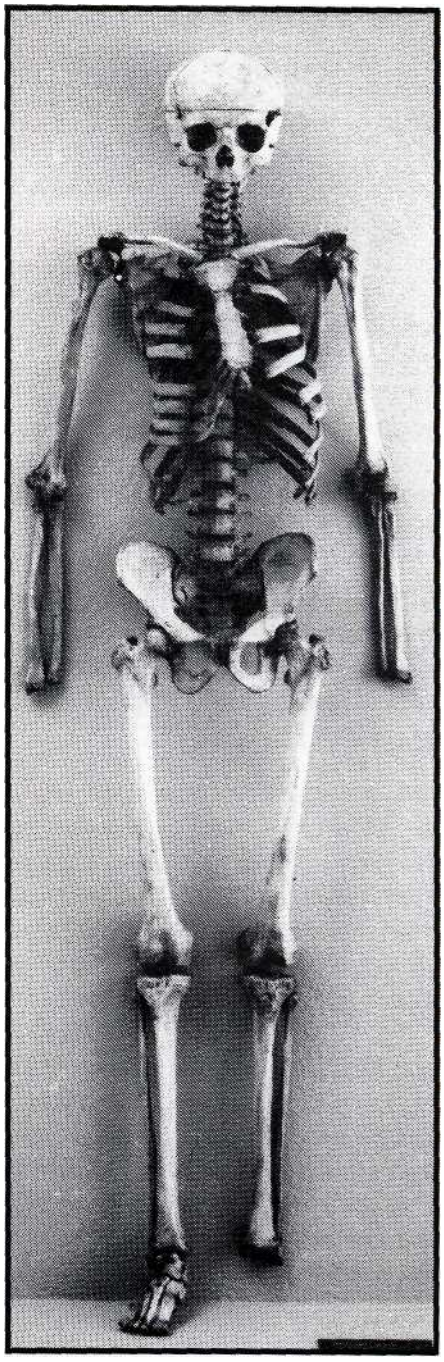

Figure 5. Jakob Karrer's skeleton prepared by Andreas Vesalius (taken from Kurz, 1992).

dissection and preparation procedures around the initials and capital letters of his book. Without any doubt, the "Fabrica" has not yet given away all its secrets.

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Figure 6. The capital letter "O" in both 1543 and 1555 editions of the Fabrica.

Figure 7. The initial "C" in the 1543 edition.

Figure 8. The initial "C" in the 1555 edition.

Figure 9. The initial "P" in the 1543 edition.

Figure 10. The initial "P" in the 1555 edition.

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An Inexpensive Method of Labelling Plastinated Specimens

James Arnold Baker

The National College of Chiropractic, Lombard, JL, USA

(received October 6, accepted October 30, 1998) ***Key Words:*** *Labelling, Storage, Equipment*

Abstract

A simple and inexpensive method is presented to mark and identify silicone plastinated specimens to aid cataloging and control. Labels are hand cut from a computer generated paper sheet and fixed in appropriate places on specimens by silicone adhesive. An additional layer of silicone over the whole label gives added protection from handling.

Introduction

In many countries, the disposition of anatomical specimens from human origin is regulated by law. As plastination becomes easier to perform and its use becomes more widespread, it is necessary to keep track of specimens, both within an organization and between institutions when they change hands. In addition, for research purposes, it is often important to know the origin of the specimen, and, especially in the case of pathological specimens, to know the cause of death and other pertinent data.

Specimens can be small, making tagging methods difficult. In addition, it can be necessary to identify tiny structures. At least two methods have been presented previously (Jackson, 1987; Pretorius, 1997), each with benefits. This paper presents a simple and inexpensive method which we have found useful.

Materials and Method

By means of a word-processing program (QuarkEXpress™ 4.0) a series of labels was prepared on a computer (Apple Power Macintosh G3). The overall size of the label was made small enough (3mm x 12mm) to fit on expected specimens, yet large enough to allow legible printing. A six-figure number (in 7.1 point type) was determined to be large enough to handle a goodly number of specimens over time without changes in label length. In smaller type (3.5 point) the name of our laboratory was placed beneath (figure 1). A bullet was printed on both ends of the label to call attention to accidental clipping of either end during label cutting out or trimming. Table 1 describes the printing parameters.

A page of labels was then printed on common ink-jet paper (figure 2). Since the numbers were identical (as shown), sequential numbers were first created on the computer screen. This requires some patience, as it is done one at a time before printing.

As each specimen is prepared, one label is cut out with common scissors. It is then attached to the previously plastinated specimen by clear silicone cement (Dow Corning Corp., Midland, MI 48686-0994 USA, catalog number 698) from a 30ml. tube obtained at a home supply store. A location for the label is selected, a smear of adhesive is applied to the specimen while using protective gloves. Using tweezers, the label is pressed into the silicone and a cover layer of silicone adhesive is applied to seal the label. Setting of the adhesive takes place in a few minutes and curing is complete overnight.

As each label is attached, a corresponding page is created in a record book, describing the sample's origins (age, sex, cause of death, etc.), how it was prepared, its disposition (where it is and who is responsible for it), and its subsequent use or treatment (teaching purposes, subsequent research information, etc.)

Results

We have found the labels to be small enough so they may be easily placed (figure 3). They are legible and adhere well. If one should come loose in a spot or two, another layer

Address correspondence to: James Arnold Baker, D.C., The National College of Chiropractic, 200 East Roosevelt Road, Lombard, IL 60148-4583, USA. Tel: 630 889 6852 / Fax: 630 889 6800. Email: jbaker@national.chiropractic.edu

-J lnt Soc Plastination Vol 13, No 2:13-14, 1998

of silicone adhesive will secure it. Labels are easily read. It is reassuring to have a record of specimens to demonstrate legal responsibility for them and to have a method for recording information about plastinated specimens which may be traced to each item.

Discussion

Such pains may seem unnecessary in the early stages of a plastination laboratory but specimens accumulate. Changes of preparation procedure, location of specimens, and success or failure of their use can be tracked by faithfully attending to identification of plastinated specimens. As the laboratory grows, with possible additions or changes of personnel, a permanent specimen record will exist.

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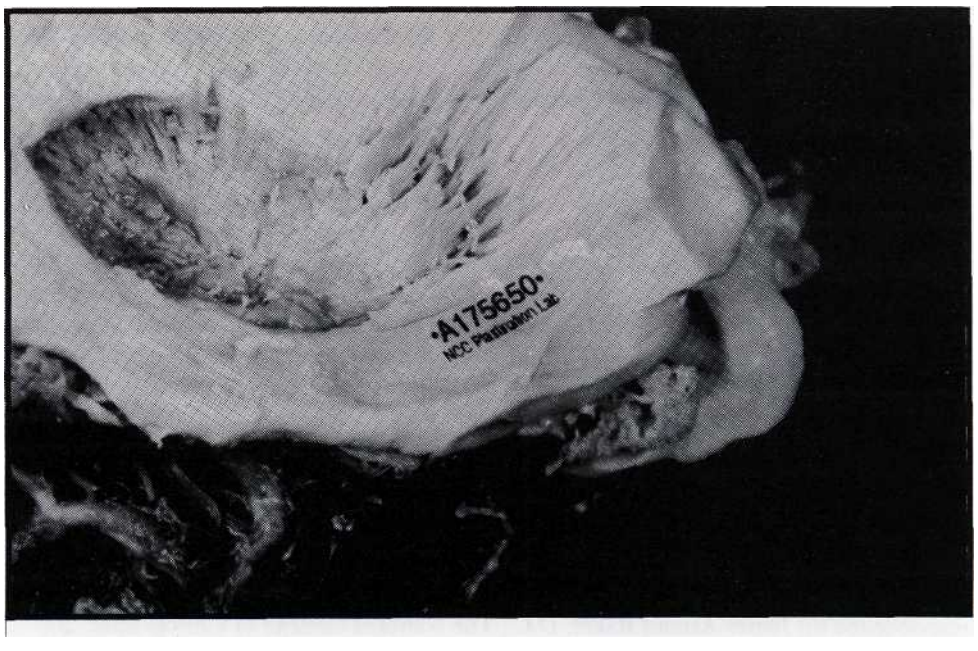
Figure 1. One enlarged label.

Table 1. Printing parameters.

Window (box) size: H = 0.517"; H = 0.171"
Font: Helvetica
Numbers: 7.1 point
"NCC Plastination Laboratory": 3.5 point
(Absolute) leading: 4 points
Magnification: 400%
Step & repeat: 0.375" x 0.750"
Actual (cut) label size: 3 x 12mm

Figure 2. A series of labels, actual size as printed. (Note. The label borders are shown for clarity here, but are not actually printed.)

Figure 3. A label applied on a specimen.



-J Int Soc Plastination Vol 13, No 2:15-16, 1998

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Inject Vessels with Epoxy Using Compressed Air and a Simple Jig

D. J. Griffiths

Section of Anatomy, Department of Morphology, Genetics and Aquatic Biology, Norwegian School of Veterinary Science, Oslo, Norway

(received September 29, accepted November 23, 1998) *Key*

Words: *Polymer E20, Equipment, Cast, Compressed Air*

Abstract

This short technical note describes a method of filling blood and other vessels with epoxy using a 100ml syringe barrel with a catheter tip. The plunger of the syringe is replaced by a rubber stopper connected to a source of compressed air. The stopper is held in place by a simple home-made jig. After the syringe is filled with epoxy and the system assembled and switched on, epoxy may be pumped into the specimen for any chosen pressure and time combination without a person needing to be in attendance.

Introduction

Coloured epoxies, such as Biodur™ E20 (Biodur, Rathausstrasse 18, 69126 Heidelberg, Germany), are excellent for casting blood vessels, bile ducts, the renal pelvis, and numerous other body cavities (Fromm et al., 1991; Riepertinger and Heuckendorf, 1993; Pretorius and Geyer, 1995). For injecting long and narrow vessel systems, the somewhat viscous nature of epoxy means that either very small syringes need be used repeatedly (Pretorius and Geyer, 1995) or the epoxy thinned with methyl-ethyl ketone (Fromm et al., 1991). The former method is labour-intensive and often messy, while evaporation of the latter reduces the strength of the cast and also its suitability for subsequent scanning electron microscopy. The following article describes a simple technique utilising compressed air to blow small or large volumes of undiluted epoxy into vessels in specimens.

Materials and Methods

A 100ml plastic syringe (Codan Medical ApS, Rodby, Denmark) with a catheter tip ideal for attaching a flexible silicon or rubber hose was used. The plunger was removed and a suitable rubber stopper was placed into the syringe barrel. A hole was drilled through the stopper and into this hole a 10mm diameter copper pipe was fed. The pipe was connected via a flexible hose to a supply of compressed air. AT-piece (not pictured) was inserted into the air supply close to the syringe, and out of the side tube a separate rubber hose led to a simple U-shaped water manometer set up on a wall of the laboratory. In this way the air pressure in the syringe could be measured with precision.

The jig used (figure 1) consisted of a wooden base, two lengths of threaded rod topped with wingnuts, and a wooden plate that moved snugly along the threaded rod. A hole in the baseplate and a corresponding slot in the upper plate held the syringe and its rubber stopper with protruding air-line. The specimen to be injected was fresh and unfixed, and was perfused overnight with tap water at a pressure of approximately 120cm water. When connecting the jig, the outlet hose from the syringe was tied into the desired artery using ligation with a braided linen thread of diameter some 0.5mm, and the syringe filled with the desired quantity of epoxy. The stopper was inserted into the syringe, then forced down using the plate and wingnuts, until there was no leakage of air. The compressed air supply was connected and the pressure adjusted according to the manometer. It is not necessary to clamp the lower hose to the syringe, for if its diameter is chosen correctly it stays in place on the tip by its own tightness. Although the volume of air in the system was reduced when feasible, no attempt was made to remove all air prior to injection. It was assumed that the air would be pushed ahead of the advancing epoxy and eventually be forced out of the arteries into the tissues.

Address correspondence to: David J. Griffiths, Section of Anatomy, Department of Morphology, Genetics and Aquatic Biology, Norwegian School of Veterinary Science, Post Office Box 8146 DEP, N-0033 Oslo, Norway Tel: 47 22964545 / Fax: 47 22964764 E-mail: david.griffithsgveths.no

Results and Discussion

At the very least this simple system provides a method of avoiding repeated and tedious pressing on a small syringe when injecting viscous solutions. However, since taking it into use other advantages have become apparent.

The first of these advantages is predictability, in that you know the exact pressure exerted on the epoxy. Since this pressure is constant for the entire injection time, the time-pressure combination can be correlated to the result obtained in the specimen. Once the most effective combination is determined, this can be used repeatedly and exactly, provided of course that the diameters and lengths of the hoses leading into the animal or specimen are not altered. Since the pressure loss along a length of hose (assuming laminar flow and all other factors constant) is proportional to the fourth power of the radius (Stephenson, 1969), halving the radius (for example) will produce a sixteen-fold increase in the resistance to flow and a great increase in the air pressure necessary in the syringe. It follows that the hose from the syringe into the specimen should be as short and as wide as possible.

The other advantage concerns time. With this method the epoxy can be pressed into the specimen right until it starts to harden, which in my experience with Biodur E20 is about 40 minutes. No time is lost in repeated disconnecting and refilling syringes, and no air is introduced unnecessarily into the system. The likelihood of vessel rupture is reduced.

This technique has to date been used for five specimens - two canine kidney pairs (via the aorta), the coronary arteries of a canine heart (via the aorta) and a dried porcine lung (via the truncus pulmonaris). Unless otherwise stated, Biodur E20/ E12 was used with a syringe pressure of 1.5m of water for a timespan of some 20 minutes. For the kidneys, some 70 ml of epoxy were placed in the syringe and some 40 ml pumped into the organs. Figure 2 shows the result of one of these attempts. The epoxy has traversed the glomerulus and entered the afferent arterioles.

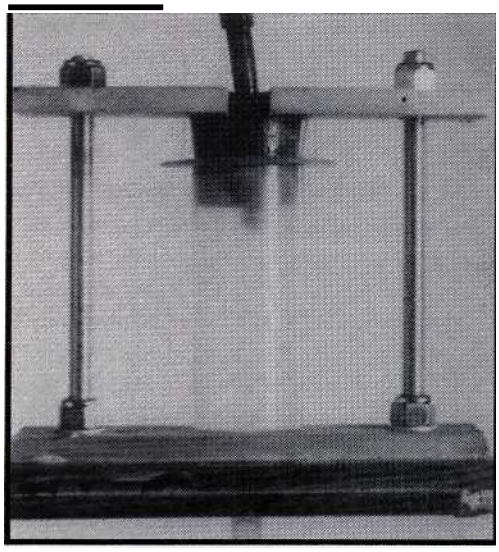

Figure 1. Syringe, stopper and stand. The feeder line for air enters the top of the stopper, while the outlet to the specimen is seen at the base. The top-plate of the stand holds the stopper in place and is tightened with the nuts until the seal is air-tight.

For the heart, 70 ml of epoxy were loaded but only 10 - 15 ml entered the tissue) the aortic valve closed immediately and no epoxy entered the ventricle). In the case of the dried porcine lung, some 350 ml of polyester resin were pumped in under pressure of 50 cm water and the interval of some 10 minutes, although here infiltration was poor due to the accumulation of numerous air bubbles in vessels of 5 - 7 mm diameter. Whether this is a characteristic of the polyester and/ or the lower infusion pressure has not been investigated, although none of the other specimens were troubled by air bubbles. A canine testicular artery was also attempted using 2.5m water pressure, but a rupture ensued at the level of the pampiniform plexus. It is suspected that poor washing (presence of blood clots) and excessive pressure contributed to this accident. This organ has not yet been repeated.

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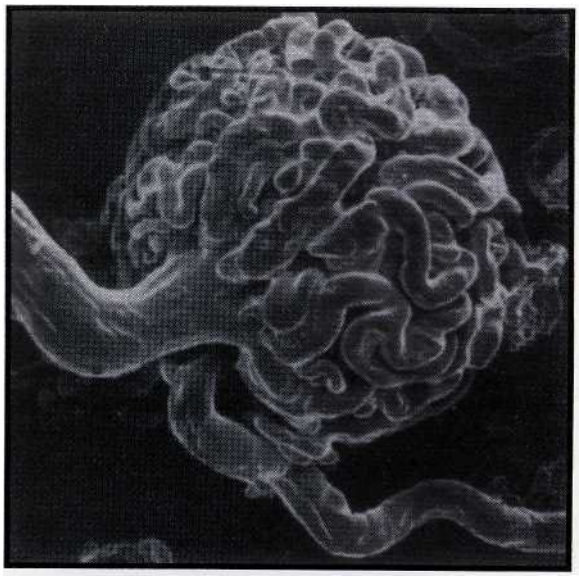

Figure *2.* Injection of a canine renal artery using a pressure of 1.5m of water resulted in the epoxy traversing the glomerulus and entering the efferent arteriole, giving a very satisfactory cast.

Labelling and Storing Plastinated Specimens -An Experience from Universidade Federal Do Rio De Janeiro

Joao Antonio Pereira Correia, Rafael Augusto Dantas Prinz, Emilia Cristina Benevides de Freitas and Lucia Helena Antunes Pezzi.

Department of Anatomy, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil

(received October 9, accepted November 16, 1998)

Keywords: *Storing, Labelling, Equipment.*

Abstract

The intent of this report is to relate the positive experience of the Department of Anatomy at Universidade Federal do Rio de Janeiro (UFRJ) in storing and making readily available large numbers of human plastinated specimens. The technique has allowed improved specimen utilization by the both professors and students representing several diverse biomedical graduate courses. A detailed description is provided of the cataloguing and storage system, which could be readily implemented by other Departments that deal with large numbers of plastinated specimens and/or whose specimens are regularly requested.

Introduction

The constantly increasing number of plastinated specimens being produced by numerous institutions worldwide has resulted in increased need for efficient methods of specimen organization (Whitten et al., 1991). Such methods must permit specific specimens within the teaching collection to be readily located and made available for teaching and research related purposes.

The Department of Anatomy at UFRJ has used specimens plastinated by the standard S10 procedure (von Hagens, 1985) since 1994, supporting a relatively large number of biomedical courses (Medicine, Dentistry, Nutrition, Nursery, Phonoaudiology, Physiotherapy, Physical Education, Psychology, Pharmacy) which together enroll over 1000 students. To effectively manage such large-scale use of these plastinated specimens, it was determined that an improved system of organization needed to be developed. This report presents that system.

Materials and Methods

Dissection and plastination of Specimens All specimens related to the aims of this report were prepared using standard sectioning and/or dissection method. They were then dehydrated, impregnated according to the standard S 10 technique (von Hagens, 1985) and fast cured (Weiglein and Henry, 1993).

Cataloguing of Plastinated Specimens

An initial-based code based on body system or body segment was developed (tables la and lb). The specimen was considered as part of a system if it showed only or mainly structures of that system. Specimen which demonstrated structures representing several systems were catalogued as belonging to a body segment (table 2). The letter and number code was then applied to all specimens which had been previously produced (table 3), and new specimens were catalogued accordingly. For specimens composed of numerous parts (i.e., slices), the code was expanded to accomodate these slices (table 4). Specifically, sections were numbered from upper to lower body slices for transverse sections; from anterior to posterior for coronal sections and from right to left for sagittal sections (table 5).

Creating a Data Storage Bank

Using Microsoft Access™ software for Windows 95™ version 7.0 (trademark of Microsoft Corporation) the

Both Joao Antonio Pereira Correia and Rafael Augusto Dantas Prinz contributed equally to this work. Address correspondence to: Rafael Augusto Dantas Prinz, Rua Gurupi, 105 Apartamento 301 - Grajau Rio de Janeiro - RJ, Brazil, CEP: 20561-100. Tel: 55 021 578 1000 / Fax: 55 021 290 0587. Email: prinz@netrio.com.br

Table la. Cataloguing plastinated specimens based on the body systems.

SYSTEM	CODE
Articular	Ar
Cardiac	Cd
Circulatory	Cc
Digestive	Dg
Endocrine	Ed
Muscular	Mu
Nervous	Ne
Osseous	Os
Reproductive	Rp
Respiratory	Rs
Urinary	Ur

Table lb. Cataloguing plastinated specimens based on the body segments.

BODY SEGMENT	CODE
Abdomen	Ab
Arm	Am
Elbow	Eb
Foot	Fo
Forearm	Fa
Hand	Ha
Head	He
Hip	Hi
Knee	Kn
Leg	Le
Neck	Nk
Pelvis	Pv
Shoulder	Sh
Thigh	Th
Thorax	To

following data fields were created: Specimen code, description of the specimen (a brief notation of the anatomical structures present), an image of the specimen (scanned on a Hewlett Packard ScanJet 4c), date of specimen completion, specimen condition (available, in exhibit, in repair) and the person responsible for the dissection. The software also displayed the total number of specimens present in the data storage bank (figure 1). Data for any given specimen can be printed by users who are planning teaching and other specimen use. A notebook containing print-outs of all specimens contained in the data bank is maintained to further facilitate these activities

Labelling

Based on Jackson (1987), the established codes were printed on 210 x 297mm blank labels in two vertical columns, using the Microsoft Word™ software for Windows 95™ version 7.0. Width of each column was limited to 65 characters with nine codes per column (eighteen codes per sheet of paper). The page was formated at 60 (sixty) lines per page and the labels separated by double lines. Labels were cut with scissors to 9,0 x 3,0 cm in size and both sides of the labels were manually covered with adhesive plastic. A tagging and labelling gun was used to attach the label to the plastinated specimen (figure 2). The hole was punched in the upper left side of the label and the plastic holder was then attached to a resistant part of the specimen.

Each label displays the name of the institution, department name, specimen code and name of the person responsable for the dissection of the specimen (for a professional appearence the symbol of the Plastination Unit of the Department is included on the label) (figure 3).

After a specimen is properly labeled and entered into the data storage bank, the specimen is stored within the Plastinated Specimens Facility of the Department of Anatomy. This facility consist of wooden shelves in a low-humidity environment. Shelves (56 x 45 x 2 cm) are arranged according to specimen type and have attached stickers giving the code of the specimen that is to be located in a given region on a specific shelf (figure 4).

Results

Plastinated specimens have been easier to locate and manage using the described system. Professors requesting specimens typically consult the specimens notebook and then

Table 2. Classifying plastinated specimens as part of a system or part of a body segment.

SPECIMEN DESCRIPTION	CLASSIFICATION	CODE
Left cerebral hemisphere	Nervous System	**Ne**
Horizontal section of a trunk revealing the lungs, the heart, thoracic muscles, thoracic vertebrae, aorta and esophagus	Thorax	To

Table 3. Adding a number based on the specimens that have already been catalogued.

DESCRIPTION OF THE SPECIMEN	SYSTEM	BODY SEGMENT	NUMBERS OF SPECIMENS ALREADY CATALOGUED	FINAL CODE
Left cerebral hemisphere	Nervous		30	Ne31
Horizontal section of a trunk revealing the lungs, the heart, thoracic muscles,thoracic vertebrae, aorta and esophagus		Thorax	15	Tol6

Table 4. Creating a code based on the plane of section.

PLANE OF SECTION	CODE
Transverse section	TS
Coronal section	CS
Sagittal section or midsagittal section	**SS**

fill out a form making the formal request. Information requested on the form includes the date of the class, borrower name, requesting date (faculty are asked to make requests at least one week in advance), specimen code, and course the specimen will be used in. This provide a permanent record of specimens use. The requested plastinated specimens are taken from the storage room for use, and, after use, returned to the proper storage location by a person responsable of the plastinated specimens. Before storage, specimens are checked for damage and necessary repairs are made.

Discussion

To date, 436 plastinated specimens have been successfully coded and stored using this system (first implemented in 1995). We have full control of all the specimens available in our institution as well as an easy way to locate and separate them for teaching. All the damaged specimens during these 3 years have also been reliably identified and repaired. Professors also indicate that they have been able to more easily find (in the data bank) those specimens which will enhance their planned teaching. Labeled specimens acquire a more professional appearance which may encourage careful use. Finally, identifying the student or preparator who performed the dissection encourages that individual to work carefully and improve his/her dissection skills.

No specimens were lost.

Acknowledgement

The authors wish to thank Mrs. Susanne Queiroz for her help with this project and everything else that is related to plastination at Rio de Janeiro.

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Table 5. Adding a new number based on the sequence of slices.

DESCRIPTION OF THE SPECIMEN	SEQUENCIAL NUMBER OF THE SLICE	FINAL CODE
The upper slice of a thorax revealing the lungs, the heart, thoracic muscles, thoracic vertebrae, aorta and esophagus	First	T0I6TSI
The second slice of abdomen from the anterior to the posterior region	Second	AblOCS2
The fifth sagittal brain slice from right to left	Fifth	Ne31SS5

-J Int Soc Plastination Vol 13, No 2:17-20,1998

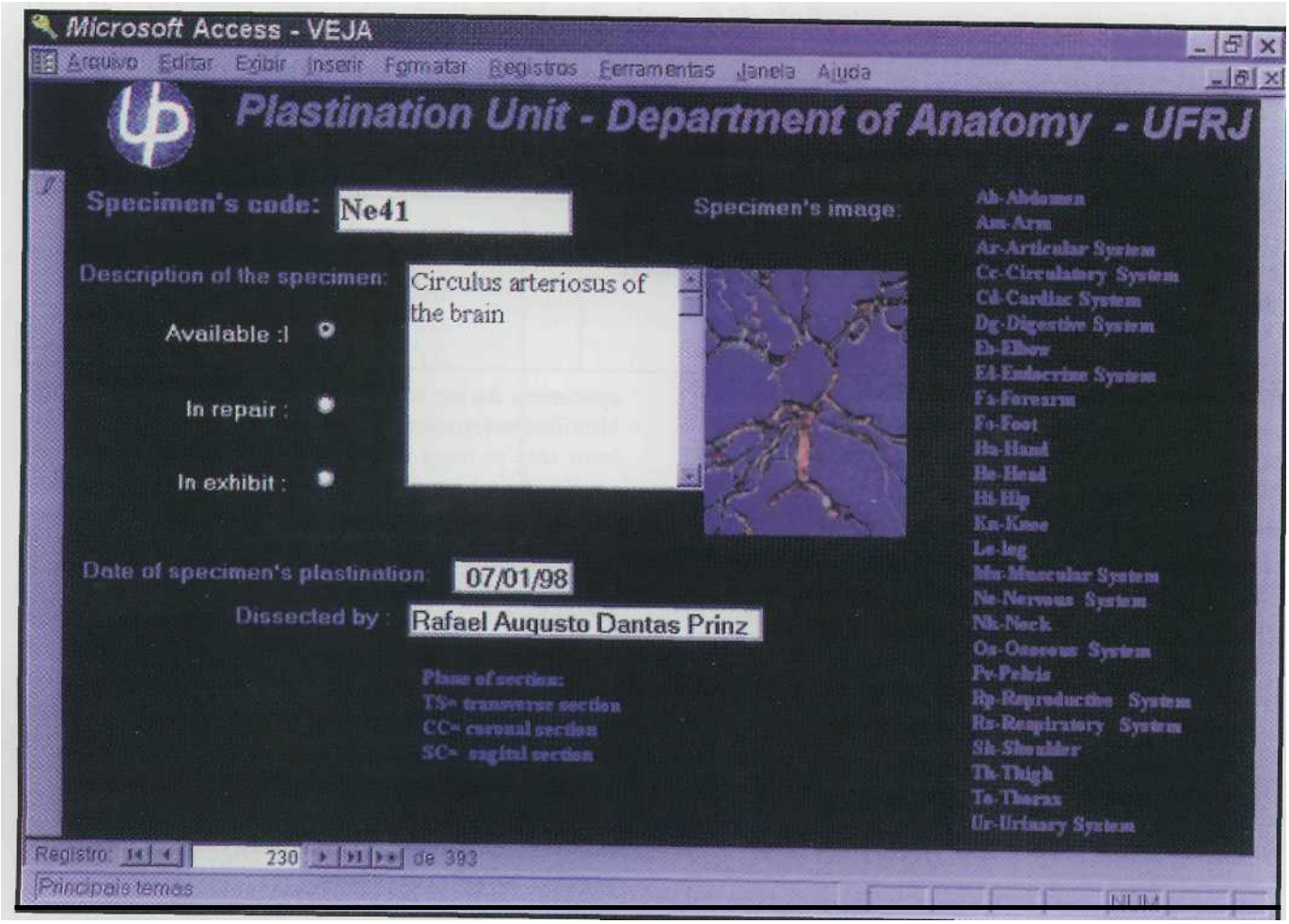
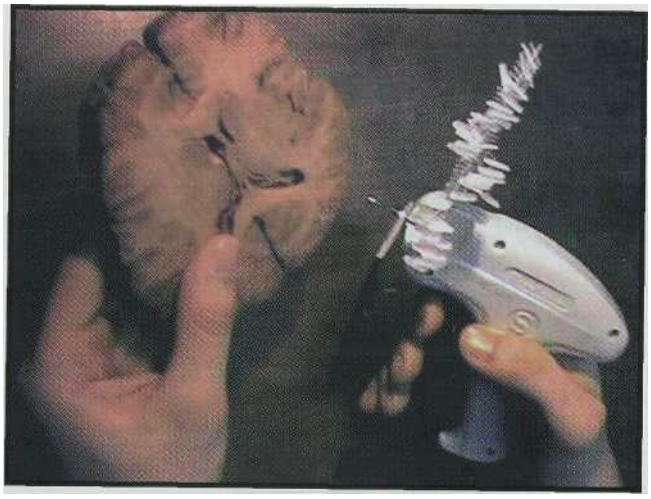


Figure 1. Computer screen showing the data of one specimen from the data storage bank.

Figure 2. The tagging and labelling gun was used to



attach the labels to the specimens.

Figure 3. Example of one label.

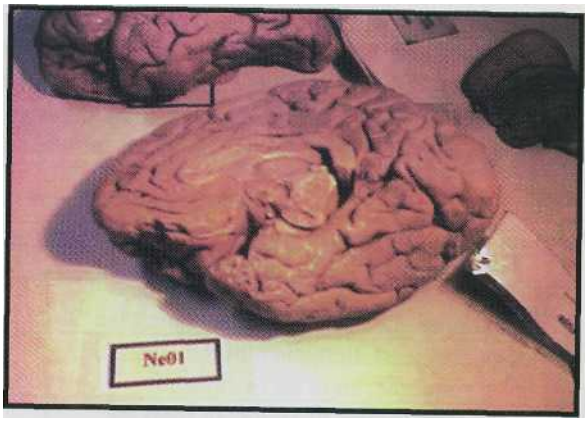


Figure 4. On each shelf we attached a sticker with the specimen's code so that we can easily find them when requested.

Plastination at Room Temperature

Zheng Tianzhong, Liu Jingren, Zhu Kerming

Department of Anatomy, Shanghai Medical University, Shanghai, P.R. China.

(received September 20, accepted November 14, 1998)

Key Words: room temperature, intermittent vacuum, Su-Yi Chinese silicone

Abstract

According to the standard plastination procedures, the dehydration by freeze substitution in acetone is normally achieved at -25°C and the forced impregnation of specimens at -15°C to -25°C in a deep freezer. Now, we have been able to modify the dehydration procedure and use room temperature for dehydration. We also developed a new silicone polymer that can be stored and used for impregnation at room temperature (10 to 25°C). An acetone filter (or recevery) system was also designed to remove some acetone before the acetone reached the pump. Many high quality gross anatomical specimens have been prepared this way. They have remained in good condition and retained stable color for five years. This paper will also describe the differences regarding equipment needs for plastination at room temperature compared to plastination at -25°C.

Introduction

In the standard plastination procedures, originally developed and described by von Hagens (1986), dehydration of specimens is normally achieved by freeze substitution in acetone at -25°C. Forced impregnation is also carried out in a deep freezer at -15°C to -25°C. Plastination experiences at room temperature have been previously reported but were not judged satisfactory because the silicone used at this time polymerized too rapidly at room temperature and leaded to expensive loss of polymer (Cook and Dawson, 1996). Successful room temperature dehydration with acetone (Henry et al., 1998; Zheng et al, 1998) and impregnation with polymer designed for room temperature plastination (Zheng et al., 1996; Henry, 1998; Glover et al., 1998; Zheng et al., 1998) have also been reported recently. We have developed a procedure that successfully allows dehydration with acetone as well as impregnation to be carried out at room temperature (15 to 20°C). We have utilized intermittent vacuum procedure instead of the continuous vacuum procedure described by von Hagens (1986). The use of a new silicone named the Su-Yi Chinese silicone (Nanjing Su-Yi Plastination Factory, 49 Ning Lie Road Ka Zi Men, Nanjing 210012, China) developed in 1996 permits this plastination procedure at room temperature.

Materials and Methods

Fixation

Human internal organs (heart, liver, spleen, trachea, brain and kidney), muscles with joints (shoulder joint and knee joint), fetuses (different sizes and ages) and some pathology specimens (lung and colon cancer) were fixed by immersion in 7% formalin for 10 days at room temperature, then kept in 5% formalin at room temperature for 1 month. Fixation was performed in plastic containers with tight lids.

Dehydration and degreasing

After fixation the specimens were rinsed in running tap water for 3 days. The specimens were dehydrated in a graded series of acetone solutions (50% - 60% - 70% - 80% - 90% - 95% - 97% - 98% - 99% - 100%) at room temperature. The volume ratio between the specimens and the acetone solutions was maintained at 1:10. A direct reading acetonometer (figure 1) (RTE Electronics Ltd, P.O.BOX 8555, 128 Reykjavic, Iceland and Nanjing Su-Yi Plastination Factory, China) was used to monitor the acetone concentration everyday, after thorough mixing of the acetone bath. The specimens were moved to the following acetone bath when equilibrium was

Presented in part at the 9th International Conference on Plastination, Trois-Rivieres, Canada, July 5-10, 1998. Address correspondence to Zheng Tianzhong, Department of Anatomy, Shanghai Medical University, Shanghai 200032, PR.. China. Tel: 86 21 6478 2982 / Fax: 86 21 6478 2982. Email: tizhengc@online.sh.cn

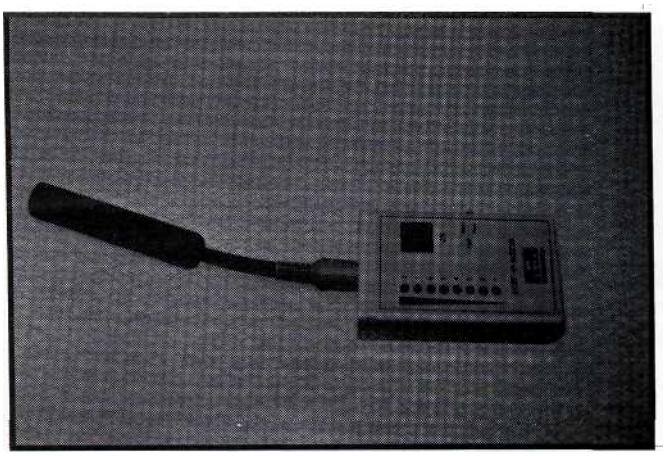


Figure 1. Electronic acetonometer.

acheived. The specimens were brought to the 100% acetone bath and dehydration was considered complete when the acetone remained at 100% for 5 days. Room temperature dehydration permitted degreasing of the specimens during the same time.

Impregnation

Impregnation was divided into 3 stages, all done at room temperature.

Pre-impregnation

After dehydration and degreasing, specimens were submerged into the Su-Yi Chinese Silicone solution at room temperature for 3-5 days which allowed excess acetone to escape and the specimens to equilibrate with the silicone solution naturally without force. During this stage the specimens were moved and turned every day. Weights were necessary to keep the specimens submerged. No special equipment was required for this step. One only needs containers (plastic or stainless) large enough to completely submerge the specimens.

Intermittent forced impregnation

After pre-impregnation, the specimens were transferred to a vacuum chamber (figure 2) designed and built by the Nanjing Su-Yi Plastination Factory. The 1.9M long by a 0.8M diameter chambers permitted impregnation of whole cadavers as well as parts.

Daily vacuum was established and the pressure slowly decreased. Vacuum was applied 4 hours in the morning, then stopped 1-2 hours for the lunch time and applied again 3-4 hours in the afternoon. Before the end of each working day the vacuum pump was turned off and the vacuum released. The chamber was then opened to allow the specimens to be moved around to relax and for further equilibrate with the silicone solution for 14 to 15 hours.

Over a period of 12-15 days, the pressure was gradually lowered to 7.5 mm Hg. Vacuum was maintained for 3-4 more days until no more acetone gas bubbles appeared. This indicated that there was no more acetone remaining in the specimens. An acetone gas filter system was designed and used to protect the vacuum pump and decrease pollution. The acetone gas filter system consisted of two phases. The first phase (figure 3) was installed between the vacuum chamber and vacuum pump. It is made of three stainless containers. The middle container contains water to absorb the acetone vapors. The other two containers protect the vacuum chamber and vacuum pump. They prevent the acetone contaminated water to be aspirated in the pump or to be aspirated in the chamber if the pump is accidently stopped. The second phase was installed at the end of the exhaust pipe of the vacuum pump, for the purpose of decreasing air pollution by filtering oil and acetone fumes.

Post-impregnation

After intermittent forced impregnation, the specimens were moved from the vacuum chamber but kept submerged in the silicone solution for 3-5 additional days.

Curing

Curing was also done at room temperature. The specimens were removed from the silicone bath and wiped of the excess silicone. The specimens were slow cured by covering their surface with old silicone mixed with varying ratios of hardener (1-5%).

Samples of liver, spleen, trachea and kidney were taken for histological study before and after plastination. The samples from plastinated specimens were placed into 70% acetone to remove silicone. They were moved in a graded ethanol series (70%, 95%, 100%), paraffin embedded for routine histology, stained with H-E, examined and photomicrographs were taken.

Results

After plastination at room temperature, the internal organs (heart, liver, spleen, trachea, brain and kidney), joints and soft tissues retain their original shape and colors and are still flexible. They have no odor or toxicity. By using room temperature, dehydration and degreasing are complete for most specimens in about 3-5 weeks. The sizes and diameters of the specimens were measured before and after plastination to evaluate the shrinkage and shrinkage of specimens was less than 5%. Flexibility of the specimens depends on the

percentage of hardener used. Low percentage hardener produces specimens more flexible with a slightly oily texture. Higher percentage produces specimens completely dry but more rigid. Specimens present no oozing of remnant silicone and can be handled without gloves. More than 500 high quality gross anatomical specimens (figure 4) have been plastinated at room temperature according to this protocol and have remained stable for up to 5 years.

The histological study via light microscopy shows that cellular structure is preserved after plastination at room temperature.

Discussion

1. Differences between room temperature and low temperature dehydration process

Chemical processes are related to temperature. Cold temperature affects the speed of the plastination process. Also there is danger of ice-crystal formation within cells at -25°C or -30°C if the tissue is not properly precooled. Compared with dehydration by freeze substitution in acetone at -25°C, the method of dehydration by a graded series of acetone solutions at room temperature can be faster as specimens are degreased during this time.

Dehydration at room temperature avoids buying of an explosion proof deep freezer or rebuilding a commercial freezer for the safety by removing the motor and compressor (Gubbins, 1990). It only requires some stainless or plastic containers with tight fitting lids.

Most plastination laboratories use an acetonometer to measure purity of acetone which is based on the buoyancy forces using Archimedes principle. As acetone density is temperature dependent, measuring must be carried out at standard temperature (usually 15 to 20°C). Therefore cold acetone must be warmed or too warm acetone must be cooled to the standard temperature. The scale acetonometer usually requires 250ml of acetone for one measurement. A new acetonometer (figure 1) using an electric principle is available. It is safe, accurate and not temperature dependent. Its compact construction renders it easy to use and portable. We just have to insert the probe tip of the acetonometer into the acetone-water solution and push a button. Indicator lights show the following concentrations of acetone: 100%, 99%, 98%, 95%, 90%, 85%, 80% and 50% within 2 to 3 seconds at any working temperature. It is constructed with low voltage explosion proof electronic circuits. Fast and accurate measurement minimizes exposure to acetone vapors and provides a health benefit.

2. Differences between room temperature and low temperature impregnation process

Silicone reaction mixture remains less viscous at room temperature, permitting faster penetration and easier acetone gas bubbles escape. This permits complete impregnation in 1/3 the time.

The only pieces of equipment needed for the pre-impregnation step are some stainless or plastic containers (without lid) big enough to permit immersion of the dehydrated specimens. We also usually need some assistance from a weight or frame to maintain the whole specimens completely submerged into the silicone solution.

Room temperature forced impregnation only requires a vacuum chamber and a vacuum pump. No freezer is necessary which may limit the size of the vacuum chamber. Our stainless vacuum chambers (figure 2) are mobile and very convenient for the impregnation of any size specimens.

3. Differences between intermittent and continuous vacuum forced impregnation

During forced impregnation the balances between silicone solution and acetone within the cells and tissues are broken many times by the intermittent vacuum process. We beleive this benefits the escape of acetone from the deep part of specimens and the penetration of silicone to the deep part of the tissues. The intermitent forced impregnation also reduces significantly the work of the pump and a less expensive pump may be used.

Many complete impregnations were acheived with simple rotary vane vacuum pumps whose pumping speed is 8L/sec. Since acetone vapors may damage plastic components and rubber seals of the vacuum pumps, plastic parts and rubber seals were replaced by metal material and silicone rubber. After rebuilding, these vacuum pumps were used for more than one and one half years without any problems. The pressure in the large vacuum chamber could be lowered to 7.5mm Hg in 30 minutes by these inexpensive pumps.

4. Cost and safety

Dehydration and impregnation, performed at room temperature as well as in the cold, need to be acheive in a well ventilated laboratory. Performing these steps at room temperature reduces capital costs and improves safety by reducing the potential hazard of explosion caused by acetone vapor accumulated in a freezer that is not designed for completely spark-proof operation. The intermittent vacuum procedure also reduces capital costs of high quality vacuum pump.

Plastination laboratories use large amounts of acetone for dehydration. Dealing with the used acetone solution is a problem for most managers of plastination laboratories. In order to protect our environment and reduce operation costs, it is recommended to recycle used acetone in our laboratories. Simple devices for the recycling of acetone in plastination laboratories have been proposed before (Grondin and Berube, 1992; Grondin et al., 1997) but were not judged adequate for big volumes of acetone. We designed an acetone recycling equipment. This apparatus (figure 5) made by the Nanjing Su-Yi Plastination Factory consists of four parts. The first part is a stainless container equiped with a oil heating system to heat the used acetone. The second part is a collecting container with a cooling system that cools down the acetone vapors and condenses them into pure liquid acetone. The third part is a control box which controls the oil heating system at the relative stable temperature about 90-110°C. This heat the used acetone at 70 to 90°C permitting a rapid evaporation of the acetone without boiling of the water that is contained. The fourth part is a vacuum generating system that leads the acetone vapors to the collecting container. The volume of the stainless container is 40L and the recycle ability is 25 liters of pure acetone per hour.

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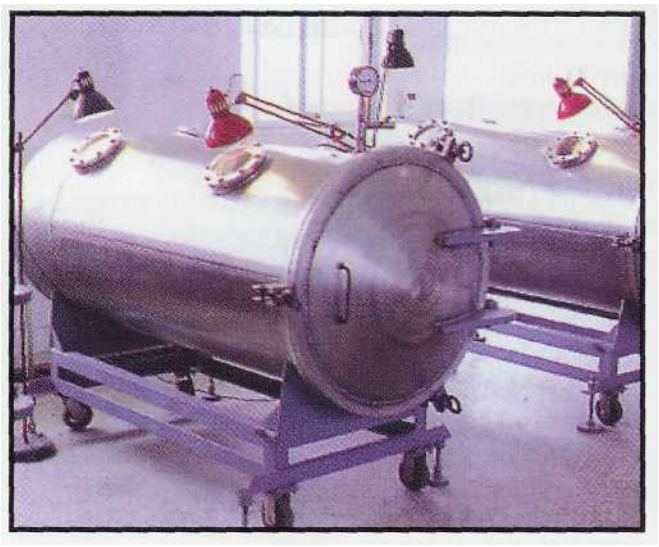
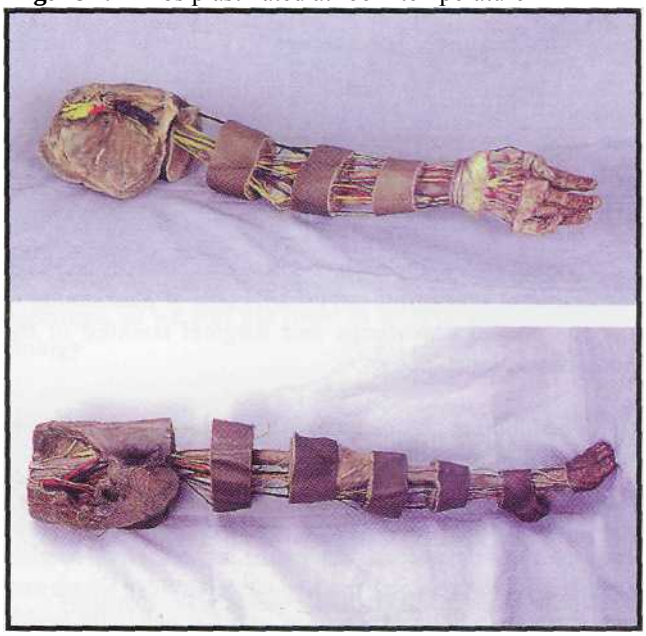


Figure 2. The mobile vacuum chambers.

Figure 4. Limbs plastinated at room temperature



with Su Yi Chinese Silicone.

Figure 3. Stainless containers located between the vacuum chambers and the pumps to collect acetone vapors.

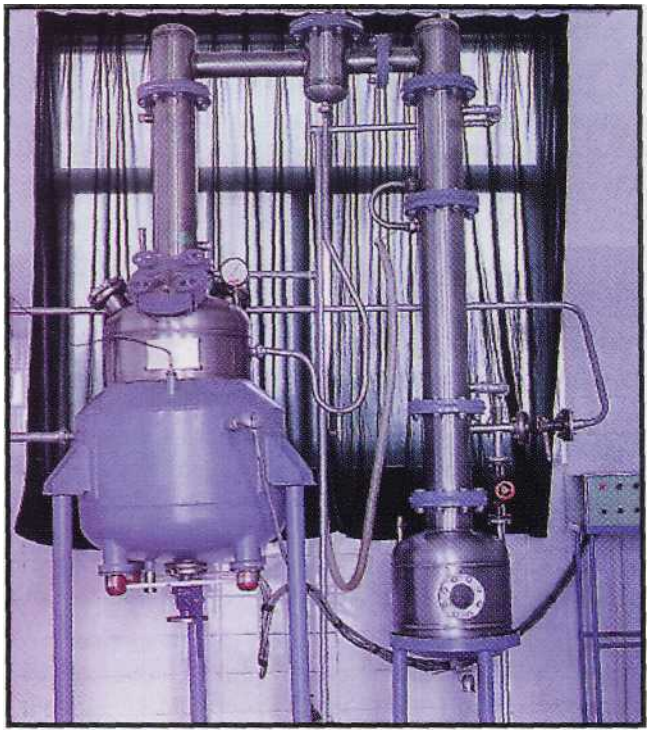


Figure 5. Distillation apparatus.

ABSTRACTS
9th International Conference on Plastination
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A BRIEF CHRONOLOGY OF PLASTINATION

Bickley H
Mercer University School of Medicine, Macon, Georgia, USA

I suspect that there is no single "Birthday" for Plastination. The one we celebrate at this meeting is actually a good estimate that establishes a date at which Plastination has gained a little momentum and something of an identity -- but, like most other important things, Plastination developed gradually from a concept.

As most of you know, it was the brainchild of Gunther von Hagens, who one day decided that, instead of embedding a specimen in plastic, the plastic should be induced to enter the tissue and then cured, in situ. This led to the principle of forced impregnation and, after several years, to the technology, the International Society for Plastination and the meeting schedule we now enjoy. If I had to assign some kind of a date for its origin, I would suggest that the intellectual process leading to Plastination began sometime around the year, 1975 - but I would have to check with Gunther to be sure or more specific.

What we can date with assurance are the international meetings, so we will use these as an approach to our chronology.

PRINCIPLES OF PLASTINATION

Henry RW
Department of Animal Science, College of Veterinary Medicine, University of Tennessee, Knoxville, TN, USA

Plastination for preservation of biological specimens for teaching anatomy or pathology has been used to a limited extent for 20 years. Plastination was invented in Heidelberg, Germany, in 1975 by the physician, anatomist, Dr. Gunther von Hagens. Scattered throughout the world several institutions routinely use the process and a few specimens are available commercially. Plastinated specimens are clean, dry and free from irritating formaldehyde vapors. They are esthetically pleasing to students and offer a convenient mode for reviewing anatomy. In brief, plastination is the process of replacing fluid in a specimen with a curable polymer.

The polymers must possess the desired properties to produce the type specimen desired. The first step is **1. Specimen preparation:** the specimen must first be prepared for the format that you wish for presentation (whole or slices). This may include fixation or not. **2. Dehydration:** After any fixative is removed by running tap water, tissue fluid must be removed in preparation for introduction of a polymer into the tissue. Cold acetone has emerged as the classic dehydrating agent. However, a graded alcohol series has merit and room temperature acetone is currently being evaluated. 3. **Volatile intermediary solvent:** Once the specimen is dehydrated, the dehydrating fluid must be replaced with a solvent which can be exchanged for the polymer. This solvent's boiling point must be sufficiently different from the polymer so that the solvent can be extracted from the specimen. As the solvent is extracted, a void is created in the tissue which will allow the polymer to move into the tissue void. Acetone has these properties as does methylene chloride (dichloromethane). Therefore, using acetone for dehydration has already completed this step. **4. Impregnation:** Is the act of boiling off the solvent from the specimen which allows the polymer to enter the tissue void. This is accomplished by decreasing pressure to the point where the intermediary solvent boils out of the specimen and is extracted from the vacuum chamber in the exhaust of the vacuum pump. [Acetone: 55cm/ 22in CTA, 40cm/16in RTA; Dichloromethane: 45cm/18in CTM or 33cm/13in RTM]. The polymer enters the specimen over a period of 24 hours to days depending on the thickness of the specimen. **5. Polymerization (hardening):** A activator or crosslinker is exposed to the polymer filled specimen to cause the polymer to polymerize and stay inside the specimen. Upon completion, the specimen is forever preserved.

CURRENT TOPICS ON DEHYDRATION

Henry RW, Brown A, Reed RB
Department of Animal Science, College of Veterinary Medicine, University of Tennessee, Knoxville, TN, USA

Dehydration for plastination has classically utilized cold (-20°C) acetone. And rightly so! Cold acetone has yielded excellent silicone impregnated specimens for two decades. One of its superior qualities is minimalization of shrinkage, especially in nervous tissue. However, acetone is often under close scrutiny by governmental safety officers and occasionally its regulation is a deterrent to establishing a plastination laboratory. Recent claims by new polymer providers for plastination have advocated room temperature acetone dehydration, which may be a more hazardous situation. Their claims are faster dehydration, decreased color loss and increased flexibility. This directed our group's focus toward an investigation of how good is room temperature ac-

etone for dehydration! Or what are the problems associated with each dehydrating agent and are there other dehydrants that may have equally good properties? Our preliminary results indicate only an average of 2.5% increase in shrinkage of tissues dehydrated in room temperature acetone when compared to those dehydrated in cold (-20°C) acetone. Our specimens have not been impregnated at this time but those results will be presented at the meeting. Alcohol dehydration results will also be presented at that time.

PRINCIPLES OF SILICONE PLASTINATION

Henry RW
Department of Animal Science, College of Veterinary Medicine, University of Tennessee, Knoxville, TN, USA

Silicone specimens provide an excellent means for preservation and presentation of any anatomical, pathological or biological specimens. Especially, difficult to understand regional anatomy can be prosected and preserved by silicone plastination and presented to medical students. Wet and often under used formaldehyde or alcohol entombed museum specimens can be transformed into user friendly learning aids. Silicone body slices are excellent adjuncts for studying sectional anatomy and for correlation with ultrasonographic, CT or MRI scans. Use of the plastination method has waxed and waned.

One reason often given for not plastinating is the expense of the process and particularly that of the polymers. On the contrary, we have found that the polymers are one of the least expensive components. In the average specimen, only 0.4 kg of polymer is used per kilogram of finished specimen. At current silicone prices ($35 to $48/kg, $16 to 22$/lb), polymer cost per kilogram of specimen is only $17. The majority of the cost of plastinating is the time spent in specimen preparation and laboratory costs (space and equipment). However, as has been presented so eloquently in the past, space and equipment costs can be minimal. What is really needed is a person dedicated to the process. Silicone plastination is a unique process which should be considered for preserving biological specimens for the 21st century.

Specimen preparation: is by far the most critical step. Specimens must be produced to clearly delineate the morphology. Once the specimen is fixed and dehydrated, it is difficult to alter its appearance. Cavities must be dilated, flexures must be fixed in place and extraneous connective tissue removed. Fixation generally should be minimal to none.

Dehydration: Cold acetone has emerged as the most reliable. A graded series of alcohol is fine and warm acetone is being used. Cold acetone is generally believed to reduce shrinkage. Care must be taken to have the specimen in correct anatomical position during dehydration.

Intermediary solvent: Acetone is one of the two recommended solvents. Logically if it was the dehydrant, once dehydrated the specimen is ready for impregnation. However, if alcohol was used, the alcohol must be exchanged for acetone or methylene chloride (dichloromethane). The advantage of methylene chloride is its great affinity for lipid and hence its rapid thorough removal of fat.

Impregnation: Classically impregnation has been in a deep freezer at -15°C. The Biodur silicone can be impregnated at room temperature, but is preferable in the cold because the impregnation mix contains an activator and chain extender which commences the thickening (curing) reaction at room temperature. New room temperature silicones which are stable at room temperature are currently being introduced. The necessary activators are not mixed into the impregnation mixture but added after the impregnation mixture is within the specimen.

Polymerization (Curing): Many terms are used for making the polymer change from a liquid to a dry state (polymerize, harden, cure, cross link, activate). Obviously this must occur after the polymer has been impregnated into the specimen. Again it is important to have the specimen in correct anatomical position while the polymer is hardening. Once the specimen has cured, it is preserved forever.

THE S6-GASHARDENING UNIT WITH COMPRESSED AIR

Riepertinger A
Institut für Pathologie, Stadt. Krankenhaus Miinchen-Schwabing, Miinchen, Germany

The S6-gashardening unit with compressed air for the hardening of Biodur S10/S15-impregnated specimens is arranged into 3 segments: First in a dripping area, second the actual gashardening with 3 large sized plastic tubs, than an ample area with the regulation-valves of the compressed air supply and a chest for the glass flask of the Biodur S6 gashardener. In the chest there is also a glass cylinder for the secretion of fluid gashardener and the switch-gear for the ventilation. To concentrate the atmosphere with gashardener in the inside of the hardener tubs we used water-free compressed laboratory air. The air is flowing over a glass flask, filled with gashardener - and enriched with it - lead over a copper-pipe-system to the specific tubs. The tubs are connected to each other with flexible aluminum tubes for better circulation of the air. In addition two ventilators are serving for an optimal dispersion of hardener gas into the tubs. A separate pressure air conducting with a reduction-valve connected in series are serving for the hardening of hollow organs in their natural shape. This gashardening unit make possible the curing of a large number of specimens within 3 to 14 days.

PLASTINATION AT ROOM TEMPERATURE

Zheng TZ, Liu J, Zhu K Shanghai Medical University, Shanghai 200032, China

In the standard plastination procedure, originally developed and described by von Hagens, the dehydration by freeze substitution in acetone and the forced impregnation of the specimens are normally achieved at -25°C in a deep freezer. Now, we have been able to develop a procedure that successfully allows these steps to be carried out at room temperature (15 - 20°C). We have also developed an intermittent vacuum procedure that replaces the continue vacuum procedure described by von Hagens. The use of a new type of silicone named the Su-Yi Chinese silicone developed in 1996 permits this plastination procedure at room temperature.

These improvements reduce capital costs (expensive spark proof deep-freezer) and improve safety by reducing the risk of explosion that acetone vapour could generate in an enclosed space. The intermittent vacuum procedure also reduces capital costs of high quality vacuum pump. Many large and small high quality gross anatomical specimens have been prepared in this way. They have remained in good condition and retained stable color. The surfaces are dry and show no oozing of remnant silicone.

The Su-Yi Chinese silicone is cheaper than the Biodur silicone developed by von Hagens and now not only being used in some universities in China but also in the University of Hong Kong.

SHEET PLASTINATION, E12 TECHNIQUE, FILLING METHOD. LECTURE / BENCH TOP DEMONSTRATION

Weber W
College of Veterinary Medicine, Iowa State University, Ames, IA, U.S.A.

Plastination of thin whole body or organ slices with E12 epoxy resin yields transparent or opaque specimens that are in particular useful for teaching cross sectional aspects of the anatomy as they appear in cat scans and similar diagnostic images. The lecture describes and demonstrates the key steps of this technique: fixation of the specimen may be omitted. Dilating of the vessels prior to freezing the specimen is advised. The blade speed of the saw, some modifications regarding the portion fence and the type of saw blade selected have major influence on the quality of the surface of the slices. The slices are stacked in packages for easier handling in the freeze substitution, degreasing and forced impregnation steps. A bench top demonstration visualizes the assembly of a "flat chamber" casting mold, filling the mold with resin, and manipulating the specimens and air bubbles inside the mold. The flat chambers are placed at a slight incline at room temperature for initial curing and later transferred to a 40°C environment for final curing. The cured sheet is released by dismantling the mold and the singular slices are cut out by means of a band saw or scroll saw. The rough edges on the slices can be smoothed over with a drum sander, wet grindstone or similar abrasive tool. A final warm water bath will both clean the surfaces from dust and relieve tensions imparted by factional heat when cutting and sanding the slices. The draining method - a variation of the filling method - can be used if a smooth surface of the final product is not required or to reduce the cost of the production. Specimens produced with the draining method are suitable for embedding in E12 resin to give them the same appearance as specimens produced with the filling method.

SUBMACROSCOPIC INTERPRETATION OF HUMAN SECTIONAL ANATOMY USING PLASTINATED E12 SECTIONS

Cook P,Al-Ali S
Department of Anatomy with Radiology, School of Medicine, University of Auckland, Auckland, New Zealand

The E12 epoxy method of sheet plastination for preparing transparent and serially sectioned cadaveric teaching specimens has for the most part seen the finished sections utilised in the correlation of MRI and CT radiographic images. The unique properties of the E12 process offer an exceptionally vivid survey of the human body in any given plane resulting in precise delineation of the structural layout *in situ.* Maximum detail of the sections is attained by way of transparency through large scale lipid extraction producing easily discernible details of anatomical structures within a gross specimen.

Sections were prepared in sagittal, horizontal and coronal planes from different regions of the body including head and neck, trunk, inguinal region, limbs and joints. The macroscopic structures within these sections correspond precisely with images of the same structures obtained radiologically.

By introducing E12 sectional anatomy specimens to the anatomy teaching laboratory, the transition between gross anatomy and histology has been made possible by studying the one specimen. When utilised in our combined topographic anatomy and histology teaching laboratories, anatomical structures of thin and transparent slices can be magnified considerably. Standard histological slides providing detail of a specific structure within predetermined parameters, are often dictated by the physical limitations of the microscope slide itself. E12 sections provide a high degree of detail whilst retaining *in situ* structural integrity of the entire region in a complete and uninterrupted state.

Students are provided with significant detail of all components to the submacroscopic level from any one specimen

thus linking the three disciplines, namely cross-sectional anatomy, radiology and histology using a single E12 slice. E12 plastinated sections have been recognised as an ideal teaching aid in conjunction with radiological correlation, but it is in the microscopy laboratory that a valuable new dimension of this multi-disciplinary plastination technique has recently been realised.

THE TISSUE LAYERS OF PLASTINATED SECTIONS COMPARED WITH TISSUE LAYERS OF CLINICAL IMAGES

Lane A Triton College, River Grove, Illinois, USA

The structural arrangement of the human body is shown in clear detail by plastinated multiplane sections. Each region and each organ show, in adequate high quality sections, layers. These layers can be seen in both cadaver plastinated sections and clinical images. In fact, this should be one evaluative criteria used in the quality control of plastinated sections and clinical images. The better the layers are differenciated by the method or device used to prepare the section the better the quality and usefulness of the sections for study and interpretation.

Four classes of tissue layers in this study are recognized which include: 1) Somatic tissue layers; 2) Extravisceral (visceral) layers; 3) Intravisceral luminar layers and 4) Intravisceral nonluminar layers. An example of somatic layers are those formed from the somatopleure. The tissue layers of the body wall of major cavities arise from the somatopleure. Examples of the other three layer systems include organs derived from splanchnopleure. The extravisceral (visceral) means the arrangement of these viscera within the major body cavities. Intravisceral luminar organ refer to those layers of hollow organs derived from the splanchnopleure and intravisceral nonluminar layers involves organs without lumen such as adrenal glands and kidneys.

One or more of each class is illustrated and compared using sectional plastinated specimen and clinical images.

SHEET PLASTINATION OF BRAIN SLICES ACCORDING TO THE P35 AND P40 PROCEDURES

Weiglein AH,Feigl G
Anatomical Institute, Karl-Franzens-University, Graz, Austria

Introduction

For the plastination of brain slices the P35 or P40 procedures are recommended. These procedures result in thin (2,4,6, or 8 mm) and semitransparent slices.

P35 procedure

1) Fixation: Fresh brain specimens are fixed the usual way with 10 % formaldehyde. Old wet specimen should not be used for the P-35 procedure, because fixatives other than formaldehyde may cause unintentional reactions with the polymer.

2) Slicing: The fixed brains are sliced with a meat sheer into 4 mm (or 6 or 8 mm) thick slices. To prevent degrada tion of the slices wet filter paper is trimmed to the size of the brain and placed on top of the brain slice before slicing. Also gelatin embedding of the formalin fixed brains can be used to keep pieces together during slicing. The slices are placed on a stainless steel grid and the grids are piled up in a stain less steel basket.

3) Flushing and precooling: The basket of brain slices is rinsed with cold tap water overnight and cooled down to 5°C.

4a) 1 st Dehydration: The basket of flushed and precooled brain slices is submerged in 100% acetone at -20°C (251 per brain) for 1 - 2 days.

4b)2nd Dehydration: The basket of brain slices is submerged in another bath of 100% acetone at -20°C (25 1 per brain) for another 1-2 days. Dehydration is checked by an acetonometer and must reach at least 98 %.

5a)lst Immersion: The basket of dehydrated brain slices is submerged in a precooled P35 - A9 mixture (100:2) for one day at 5°C (to -25°C).This bath must be discarded after use.

5b)2nd Immersion: (This step may be omitted when using a fresh 1 st immersion mixture). The basket of brain slices is submerged in fresh P35 - A9 mixture (100:2) for one more day at 5°C. This bath might be used as 1st immersion bath for the next procedure.

5c)Forced impregnation: Once more the basket of brain slices is submerged in a fresh P35 - A9 mixture (100:2) and exposed to vacuum for 24 hours at - 25°C (or at room temperature). The vacuum is increased down to 10 -15 mm Hg. This bath may be used as 2nd immerion bath for the next procedure.

6)Casting / double glass chambers: The slices are removed from the vaccum chamber and each single slice is placed between two sheets of glass plates. Each sheet consists of one safety glass plate and one float glass plate, the latter facing the brain slices. A silicone gasket is used to seal the chamber around the edges and fold-back clamps are used to fix the two double glass plates together. Then the double glass chambers are filled with a fresh P35 - A9 mixture (700 cc for a 35 x 45 cm standard size chamber). Air bubbles are removed either by exposing the double glass chambers to vacuum for a short time (approx. 1 hour) or by heating them in the heat cabinet for a short time (approx. 1 hour). Finally the double glass chambers are turned to an almost horizontal position. Then the slices are arranged in the desired position either by use of steel wire or by use of small steel balls inside the chamber, that can be moved by a magnet outside the chamber.

7a)Light Curing: After casting the double glass cham-

bers are exposed to UVA-light for 45 minutes to 4 hours depending on the watts and on the distance of the UVA-lamps. During this procedure it is necessary to cool the chambers either by ventilators or by blowing compressed air over both sides of the double glass chamber.

7b)Heat Curing: After light curing the double glass chambers are exposed to 45°C for 4-5 days in a well-ventilated oven.

8)Finishing: After curing is finished the slices are dismantled, trimmed by a band saw, the edges smoothened using a belt sander, and the surface polished using car polish.

P40 procedure

The P40 procedure has some remarkable advantages, particularly this procedure is faster and cheaper compared to the P35 procedure.

The advantages are:

The same polymer is used for immersion, impregnation, and filling of the chambers (steps 5 and 6).

Only single float glass chambers are necessary instead of the expensive double glass chambers with safety glass (step 6).

P40 does not cure with heat and is cured by UVA-light only. Thus, no expensive ventilated heat cabinet is needed (step 7).

P40 can also be used for transparent body slices and thus enables us to produce transparent head slices with the brain in situ.

There are, however, some remarkable disadvantages:

P40 is a ready-mix polymer, i.e. the hardener is already in the polymer. This results in a relatively shorter shelf-live.

P40 is much more sensitive to even smaller changes in the protocol. Particularly the light curing step caused many troubles within the last years. Too fast curing, caused by high watt lamps, too short distance between lamp and glass chamber, and insufficient cooling during light curing resulted in orange spots, that ruined the final specimen.

Thus, it is still recommendable to prefer the P35 procedure especially for beginners.

UPDATE ON POLYESTER PLASTINATION (P40)! WHERE HAVE ALL THE "ORANGE SPOTS" GONE?

Henry RW
Department of Animal Science, College of Veterinary Medicine, University of Tennessee, Knoxville, TN, USA

P40 (polyester) sheet plastination of brain slices was commenced at the University of Tennessee one and one half years ago. Our first groups of specimens were quite unique but held to The University of Tennessee color tradition, "Orange and White". The gray matter had consolidations of orange color. Even though we had tried to follow the protocol to the letter. Of course, demonstrations often do not go as expected and the 1997 plastination workshop could only produce such brain slices. However, since the close of the workshop, we can not produce orange gray matter. What did we do wrong? 1. Slices were cut with a brain knife and were at least 6mm and not of uniform thickness. 2. Impregnation was apparently not complete. 3. Temperature was monitored only by digital touch. When the areas of the brain slice with orange spots were opened, they appeared dry and flaky. This would seem to indicate that acetone was not entirely extracted and thus P40 had never reached the depths of the cellular gray matter. Since using a mechanical slicer (which was used to produce 2 & 3 mm uniform slices) and making sure that impregnation was complete (all acetone extracted), we have had perfect slices using only UV light as the curing agent. We have also used a chemical activator with similar success.

ADAPTING THE P35 PLASTINATION PROTOCOL FOR BRAIN STEM THIN SECTIONS

Langdon HL, Stone C
Department of Anatomy and Histology, School of Dental Medicine, University of Pittsburgh, Pittsburgh, PA, USA

Sheet plastination offers an ideal medium for presenting neural structure visually. However, the use of a standard 4 mm section-thickness that works well in depicting anatomy of the forebrain loses resolution when applied to the smaller dimensions of brain stem or spinal cord sub-structure. A pilot project was undertaken to devise a simple method for producing sections sufficiently thin to present finer detail while, at the same time, being thick enough to demonstrate inherent structural contrast.

A B&L sledge microtome was modified by replacing the blade-holder with a plexiglas stage having a centered 3 cm aperture. A segment of brain stem or spinal cord, frozen at -40°C, is mounted on a plywood block chucked in the specimen holder. The specimen, then, is advanced a critical distance through the stage aperture to be sectioned with a straight razor at a thickness ranging from approximately 120 to 200 micrometers. The thinness of the blade together with the shearing nature of the incision minimize compression fracture in the specimen.

The plastination procedure used (freeze substitution followed by vacuum infiltration) and mounting on a glass slide under a coverglass is adapted closely from the standard protocol.

This procedure provides a relatively quick and economical way in which to prepare either experimental or instructional material for review under low magnification.

PLASTINATION OF THREE DIMENSIONAL STRUCTURES WITH P40

Sora MC, Brugger P, Traxler H
Department of Anatomy 2, Institute of Anatomy, University of Vienna, Austria

This study intends to present a new aspect in plastination with P40, not only in processing brain slices, but also in plastination of three dimensional structures. We thought that working with nervous tissues would make the modification of the P40 plastination process easier, so decided to plastinate a human brachial plexus and a dissected human brain. The plexus was removed from a fixed body, from the dissection room. The brain was obtained fresh from an individual who had donated his body to the Institute of Anatomy. The brain was fixed in 5 % formalin solution for three months. After dehydration both specimens were immersed and impregnated with P40. The main problem in curing P40 is that it should be done under UV-light and in a closed, airless chamber, otherwise the surface of the plastinated specimen remains sticky. Curing was therefore performed by using UV-light and simultaneously keeping the specimen under vacuum.

P40 PLASTINATION OF HUMAN BRAIN SLICES: COMPARISON BETWEEN DIFFERENT IMMERSION AND IMPREGNATION CONDITIONS

Sora MC[1], Bareck J[1] Motoc A[2] ^Department of Anatomy 2, Institute of Anatomy, University of Vienna, Austria
department of Anatomy, University of Medicine and Pharmacy Timisoara, Romania

Human sagittal slices, 4 mm thick, were plastinated with P40 using different immersion and impregnation conditions. Both brain halves were sliced. From each brain half we selected 8 slices. Two points were marked on each slice and subsequently an imprint of the slices was drawn on transparency film. After dehydration in -25°C acetone, the slices of the left brain half were immersed at -25°C for two days and impregnated 24 hours, the slices of the right brain half were immersed at +5°C for two days and impregnated at room temperature at + 15°C for 24 hours. All impregnated slices were plastinated. The imprints of the brain slices were scanned in computer, as well as the plastinated slices. By using a Kontron KSA400 v. 2.0 (ZEISS) software we calculated the area of the plastinated brain slices as well as the area of the scanned imprints. Comparing the obtained data we were able to determine the shrinkage rate of the slices. The slices processed at -25°C showed a shrinkage rate of 4.47% . In comparison the slices immersed at +5°C and impregnated at +15°C showed a shrinkage rate of 6.95%.

A COMPARATIVE STUDY OF THREE POLYESTER POLYMERS FOR PLASTINATION OF THIN HUMAN BRAIN SLICES

Goyer M-F, Grondin G, Olry R
Departement de Chimie-Biologie, Universite du Quebec a Trois-Rivieres, Trois-Rivieres, Quebec, Canada

The goal of this study was to compare two polyester polymers [Caroplastic (Carolina Biological Supply) and Bio-Plastic (Ward's Natural Science)] with P35 (Biodur) used for plastination of human brain slices. For every type of polymers used, the basic procedures where the same. We wanted to emphasize on the principal advantages and disadvantages of each products in two aspects, that is to say, financial cost and also the quality of the plastinated specimen obtained. The brains were obtained from cadavers fixed for dissection. They were embedded in gelatin, sliced and kept in 10% formalin at 4°C for about one year. After fixation they were rinsed with cold water and dehydrated with 100% acetone at -25°C. Next, the slices were immersed twice, impregnated and casted in glass molds. Our preliminary results suggest that the three polymers lead to brain slices that show a similar color differentiation between gray and white matter.

AN ECONOMICAL PLASTINATION PILOT PROJECT AND TRIAL OF THE COR-PR-10 POLYMER

Baker JA
The National College of Chiropractic, Lombard, IL, U.S.A.

For some time we have been interested in plastination. With the support of the Chair of Anatomy, Dr. Cramer, in 1996 I joined the International Society for Plastination and actively explored literature about the procedure. In late 1997 our initial proposed US$3000 budget for an inexpensive pilot plastination laboratory was not able to be funded. So we began anyway. We had no budget and no experience, but had enthusiasm and great help from many experienced plastinators. An existing, broken but functioning, household countertop refrigerator was modified extensively to incorporate a vacuum manifold and produce low temperatures. I rebuilt one vacuum pump from two old nonfunctioning l/2hp Gast vacuum pumps which I discovered in our clinic machine room. Our vacuum chamber is a stainless steel four quart pressure cooker (Presto) with a 3/8 inch Lexan cover. We began in a temporary room which has a piped roof vent for the pump acetone exhaust. We wanted to try the new COR-PR-10 polymer from Corcoran Laboratories Inc., so for the first trial we planned a broad range of specimens: a lumbar parasagittal section, a half kidney, a gall bladder, a section of pancreas, wrist carpal bones, a small piece of

muscle, and a small portion of brain. A description of our apparatus, procedures and results will be presented.

A STUDY ON PRESERVATION OF ANCIENT CORPSES USING THE TECHNIQUE OF PLASTINATION

Zheng TZ, Liu J, Zhu K
Shanghai Medical University, Shanghai 200032, China

Using the technique of plastination, through fixation, dehydration, forced impregnation and curing, two ancient corpses died 400 years ago have been successfully plastinated. All the plastination procedure was carried out at room temperature (20°C). We also used the intermittent vacuum procedure and the Su-Yi Chinese silicone. After plastination the ancient corpses retained their original shape but weight has increased. The colors of the ancient corpses are much better than before plastination. The soft tissues remained flexible and the specimens presented no smell and no toxicity. The surfaces are dry, present no oozing of remnant silicone and can be touched by bare hands. The ancient corpses can now be preserved easily for long time without special care.

During the histological study performed before and after plastination, we found some red cells in the lung tissue of one of the ancient corpses. The morphology of these 400 years old red cells has been preserved as fresh ones.

PLASTINATION AND CEREBELLOPONTINE ANGLE

Durand M, Prades J-M, Martin C
Service d'ORL et de chirurgie cervico-faciale, Laboratoire d'Anatomie de la faculte de medecine, CHRU Saint-Etienne, France

The plastination is a new and recent method of preservation of anatomical specimens. It involves the extraction of the water and fat, which are replaced by a polymer in the organic tissues. The authors have determined a protocol of plastination of the cerebello-pontine angle. Five specimens were prepared by the retrolabyrinthine approach, four have received a coloured arterial injection, three have benefited from a superior approach after ablation of the cerebral hemisphere and the tentorium cerebelli. The plastination shows its potential in the preservation of the specimens which can be examined at any time without particular precaution.The examination of the anatomical relations is exceptional. The plastination technique offers educational possibilities unknown until this day which have a great importance for surgical practice and training.

ASSESSING THE FEASIBILITY OF USING PLASTINATED HUMAN SPECIMENS IN THE TEACHING OF RADIOLOGY

Veilleux M, Kogon P, Gagnon M, Grondin G
Departement de Chimie-Biologie, Universite du Quebec a Trois-Rivieres, Trois-Tivieres, Quebec, Canada

Our goal was to demonstrate whether plastinated human tissue specimens could be used successfully as radiology phantoms. Phantoms are used to teach radiology techniques, including positioning and parameter setting. Plastinated specimens could possibly be used, at a fraction of the cost of a commercially produced phantom.

Two knees obtained from the same cadaver were used, and a classic phantom was used to allow for comparison. We used a typical plastination technique, with fixation by immersion, freeze substitution in acetone, impregnation with silicone S10 and fast curing. Both knees were x-rayed after each step of the process, beginning with the fresh specimens and ending with the final plastinated specimens. The x-ray parameters used were identical for each step.

The preliminary results demonstrate that the plastinated knees could be used to teach radiology positioning. Nevertheless, a better quality has to be obtained if the specimens are to be used as resources to teach parameter setting or for other purposes, were image quality is of importance. We are pursuing research to obtain plastinated specimens better suited for these purposes.

AN EDUCATIONAL COMPARISON OF THIN PLASTINATED CADAVERIC SECTIONS AND MAGNETIC RESONANCE IMAGES

Magiros M
University of Sydney, Sydney, Australia

The revolution in diagnostic imaging has necessitated a return in the teaching of cross-sectional anatomy. It is clinically important that anatomy students of all disciplines, as well as physicians and medical technologists, understand the three-dimensional structural relationships of the body. The relatively new technique of plastination first described by von Hagens in 1979 is believed to be a valuable method for the production of highly instructive thin cross-sections. Plastination involves the impregnation of perishable biological specimens with a curable polymer. Several variations of this technique are available, depending on both the type of specimen and polymer being used. In this study, the effectiveness of BIODUR® PEM 11 prepared cross-sections and magnetic resonance images (MRIs) as teaching aides for sectional anatomy was investigated.

Three human cadaveric heads were scanned on a magnetic resonance (MR) imager. Coronal, transverse and sagittal slices, ~6 mm in thickness, were recorded. Correspond-

ing slices of cadaveric head were cut in each plane and plastinated by the BIODUR® PEM 11 method. In general, a good correlation existed between the plastinated sections and the MR scans. Additionally, the plastinated sections displayed an excellent differentiation between all tissue types. Hence, the PEM 11 technique is a viable alternative to plastination by other methods.

The efficacy of the two modalities as teaching tools was evaluated by testing 45 students studying head and neck anatomy. The students were divided into 3 groups, with each group using a different medium for testing (ie. plastinated section only, MRI only or corresponding section and scan together). The existing anatomical knowledge of each group was pre-tested using numerically labelled specimens. A 40 minute "study" period enabled the students to revise the topographical arrangement of labelled features in their specimen. Following this, each group completed a post-test using a corresponding MRI and plastinated section.

A series of statistical analysis of variance tests were performed on the results. It was shown that no significant difference existed in the mean scores between the 3 teaching procedures. Therefore, MRIs and plastinated sections are equally effective as tools for learning cross-sectional anatomy.

ELABORATION OF A THREE-DIMENSIONAL IDENTIFICATION KEY FOR MICROCHEIROPTERANS SPECIES OF QUEBEC WITH THE S10 PLASTINATION TECHNIQUE

Caron M, Grondin G, Bourassa JP
Departement de Chimie-Biologie, Universite du Quebec a Trois-Rivieres, Trois-Rivieres, Quebec, Canada

This study aims at conceiving a three-dimensional identification key for bats found in the province of Quebec. These are the first results obtained from experiments carried on seven (7) different specimens of cave-bats (5 *Myotis lucifugus* and 2 *Myotis septentrionalis*). The main challenge of this research is to obtain, through the use of plastination, specimens perfectly conserved so that all the morphological criteria used for identification can be easily found and in accordance with the species. Moreover, to accelerate the process, we relied on two techniques of dehydration (freeze-drying and freeze substitution in acetone) and are trying to develop a useful technique in rendering a natural aspect to the body and by keeping the fur free of silicone during the curing. The analysis of the results, which were obtained and presented during this conference, will serve to develop a unique plastination technique useful for microcheiropterans and the final results should be available by December 1998.

THE USE OF S-10 PLASTINATED SPINES FOR RADIOLOGY TEACHING

Kogon P, Grondin G, Giard M
Departement de Chimie-Biologie, Universite du Quebec a Trois-Rivieres, Trois-Rivieres, Quebec, Canada

The purpose of this study is to add a new perspective to the usual methods and approaches in teaching radiology.

We took the cadavers that had been dissected by the chiropractic students and radiographed them to search for abnormalities.

After evaluating the x-ray, we selected the specimens with pathology and plastinated them according to the S-10 method which gave a very satisfying result. It helped visualize, in 3-D, what was perceived in the x-ray.

Plastination and radiology combined, is a very useful tool for diagnostic purposes. A survey among teachers, clinicians, 4th and 5th year chiropractic students allowed us to evaluate plastination relevance to radiology education.

HUMAN BRAIN AND SPINAL CORD WITH NERVE PLEXUSES DEMONSTRATED BY THE S10 TECHNIQUE

Asadi MH, Joghatai MT
Iran University of Medical Sciences, Tehran, Iran

The purpose of this paper is to outline a process of producing 3D-models of human brain and spinal cord along with neural plexuses demonstration. For preparation, the cadaver was fixed. During the dissection, we tried to save most of the peripheral nerves.

After removal of the calvaria and the brain, dissection of the spinal cord was begun from the upper end of the vertebral column to its lower part. Plexuses and nerves were dissected from their proximal to their distal ends. Dehydration was performed by the freeze substitution method. Specimens were immerged in a mixture of S10/S3 (100:1) for three days and then forced impregnated at -25°C during three weeks. The pressure was slowly decreased down to 4 mm of Hg. After removing of the excess of polymer from the specimens surfaces, they were fixed on a PVC board with needles and procured for eight weeks. They were after covered with plastic and gas cured.

S10 plastinated brains and spinal cords provide a good pedagogical instrument. They can also be used by the students to help the understanding of the three dimensional concept of neurological structures. They can be used to teach neuroanatomy to medical students, neurologists, physiotherapists as well as nurses.

PLASTINATED SPECIMENS FOR FURTHER DISSECTIONS

Zheng TZ, Liu J, Zhu K
Shanghai Medical University, Shanghai 200032, China

After fixation and dehydration, two forearms with hands and two legs with feet were placed into the Su-Yi Chinese silicone for intermittent forced impregnation during 20 days. After this impregnation, these specimens were taken from the vacuum chamber, drained from the excess silicone and wiped. They are soft, still flexible and can be dissected just as fixed specimens.

The main characteristic of the present technique is that these plastinated specimens present no smell and no toxicity. The dissector can concentrate on his dissecting work and enjoy teaching and dissecting. During the dissecting procedure every step can be done easily. The skin can be cut, fat can be removed and the fascia and muscles can also be easily separated. The blood vessels and nerves are much stronger and much more easily separated from other structure. So you can take the plastinated specimens to make dissection more convenient, more effective and prepare perfectly dissected works. After the dissection you can cure these specimens.

These plastinated specimens can be preserved in a plastic bag. They can be stored in this way for 10 to 12 months or more before being cured.

A NEW TECHNIQUE FOR EMBALMING AND PRESERVING CORPSES

Jimenez Collado J, Arene E, Chavez R, Perez Bedox R
MAESA, C/ Sta. Leonor, 61 2°, 28037 Madrid, Spain

The Department of Anatomy of the Complutense University of Madrid, under the supervision of Prof. Dr. Jimenez-Collado, has conducted a series of research projects over the last few years, whose results are of vital importance for thanatologist, forensic and public medicolegal officers, coroners and anatomists. Prof. Dr. Arene former head of the Department of Anatomy at San Andre's Central University, Bolivia, is acknowledge to have made essential contributions in the course of this research. The product is based on a new concept regarding the techniques of embalming and preservation practiced to date and provides for a series of exceptional benefits, among which the following features should be highlighted. As a means of embalming organic tissue, the product solves the problem of contamination by microbiological agents, particularly fungi as the agents triggering corpse degradation. It was shown remarkably more efficient agent than other commercially available products, as regards the quality and the durability of the results obtained. Application of new product helps to repair the deformed anatomy, thus easing autopsy and necropsy. The same beneficial effects have been proven on mutilated corpses. Product application techniques are similar to the practice with conventional preservatives. On the other hand and very importantly, the developments allows to dispense with the use of formaldehyde for good and hence to avoid the problems inherent in this chemical, above all that of health hazard for the operators handling the product and the consequential labor incidents. This scientific finding has been patented and registered under the trade name Complucad®.

PRESERVATION TECHNIQUES IN EGYPT: SPECIAL CONSIDERATIONS

Ahmed Ali AM
Faculty of Veterinary Medicine, Zagazig University, Zagazig, Egypt

There are many methods of preservation used in Egypt. They vary depending on the departments where they are used and on the utilization of the preserved specimen.

In Egypt, preservation of specimens and bodies began more than 5000 years ago when the ancient Egyptians invented the technique of mummification. Since years, many Egyptian and international scientists are studying mummification but have not yet succeed to understand it completely. They are also trying to know how these peoples were so great as they wanted to preserve their bodies and use them in a second life.

SPECIAL TECHNIQUE OF VASCULAR INJECTION AND CASTING: A MODEL TO STUDY THE PATTERNS OF SEGMENTAL ANATOMY OF LIVER

Ajmani ML
Anatomy Department, All India Institute of Medical Sciences, New Delhi, India

Introduction: The vascular anatomy of the liver has been a topic of interest in the past and more so in this present age, where surgery on the liver has tremendously increased bringing in the necessity to know more about the anatomy of the liver. Segmental anatomy has been described by many scientists, but the most widely used and accepted by surgeons is the segmental anatomy based on the hepatic veins and the portal vein distribution in the liver. Carcinoma of the gall bladder is a common malignancy in Northern India. This malignancy is known to invade the liver either by direct infiltration or haematogenously at an early stage of the disease. Compared with gross dissection and radiological technique, the cast preparation appears to give a better display of intrahepatic anatomical relationship. The cast prepared by vascular injection may be of immense help in localizing and understanding various pathological processes and in planning the consequent surgical approach. Because of the conflicting accounts in the literature it has been decided to make

an exhaustive study of the anatomical/surgical segmentation of the liver by cast technique.

Material and Methods: The liver specimens were obtained from the autopsy room. These liver were taken from persons who have died due to RTA or suicide by hanging. 30 specimens were studied. PVC granules in 4 different colors, red, blue, green and white were used. PVC granules are normally used in plastic industry and first time has been tried for the preparation of vascular casts and standardized the technique. These granules were dissolved in acetone and an homogenous solution of optimum concentration was prepared. The different colored solution was injected in different vessels and casts were prepared.

Results: The vascular casts prepared with this material were of high quality and gives well defined delineation of hepatic segmentation. The study showed the marked variation in the sizes of segmentation.

ULTRASTRUCTURE OF THE TRACHEOBRONCHIAL EPITHELIUM OF THE NORMAL AND FORMALDEHYDE-EXPOSED GUINEA-PIG (A RESEARCH IN FAVOUR OF PLASTINATION)

El-Ashtokhy MA, El-Sheikh ME, El-Sayed GH, Bahgat M
Anatomy Department, Faculty of Medicine, Zagazig University, Zagazig, Egypt

Formaldehyde has long been used as a preservative of cadavers in most of anatomy departments all over the world. The ultrastructural changes of the tracheobronchial epithelium of guinea pig after formaldehyde exposure included increased mucous secretion, epithelial desquamation, erosion, ulceration, thickening of the basement membrane and proliferative changes in the form of basal cell hyperplasia, squamous metaplasia, dysplasia and micropapillomatosis. The ciliated cells showed numerous changes including cloudy swelling of mitochondria, vacuolization of cytoplasm, dilatation of rough endoplasmic reticulum, chromatin margination and many ciliary changes. Three forms of ciliated cells changes were identified: (1) desquamation of intact cells, (2) rupture of the apical cells membrane and (3) ciliocytophthoria. The goblet cells underwent massive secretion of their contents and the mode of secretion was changed from merocrine to apocrine. Later on, goblet cell hyperplasia occured. New cells (tunnel cells) were observed after formaldehyde exposure. The presence of many submucosal undifferentiated cells raises the possibility of fibrosis and permanent airway obstruction as sequelae of long term exposure. The similarity between the lesions produced by formaldehyde and the early lesions occuring during carcinogenesis raises the possibility of carcinogenic effect of formaldehyde.

Assessment of formaldehyde carcinogenicity, teratogenicity and its effect on different parts of the body deserves further studies which are planned to be done in our department in the future. According to our results, we recommend the stoppage or at least minimizing usage of formaldehyde and the use of other safer available methods e.g. plastination.

BIODUR E20 EPOXY RESIN INJECTION OF THE PRESERVED GREYHOUND

BorgR
Department of Veterinary Anatomy and Pathology, The University of Sydney, Sydney, Australia

Biodur E20 epoxy resin was developed by Dr Gunther von Hagens in Heidelberg, Germany. E20 epoxy resin is used primarily as an injection medium to highlight the vascular system of plastinated specimens but can also be used to manufacture high quality corrosion casts. A greyhound was anaesthetised and exsanguinated via a carotid cannula. A 10% buffered formalin solution was perfused at a pressure of 7 lbs with the aid of an embalming tank. Perfusion ceased at saturation point. The injection of E20 resin was commenced approximately 12 to 24 hours after the completion of perfusion. Approximately 500 ml of red E20 epoxy resin was injected at a pressure of 5 lbs. Injection of E20 resin was judged to be complete when E20 resin was visible at the site of an incision made in a hindlimb footpad. The cadaver was sectioned into specimens prior to dissection. The final stage, plastination, was carried out according to the S10 procedure. The final result is a precise arterially injected anatomical teaching specimen.

COMPUTER PRESENTATION IN VASCULAR INJECTED SWINE HEART

DieskiV
Department of Anatomy, Veterinary Faculty Skopje, Republic of Macedonia

Using computer technique in education allows for a lot of data to be processed and presented in variety of ways. In this work we use scan photos from corrosion casts materials of the coronary circulation. Vascular injection materials of the left and the right coronary arteries are photographed and scanned on power point software. These specimens represent scientific examples, for anatomical study and comparative demonstrations. The technique is performed in ambient temperature by injecting liquid acrylic polymer (HH 772 Acrylic Casting and Embedding kit). The scans are adapted and presented in power point programs as slides. In this program, they are presented from different aspect for e.g. the anterior and the posterior side of the left and the right side of

the heart be seen separatly. On every single slide major branches of the right and the left coronary arteries and their anastomosis are marked.

For the presentation we need the following equipment: PC, CD-ROM and LCD projector (video beam). If this technique is implemented in the curriculum, the students would amass a computer-based collection of anatomical database. Generally speaking computers are more suited for this application than teaching materials like slides projectors, pictures or video tapes.

Computer-aided teaching programs are superior to other teaching programs due to the advantages that this media offers and should be used for the tasks such as animation, simulations, feedback, reference and searching, self-testing, revision, substitution for repetitive information given to small groups, etc.

PECULIARITIES OF THE BLOOD SUPPLY OF THE STERNOCLEIDOMASTOID MUSCLE DEMONSTRATED BY INJECTION OF COLOURED S-10

Sora MC[1], Kierner AC[1], Burian M[2]
^Department of Anatomy 2, Institute of Anatomy, University of Vienna, Austria
[2]Department of Otorhinolaryngology, University Hospital Vienna, Austria

Although the use of the sternocleidomastoid (SCM) muscle flap has a long tradition in plastic and reconstructive surgery of the head and neck the reliability of this technique is still doubted by some authors. This might at least partly be due to the fact that data dealing with the exact blood supply of this muscle are rare and confusing. In our last work we could show that the occipital, external carotid and suprascapular arteries send one or more branches into the SCM muscle. Yet, how much each of these arteries contributes to the blood supply of the whole SCM muscle remained to be determined. In 5 individuals who had donated their bodies to the Institute of Anatomy the occipital, external carotid and subclavian arteries were dissected free on both sides leaving the skin of the neck intact. After injection of three differently coloured mixtures of Silicon (S-10 Biodur) and Pintasol (Sandoz) into these three vessels the muscles were taken away together with a piece of the clavicle and sternum. Then they were made translucent using the Spalteholtz-technique. All muscles investigated were supplied by a branch of the suprascapular artery and one or two branches arising from the external carotid artery. In contradiction to common opinion among surgeons the occipital artery turned out to be the least important vessel for the blood supply of the SCM muscle. The findings presented suggest that more emphasis should be layed on the identification of the branches arising from the external carotid artery in order to further minimize the risk of flap necrosis. If the flap is based cranially and only one head of the muscle is shifted in the anterior region of the neck the branch arising from the suprascapular artery should be identified as well. Baring in mind these anatomical peculiarities the SCM muscle flap in our opinion represents a practicable and reliable alternative for plastic and reconstructive surgery of the head and neck.

PLASTINATION OF CAVIAR FISH WITH S10 TECHNIQUE IN IRAN: FIRST TRIALS

Asadi MH
Iran University of Medical Sciences and Baghiatollah University, Tehran, Iran

In this paper, the complete procedure for caviar fish plastination with S10 will be stated. Fishes (weight 350-3000 g) were fixed in 5% formaldehyde. For dehydration, acetone at -25°C was used. Then, the fishes were immerged in a mixture of S10/S3 (100:1) for 24 hours. During the forced impregnation step, specimens were placed under vacuum at -25°C and pressure was decreased slowly down to 5 mm of Hg. Curing was done in two stages. In the precuring stage, the excess polymer was drained from the specimens surfaces and they were placed in an oven at 40°C for two days. In the gas curing stage, they were exposed to S6 vapors for 3 days at normal room temperature.

Compared with other techniques, such as taxidermy, plastination provided a better specimen. Due to the forced impregnation bath, the size of the specimens can be varied. One of its advantage is that we can plastinate the whole bodies of the fishes while retaining all the inner parts even viscera.

PREPARATION OF SPECIMENS ACCORDING TO THE E12 SHEET PLASTINATION METHOD

Cook P[1], Barnett R[2]
1 Department of Anatomy with Radiology, School of Medicine, University of Auckland, Auckland, New Zealand
department of Anatomy and Structural Biology, Otago Medical School, Dundin, New Zealand

The E12 plastination technique is a unique means to achieve precise human sectional anatomical specimens which correlate well with radiographic imaging techniques such as Magnetic Resonance Imaging and Computed Tomography. Sections are smooth, semi-transparent, durable and offer an unusually clear degree of anatomical details not often seen in traditional wet specimens or with other plastination methods such as S10, PEM or P35.

Whole cadavers or regions are cut into 2.5 mm thick sections. Sections are dehydrated, degreased and impregnated

according to standard plastination protocols.

Congruent overall thickness and finish is achieved by use of glass flat chambers. Impregnated sections are placed between two toughened glass plates which are secured with rubber gasket to prevent polymer leakage. The flat chamber is filled with epoxy polymer and catalyst enabling both surfaces of the encapsulated tissue section to be completely covered in curable polymer. Curing is initiated through low heat in a laboratory oven.

INFLUENCE OF FORMALDEHYDE/PHENOL FIXATION ON MRI OF THE KNEE AND CORRELATION WITH PLASTINATED SLICES

Entius CAC[1], van Rijn RR[2], Zwamborn AW[2], Kleinrensink GJ[1], Robben SGF[2]
Departments of Anatomy[1] and Radiology[2], Erasmus Medical Center, Rotterdam, The Netherlands

Introduction: At the department of anatomy, students are taught using, amongst others, plastinated tissue. Due to a relative shortage and associated bio-hazards of working with fresh cadaver material, it would be beneficiary if embalmed material could be used. However, it is unknown how embalming affects MRI acquisition and its correlation with plastinated slices.

Materials and Methods: A fresh knee joint, dissected two hand widths above the knee, was obtained within 48 hours after death. Before, during (after 4 days) and after embalming MR (Tl and T2 weighted) images, of the same region of interest, were obtained. The MR images were later compared with sagittal plastinated slices.

Results: After embalming a distinct difference was visible on MR images. The contrast between different structures decreased due to a homogenisation of signal intensity.

Discussion: Although the quality of the MR images deteriorated as a result of embalming, it was still possible to evaluate the gross anatomical structures. Correlation with plastinated slices was also possible. Our results suggest that embalmed material can be used in correlation studies and for educational purposes. Although, further research into the effect of embalming on microstructures is necessary.

PLASTINATION AS TEACHING ASSISTANCE FOR PARAMEDICAL STUDENTS

Taguchi M
Department of Anatomy, School of Allied Health Sciences, Kitasato University, Japan

In the anatomical classroom, real human specimens are indispensable. However, in Japan, it is only the medical or dental school students who can have an anatomy education with dissecting real human bodies.

Therefore our students, in other paramedical courses, have dissected foetal pigs being sold on the market instead of dissecting real human bodies. They have to learn the differences between human body standing on the two feet and pig, a four-legged animal, moreover adult body structures and foetal ones. The foetal pig is about 20cm long (from the head to the hip), structures are very small, consequently students often destroy delicate structures such as the nervous system.

We prepared plastinated foetal pig bodies of some patterns, e.g. showing the nervous system, the muscle system and the abdominal viscera, the students who have failed to dissect delicate structures observe their specimens to understand what they have failed to do. And plastinated specimens help the students to get knowledge for the details of dissection.

PLASTINATION OF FISH AND LOBSTERS

Schaap CJ
Department of Anatomy and Physiology, Atlantic Veterinary College, University of P.E.I., Charlottetown, Prince Edward Island, Canada

Both fish skin and the exoskeleton of the lobster are relatively impermeable. Plastination depends on the ability of formalin, acetone and polymer to move into the specimen and reach an equilibrium between the specimen and it's environment. Mechanical means have been used with success to make the fish skin and lobster exoskeleton more permeable: a fine gauge needle is used to prick holes into fish skin; a midventral incision in larger fish exposes the abdominal contents; small scalpel incisions are made into the soft tissue between joints in the lobster exoskeleton; small holes are drilled into the ends of the large lobster claws. To minimize shrinkage around the eyes some 20 % formalin is injected into the eye sockets. Following these initial mechanical disruptions standard S10 techniques is used. Fixatives include 5 to 10 % formalin or Klotz solution gradually made up to 6% over a period of several days. Dehydration occurs via freeze substitution in acetone. A relatively fresh and hence low viscosity S10/S3 solution is used for impregnation. Initial impregnation occurs at room temperature and atmospheric pressure (24 to 48 hours). This is followed by standard forced impregnation at -20°C and gas curing at room temperature. Swim bladders and cysts can be filled with S10/S3 supplemented with 2% S6. This will cure rapidly, maintaining the shape of the swim bladder or cyst. A variety of fish have been plastinated in this way as have whole and medially sectioned lobsters. The mechanical disruptions have minimal cosmetic effects on the final product and in fish minimize shrinkage in the susceptible areas (tail and back near dorsal fin).

MACROSCOPIC INTERPRETATION OF HORSE HEAD SECTIONAL ANATOMY USING PLASTINATED S10 SECTIONS

Latorre R, Vazquez JM, Gil F, Ramirez G, Lopez-Albors O, Arencibia A, Moreno F
Departamento de Anatomia y Embriologia, Facultad de Veterinaria, Universidad de Murcia, Murcia, Spain.

Twenty four transversal sections of a horse head were plastinated in 1992 according to the standard S-10 technique in the Veterinary Anatomy laboratories, Murcia University, Spain. The sections, 1 cm thickness, lied from the first cervical vertebra to the medial angle of the eye. Students are using them in the practical lessons with high didactic success. Despite of six years of intensive use the quality of the material and differentiation of the anatomical structures is maximum. This fact let us give to undergraduate students and veterinary professionals a clear and accurate overview of the extension, limits and relationships of anatomical complex structures as the guttural pouchs, vascular supplies, pharynx, larynx, vestibulocochlear organ, eye, etc. These sections are also used to correlated sectional anatomy with modern diagnostic imaging techniques such as radiology, CT and MRI.

POLYMER PRESERVATION TECHNOLOGY: POLY-CUR. A NEXT GENERATION PROCESS FOR BIOLOGICAL SPECIMEN PRESERVATION

Glover RA[1]* Henry RW[2'] Wade RS[3]
iDepartment of Anatomy and Cell Biology, The University of Michigan, Ann Arbor, Michigan, USA
[2]The University of Tennessee College of Veterinary Medicine, Knoxville, Tenessee, USA
[3] Anatomical Services Division, The University of Maryland, Baltimore, Maryland, USA

Since its introduction in the late 1970's, "Plastination" has been the only process available to individuals interested in permanent biological specimen preservation. And over the intervening 25+ years, in the hands of trained preparators, it has proved to be a highly successful process. Recently, chemists at Dow Corning Corporation, in conjunction with C. Wayne Smith at Texas A & M University, have developed an alternate technology for permanent biological specimen preservation. This next generation process, which they call, "Polymer Preservation Technology", offers preparators several unique advantages:

Specimens can be impregnated at room temperature thus eliminating the need for a low temperature freezer. This saves cost and lab floor space. In addition, processing specimens at warmer temperatures makes them less rigid and increases their flexibility.

Several different polymer, crosslinker, catalyst combinations are available. The combination choosen provides the preparator with a more precise way to control the degree of specimen firmness and flexibility.

The polymers used in the process are all relatively thin. This increase the rate and effectiveness of their tissue penetration and significantly reduces forced impregnation time. The end result is better, faster specimen processing.

The use of less viscous polymers enhances the impregnation of skin, tunica albuginea, sclera, etc.. This makes syringe injection of polymer unnecessary.

Specimens are impregnated with a polymer and crosslinker mixture which does not thicken at room temperature. This significantly increases the shelf life of any mixed polymer. Also specimens can be left out to drain indefenitely; and all the recovered polymer can be reused.

Specimen curing in initiated immediately by wipping with a thin layer of catalyst. Therefore, the constant wiping and attention given to specimens during this process is markedly reduced.

Specimens prepared using this new technology will be on display.

SURGICAL EXPOSURE OF THE NERVES OF THE LIMBES IN DOG

EI-Dein MAA
Department of Anatomy and Histology, Faculty of Veterinary Medicine, Assiut University, Assiut, Egypt

Twenty dogs were used in the present study to delineate the proper sites of exposure of the radial, median and ulnar nerves in the thoracic limb and tibial and fibular nerves in the pelvic limb.

The site, length, width and topographic relations of the subcutaneous parts of these nerves were perfectly described. The length and direction as well as the proper site of the incision were also determined. Blocking of the nerves at these sites was undertaken and the desensitized area for each was outlined. The specimens could be plastinated and preserved for teaching purposes.

PLASTINATION - UTILITY AND ADVANTAGES

Bordei P, Diescu D, Ulmeanu D
Faculty of Medicine, Constanta, Romania

The plastination, relatively recent procedure for preparation and preservation of internal organs or even whole body slices, represents a certain benefit for the anatomical study. In Romania, as in the greater majority of the Eastern European countries, the main preservation and preparation procedures are based on toxic fumes (formaline), with a well known toxic action over the human body.

The plastination, relatively less known and extremely

rare applied in our country, offers some certain, major advantages: nontoxic conservation method with a perfect visualization of the anatomical elements and preservation of their normal aspect; perfectly clean, dry and odorless, with an easy handling and without risk of damage of the anatomical samples. According to us, the major advantage is represented by the durability of the anatomical specimens, because, nowadays, the access to biological material (human bodies or organs) becomes more and more difficult.

Apparently a problem, is obvious that the cost is counterbalanced by the advantages.

ARTERIES AND VEINS OF THE HEART INJECTED WITH COLORED EPOXY RESIN (BIODUR E20)

Miklosova M
Department of Anatomy, Faculty of Medicine, Safarik University, Kosice, Slovak Republik

The diseases of the heart especially the myocardial infarct and the disorders of the vessel supply of the heart are one of the most expanded diseases in the world. Detailed knowledge of the vessel supply of the myocardium and it's disorders may lead to development of diagnostic and therapeutic procedures that will allow reduction of the mortality rate of such diseases. Modern plastination methods will contribute to understanding the origin and course of this category of diseases. Epoxy resin E 20 (Biodur, Germany) has been used for the injection of dye into arterial and venous vessel network of the heart. A twenty percent formalin solution was used for the primary fixation of the material. The coronary arteries were injected by the use of a blunt cannula. The heart veins were injected with blue dye through the coronary sinus via the vena cava. The mixture of blue Biodur E 20 (in 100 parts) with the hardener Biodur E 2 (in 45 parts) was used for one injection. A total of 85 ml was used for the artery injection. A five percent formalin solution used for fixation of the heart after the colouring of the vessels was applied at a temperature of 5°C. The demonstration of the arterial and venous network of the heart by using the above-mentioned method enables medical students to obtain detailed knowledge of the vessel perfusion supply of the heart. Contingent disorders and anomalies in the vessel network of the myocardium are demonstrated and thus anatomy is linked with other clinical subjects in the medical curriculum.

EARLY EMBRYONIC INVOLUTION OF THE CAMEL GALL BLADDER

Abdel-Moneim M
Department of Anatomy & Histology, Faculty of Veterinary Medicine, Assiut University, Assiut, Egypt

Camel foetuses at CVR length of 24, 25, 47, 53, 90, 131, 163 and 168 mm were collected from Cairo slaughter house, these ages represent the early stages of prenatal development. The primordia of gall bladder and cystic duct were detected at 24 mm CVR length as a pear-shaped primordia which differentiated from the caudal part of hepatic premordia. At 47 mm CVR length, the hepatic duct system showed higher rate of growth and clear signs of canalization, in contrast to the gall bladder and cystic duct primordia remained solid. Also there was a mesenchymal condensation along the hepatic ducts which represent the future smooth muscle coat but no such mesenchymal condensation was obseved around the solid gall bladder premordia. In embryo of 35, 73 and 90 mm CVR length the situation described above became more prominent and the size of the gall bladder premordia remained constant or even reduced. In 131 and 168 mm camel foetuses, the gall bladder premordia was no longer visible. Foetuses could be plastinated and preserved for teaching purposes.

THE COMBINED TEACHING AND RESEARCH POTENTIAL FOR THE E12 SHEET PLASTINATION TECHNIQUE

Barnett RJ, Dias GJ
Department of Anatomy and Structural Biology, University of Otago, Dunedin, New Zealand

The E12 technique for transparent body slices was initially introduced to this Department for the teaching of cross-sectional anatomy to second and third year medical students, the ophthalmology primary course and second year dental students. The slices are also used for interpretation, by comparison, of images obtained by sophisticated techniques such as M.R.I, and C.T. scans. A portion of a cadaver, sectioned transversely from the sternum to the top of the head, was at first processed using the E12 drainage method. After the introduction of the technique the potential also became evident for these same specimens to be used in areas of research that were in progress in the Department at that time. Three academic staff members undertaking different areas of research, but within the same anatomical region, have utilised these first slices and two of these staff members have since had additional specimens processed specifically for their areas of research. One of these research projects is now completed and has been accepted for publication.

An acknowledged disadvantage of the traditional lateral approach to dissection of the temporomandibular joint (TMJ) is that detailed observations of the deeper medial part of the joint become impossible. In this study the joint was approached from its inferior aspect, which allowed viewing of its deeper structures from a new perspective. A striking feature observed was the existence of a horizontal band of tissue consisting of striated muscle bundles interspersed with fibrous tissue, in the posteromedial aspect of the mandibular

condyle. This has not been described before.

Demonstration of this structure by direct photography is difficult because of the depth of its position and its relationship to the surrounding bony structures. To overcome this problem, it was decided to show the structure in tissue sections of the joint. Joint specimens were sectioned in different planes and it was found that horizontal sections showed this structure best. Tissue sections processed by the E12 sheet plastination technique were superior to plain cryosections in demonstrating this structure. In resin sections the presence of this muscle band could be demonstrated very clearly, together with its relationships to the joint structures. The resin sections also closely matched magnetic resonance images (MRI) of the joint which were utilised to confirm the presence of the muscle band. In conclusion, the resin sections contributed greatly to the confirmation of the presence of this previously undescribed muscle band.

THE CONTRIBUTION OF PLASTINATION TECHNIQUES TO NEUROANATOMY TEACHING

Jones GD, Barnett RJ
Department of Anatomy and Structural Biology, University of Otago, Dunedin, New Zealand.

Over recent years this Department has experienced considerable problems in obtaining fresh brain material for teaching. As a result, considerable efforts have been made to utilize to it's fullest extent the small amount of material available. A great deal of work has been focussed on developing and extending techniques for the plastination of brains. The major types of specimens plastinated have included whole brains, half brains, horizontal, coronal and sagital slices, and prosections. In this manner it has proved possible to demonstrate a wide range of relevant features including the meninges, sulci and gyri, ventricular system, cranial nerves, major fibre systems, deep nuclei, the hippocampal formation, and internal capsule.

Conventional plastination techniques, such as the S10 procedure, make available well preserved dry, odourless, and nontoxic tissue for handling and study, and this is exemplary when external features are being studied. However, in order to highlight internal features (such as the distinction between white and grey matter), the P40 method, using the Biodur polymer P40, has proved invaluable. The P40 method was designed to supersede the P35 technique which has a longer production time and is more expensive. Both the P35 and **P40** procedures offer comparable results and have proved of It enormous value for the study of slices of varying thickness. Our department is only undertaking the P40 technique which has proved excellent for the demonstration of very fine anatomical detail, thereby making it an indespensable addition to the range of plastinated techniques currently available in neuroanatomy.

ANATOMICAL SECTIONS OF THE HEART REPRESENTING VARIOUS ECHOCARDIOGRAPHY CURVES (PARASTERNAL POSITION)

Saleh M-NM
Department of Anatomy, Faculty of Medicine, Assiut University, Assiut, Egypt

A total number of 50 adult hearts was used in the present study. The hearts were fixed in 10% formalin. Embedding was done in gelatine. The hearts were sectioned in the presumed planes of the echocardiographic sections. The parasternal position is the most important transducer position because it allows visualization of the heart along all planes. There are four parasternal long axis views and six parasternal short axis views. For the purpose of identification and validation of these echocardiographic sections, anatomical sections were performed in the presumed planes of these echocardiographic sections and they were photographed with the same orientation as the ultrasound image.

However, comparing gelatine embedding with plastination we are in favour of the latter. Plastination needs no fluid fixative for preservation and so students can handle the specimens easily for demonstration and teaching. Furthermore, we faced difficulties in obtaining good sections through gelatine embedding but plastination can give good quality of sections.

PLASTINATION OF VASCULAR VARIATIONS: A CASE REPORT OF A SUBCLAVIAN-BICAROTID TRUNK AND A LEFT VERTEBRAL ARTERY ARISING DIRECTLY FROM THE AORTIC ARCH

Olry R, Grondin G, Hache G Universite du Quebec a Trois-Rivieres, Trois-Rivieres, Quebec, Canada

A very interesting vascular variation of the aortic arch was found on a 74 year-old man during the dissection course. The aortic arch gave rise to three branches: a subclavian-bicarotid trunk (from which arose both right and left common carotid arteries and the right subclavian artery), the left vertebral artery and finally the left subclavian artery (type F of Adachi, 1928). The specimen, including the aortic arch and the vertebral column, is currently kept in Kayserling's solution at room temperature before being further dissected for plastination (S10). The vertebral column was preserved so that the course of both vertebral arteries and especially through the foramina of the cervical transverse processes could be observed. This anomaly of the vertebral artery is supposed to be related to the persistance of the 4th or 5th intersegmental cervical artery (Bracard, 1983). The outstanding importance of all variations of the neck arteries for our students in chiropractic leads us to preserve this kind of vascular anomaly by the way of plastination.

PLASTINATION OF MUSCULAR VARIATIONS: A CASE REPORT OF STERNALIS MUSCLE

Grondin G, Olry R
Universite du Quebec a Trois-Rivieres, Trois-Rivieres, Quebec, Canada

An unilateral right sternalis muscle (type XI of Grisoli et al., 1951) was observed on a 45 year-old woman during the dissection course at our university. It was carefully dissected and the specimen, including the sternum, the first ribs with their cartilage, and part of pectoralis major was kept in Kayserling's solution at 4°C for 2 months. It was then dehydrated by freeze-substitution for 11 weeks, impregnated with S10 (6 weeks), and cured (fat-curing).

The sternalis muscle is an accessory muscle of the ventral surface of the thorax. It ascends usually from the lower costal cartilages and rectus sheath to blend with the sternocleidomastoid or attach to the upper sternum or costal cartilage. However, many variations have been described in the literature. Since its first report by Cabrol in 1604, a few hundred case reports of sternalis muscles have been published, but the embryological origin of this accessory muscle is still debated: extension of other muscles (rectus abdominis or its sheath, sternocleidomastoid, obliquus externus), equivalent to the pectoral cutaneous muscle of marsupial or to the anterior supracostal muscle, or part of pectoralis major. Though the sternalis muscle is not exceedingly rare, we decided to plastinate it, and to start a series of muscular anomalies for our museum of plastinated specimens. Every time we will find a sternalis muscle during the dissection course, it will be plastinated so that we could in the future compare these specimens, and try to understand the embryological development of this accessory muscle.

PLASTINATION TRAINING

At the last meeting of the Society, a point was brought in the new business under the name "PLASTINATION TRAINING". This resulted from a positive experience of sending a student from Trois-Rivieres to Graz for three months. We regularly receive requests from students how would be interested to learn more about plastination and participate to research on plastination, or to a research project where plastination is involved, in an overseas laboratory. We believe that some similar requests were also probably made in other laboratories.

After discussions, everybody aggreed that this kind of program would be good for the Society as it would contribute to give knowledge about the plastination technique to young students who would probably in the future participate to elaboration of new labs. It was suggested that a survey should be carried out on this subjects.

I would greatly appreciate your comments on the subject.

Did you have similar requests in the past?

Would you accept to receive in your lab a student for a period of 1 to 3 months?

Should these exchanges be undertaken on a one on one basis between the applicant and the plastination laboratory or should the Society be involved in this kind of program?

What should be the task of the Society in this kind of program?

Please send me your comments as soon as possible. The results of this survey will be published in the next issue of the Journal.

Thanks for your collaboration,

Gilles Grondin

University of Rochester School of Medicine & Dentistry
Multidisciplinary Labs & Plastination Lab
Present

SIXTH INTERIM CONFERENCE ON PLASTINATION

Sunday, July 11, 1999
Thru
Friday, July 16, 1999

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601 Elmwood Avenue
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Course Directors

Leon A. Metlay, M.D.
Associate Professor
Pathology & Lab Medicine

Cynthia A. Ryan
Technician
MDL & Plastination Lab

If interested in attending or receiving information on the call for abstract for either paper or poster presentations please contact:

University of Rochester Office of Continuing Professional Education
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Fax: 716-275-3721

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TENTH INTERNATIONAL CONFERENCE ON PLASTINATION

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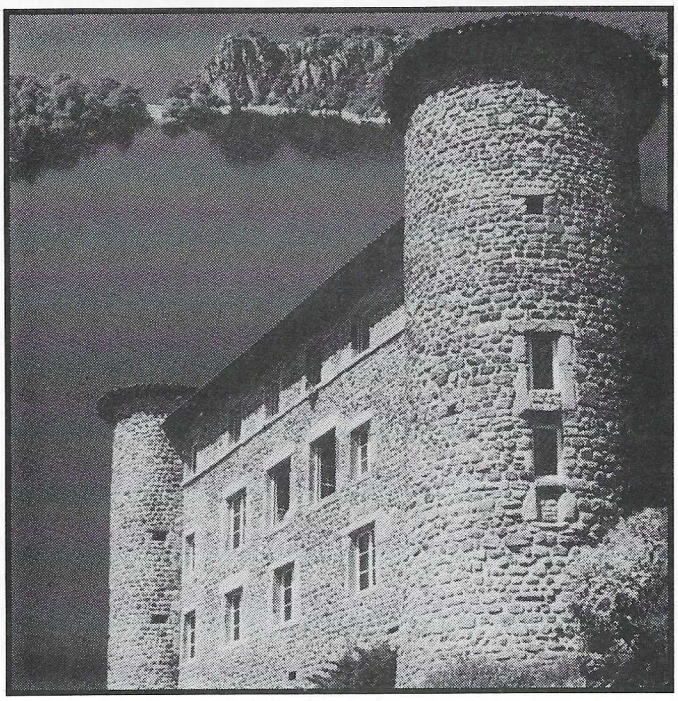

Saint-Etienne
FRANCE

Organization : **J.M. PRADES, Ch. MARTIN, M. DURAND**

Information :

Laboratoire d'Anatomie
Professeur J.M. PRADES
Faculté de Médecine J. Lisfranc
15, rue Ambroise Paré
42023 - SAINT-ETIENNE Cédex
FRANCE

Tél: 4 77 42 14 69
Fax: 4 77 42 14 68

email: marc.durand@univ-st-etienne.fr

INSTRUCTIONS TO AUTHORS

Aims

The Journal of the International Society for Plastination (ISSN 1090-2171) is an international forum for the diffusion of the plastination technique among scientists interested in preservation of biological specimens for teaching and research. The Journal permits communication of every new application or development of the plastination technique, as well as any other innovating complementary preservation technique, applicable to animal or plant specimens.

Submission

All manuscripts are subject to peer review. The acceptation of an article implies the transfer of the copyright from the authors to the publisher. It is the author's responsability to obtain permission to reproduce illustrations, tables, etc from other publications. The Journal will accept articles, brief communications as well as reviews. Editorials may also be accepted. They are generally invited, but unsolicited editorials will be considered. Letters may also be considered for publication if they are judged of general interest.

Format

Manuscripts should be written in English. They should be submitted in triplicate (with 2 sets of illustrations), typewritten double-spaced on one side of the paper with 2,5 cm margins. Lines should be numbered on the margin and all pages should be numbered.

Title Page

Title page should include title, the author's names and the institute where the work was conducted, and full address of the authors. Please, also supply Phone and Fax numbers, as well as e-mail address of the author to whom correspondence should be sent.

Key Words

For indexing purpose, provide a list of up to 5 keywords.

Abstract

Each paper needs an abstract of up to 20 lines, summarizing the essential new information communicated. Abbreviations and citations should be avoided in the abstract.

Subheadings

Each paper should include an

INTRODUCTION
MATERIALS AND METHODS
RESULTS
DISCUSSION OR CONCLUSION
BIBLIOGRAPHY

Numbers and abbreviations

Arabic numerals should be used wherever digits are needed except at the beginning of a sentence. Abbreviations of weights and measures as given in standard dictionaries are usually acceptable. Other abbreviations should be followed by an explanation (within parentheses) the first time they are mentioned.

Nomenclature

The nomenclature used should conform, wherever possible, to the current edition of the *Nomina Anatomica* or the *Nomina Anatomica Veterinaria.*

Tables and illustrations

Tables and illustrations (both numbered in Arabic numerals) must be cited in the text and should be prepared on separate sheets. Tables require a heading and illustrations a legend, also prepared on a separate sheet. They should be one column (8.4 cm) or two columns (18 cm) width. On the back of each illustration, indicate its number, the author's name, and "top". For the reproduction of illustrations, only good drawings and original photographs can be accepted.

References

References to published works, abstracts, personnal communication and books should be limited to what is relevant and necessary. Citations in the text should be given in parentheses; e.g., (Bickley et al., 1981; von Hagens, 1985; Henry and Hayes, 1989) except when the author's name is part of a sentence; e.g., "von Hagens (1985) reported that..." When references are made to more than one paper by the same author, published in the same year, designate them as a. b. c. etc.

Bibliography

The bibliography should include only the publications which are cited in the text. References should be listed alphabetically using abbreviated journal names according to the Index Medicus.

Examples are as follows:

Bickley HC, von Hagens G, Townsend FM: An improved method for preserving of teaching specimens. Arch Pathol Lab Med 105: 674-676, 1981.

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Correspondence

All correspondence should be addressed to the editor:

Gilles Grondin
Département de Chimie-Biologie
Université du Québec à Trois-Rivières
C.P. 500
Trois-Rivières, Qué.
CANADA
G9A 5H7
Tel: 819 376 5053
Fax: 819 376 5084
E-mail: gilles_grondin@uqtr.uquebec.ca