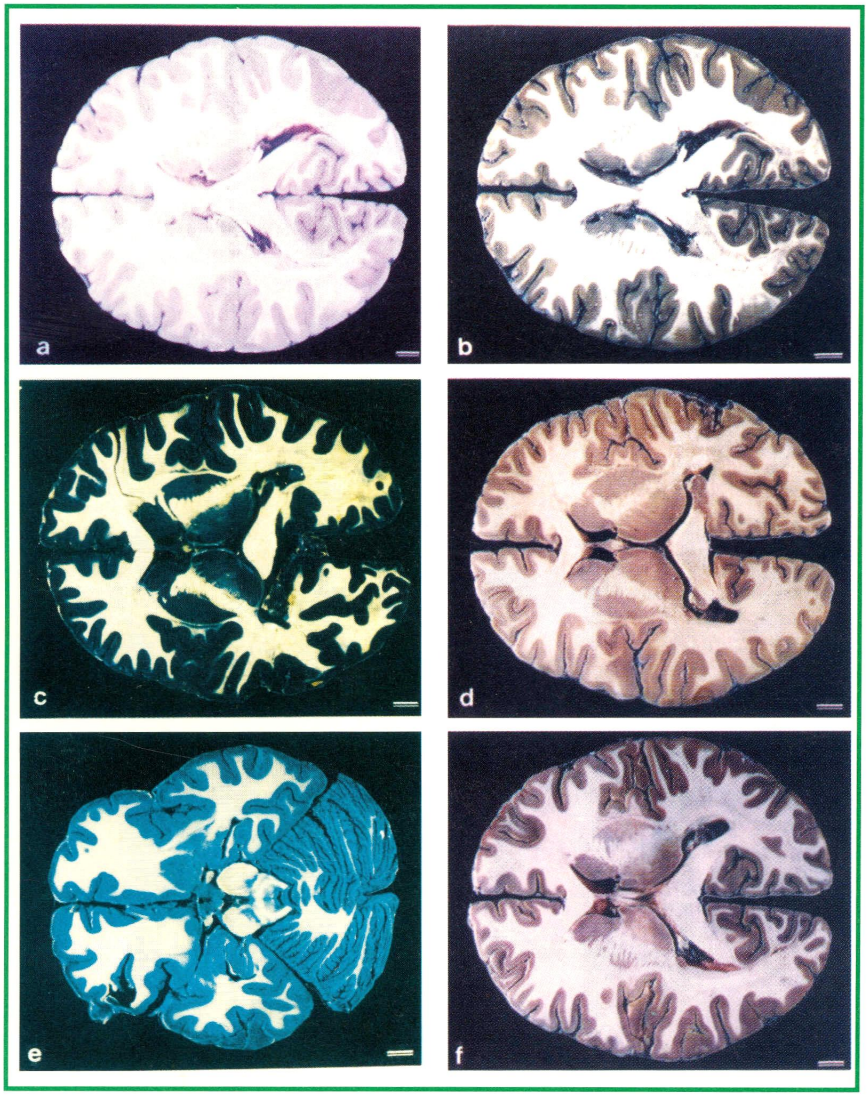
Journal of the INTERNATIONAL SOCIETY for PLASTINATION



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Editor's Note

Dear Readers,

It is indeed an honor for me to have been elected editor of the Journal of the International Society for Plastination. Our publication is now in its eleventh year and, as you can see, has undergone a few changes in its look and general arrangement.

For his invaluable advice concerning its publication, I am deeply indebted to Dr. Régis Olry. I also wish to thank my employer, l'Université du Québec à Trois-Rivières, and its audiovisual department for allowing me free access to needed equipment. Special thanks, too, to Mr. Jean-Pierre Côté for instructing me in the proper use of this equipment.

With the assistance of our editorial staff, I promise to make every effort to produce a journal that will satisfy the criteria for a scientific publication. To do this, however, the participation of writers in the field is essential, and I therefore invite each of you to submit discussion papers of your findings and ideas.

A quick glance at the *Current Plastination Index* shows there is still much room for innovation in the fields of application for the plastination technique. In his editorial, Professor Pieter Nel mentions many fields where plastination may be used in research. If each member of the Society were to write a paper every two or three years, there would be plenty of material for two or more issues of our journal each year.

On the first editorial page of the Journal (1,1, January 1987), Dr. Harmon Bickley wrote that most of the members of our Society expected the Journal to "emphasize practical information, equipment suggestions and a how-to-do-it approach to technique." Though much has been published on these topics since then, I feel we still have the responsibility to publicize any new technical procedure, however minor or seemingly trivial, that may facilitate work in the plastination laboratory and improve our specimens. For this reason, we welcome brief communications as well as full-length papers.

In the present issue, Dr. Régis Olry and Miss Kaoru Motomiya present the first paper in a series that will discuss the history of anatomical dissection and preservation techniques. Although it does not deal with plastination techniques as such, this historic series should prove of great general interest. Another paper by Mr. Peter Cook discusses security in the plastination laboratory, a topic of concern to everyone. The Journal also breaks new ground by publishing a first "Review" in the field of plastination, in which Dr. Bob Henry and his collaborators describe the various ways to prepare specimens before plastination with Silicone S10. These are only three of the excellent articles to be found in this issue.

Starting now, our publication will display colored pictures of plastinated specimens on its cover page. These will not necessarily correspond to the contents of the issue, and for this reason, I invite readers to submit colored pictures of their more notable plastinated specimens. The picture should be 5x7 inches (13x18 cm) in size and must be accompanied by a brief description of the specimen and the technique used to produce it. A picture bank will then be made for future reference.

Like the Society it represents, the Journal must continue to evolve. Accordingly, I invite our readers to send in any comments or suggestions they think would make our publication more responsive to their needs. There is room for more members on our editorial staff, so if you're interested, please be sure to let us know. Your task will be to review the papers we receive. You should have an E-mail address and/or FAX for rapid communication, and you must be able to review the paper within two weeks.

Finally, I wish to express my gratitude to members of our present staff for their truly remarkable work in preparing this issue.

Gilles Grondin
Editor

1) **nomination committee** (according to art. VIII/sec. 3 of the ISP-bylaws),

2) **journal committee** (VIII/ 4),

3) **conference planning committee** (VIII/5),

4) **alternative financing committee** (ad hoc committe established in 1994).

ad 1) The NOMINATION COMMITTEE (NC) shall be responsible for preparing nominations for the biennial meetings (next: July 1998, Trois-Rivières/Québec/Canada). I.e. in January 1998, prior to the meeting, the NC shall mail out to each member, a call for nominations. Each member may nominate one person for each executive office, and shall mail such nomination back to the NC no later than the end of April. The NC shall then prepare a slate of no more than three or no less than two names for each position according to the response of the members.

ad 2) The JOURNAL COMMITTEE (JC) shall assist the journal editor in reviewing all articles submitted for publication. It shall be their responsibility to ensure that such submissions meet with current standards for scientific journals.

ad 3) The CONFERENCE PLANNING COMMITTEE (CPC) shall be responsible for solicitation of possible future venues; establishment of a standard format for meetings; establish guidelines on financial aid to participants, - honorarium to speakers, - differential prices for members/ non-members, - distribution of profits, - financial backing of the ISP, - expenses of those with large displays; any other matters pertaining to the organization of the conferences.

ad 4) The ALTERNATIVE FINANCING COMMITTEE (AFC) shall be responsible for the acquisition of other financial resources, such as corporate advertisement etc.

Committee members should have Email or at least fax for easy communication.

Finally I want again to encourage you to participate in the business and activities of our society! Awaiting your response shortly!

Yours sincerely,

Andreas H. Weiglein
President.

Presidential Letter

Dear fellow plastinators,

We are looking back to a pleasant meeting in Brisbane where we met old and new friends. An excellent social program including a taste of kangaroo, crocodile and emu and a Waltzing Mathilda performance by Gunther von Hagens completed the interesting scientific program. With the typical Australian barbecue we said a farewell to each other. **Robbie Boyes**, **Peter Bore** and **Carol Lambert** did a very good job.

The New Zealanders **Peter Cook** and **Russell Barnett** managed the well attended pre-conference workshop, one of the best prepared plastination workshops ever. They also produced a video step-by-step instruction for all main techniques. It is now available from Peter Cook.

Brisbane was again a step forward for the International Society for Plastination:

• The official **LOGO** of the ISP was accepted and legalized.

• A " **PLASTINATOR'S HOMEPAGE** " has been set up at the Karl-Franzens-University of Graz. This WorldWideWeb page covers all the important things related to plastination and the ISP.

internet address:

http://www.kfunigraz.ac.at/anawww/plast/index.html

• A new important tool for looking up references on plastination was presented and distributed by Gilles Grondin and Régis Olry: The **CURRENT PLASTINATION INDEX**. An update of this excellent index is already in preparation.

• On the proposal of the treasurer, Ronn Wade, the membership DUES have been **reduced** to USD 75. for TWO (!!) years for ALL members. The FIRST YEAR of membership will be FREE OF CHARGE. - So please sign up for the ISP, pay your dues and get the new ISP journal, the Current Plastination Index and a price reduction on registration fees of future conferences and workshops.

• A new **EXECUTIVE COMMITTEE** that promised to maintain and improve the reputation of the ISP and to improve the Journal of the ISP to the best possible scientific standard was elected.

President: Andreas H. WEIGLEIN, Graz/Austria/Europe

Vice-President: Régis OLRY, Trois-Rivières/Québec/Canada

Secretary: Peter COOK, Auckland/New Zealand

Treasurer: Ronald S. WADE, Baltimore/Maryland/USA

Journal Editor: Gilles GRONDIN, Trois-Rivières/Québec/Canada

• **TROIS-RIVIERES/QUEBEC/CANADA** got the honor to host the 9th International Conference on Plastination in July 1998.

One of my ambitions for the future is to involve every ISP-member into the organization of the International Society for Plastination as far as possible and wanted.

One of my duties together with the other officers is to appoint several committees, or at least to replace or add some members to already existing committees.

Both my ambitions and my duties meet in this point: I want every ISP-member to consider if she/he will serve as a member of one or more of the following committees and apply for this/these position(s)- the members of each committee will than be appointed by the executive committee, i.e. the president, the vice-president, the secretary, the treasurer, and the journal editor:

MINUTES

FIFTH BIENNIAL MEETING OF THE INTERNATIONAL SOCIETY FOR PLASTINATION

Brisbane, Australia, July 16th 1996

I. Call to order, 3.20 pm

39 members (= 49% of active members) attended the meeting. The agenda was approved.

II. Reading and approval of the minutes of 1994 conference

The minutes were approved as read/ printed in ISP-Journal Vol. 9 (1). Motion: Alex Lane; seconded: Tage Kvist.

III. Reports of officers

President's report:

The president, Robert W. Henry, reported that a loan fund based on the profits of the Graz conference was set up as an opportunity to provide financing of early conference expenses prior to receipt of registration fees. The loan is to be paid back from congress receipts and it is hoped that some of that congresses profits will also be added to increase the loan fund balance.

Thank you Dr. Weiglein for your generous contribution from the Graz receipts.

The ISP logo was approved without changes and may be used in any color (Motion: Peter Nel, seconded Peter Cook).

G. Vawda suggested to have neck-ties and scarfs showing the logo.

The work of the officers as they completed their term of office and the host of the Brisbane-meeting were acknowledged per acclamation.

Treasurer's report:

The treasurer, Ronald S. Wade, reported that an accounting data base in 1994 was set up and that this database has been updated periodically since then. The treasurer's report was read and accepted (motion: Peter Nel, seconded: Régis Olry).

Peter Bore offered to cover the mailing costs for the journals to Australian and New Zealand members by the University of Queensland.

Ronn Wade made a motion to offer the first year of ISP membership for free, valid from the time of application. Peter Nel seconded the motion and the motion was carried unanimously.

IV. Reports of Committees

Report - Local Committee:

For the local committee Peter Bore reported that he appreciated that many registrants were on E-mail and that most registered early for the 8th Congress. He urged everyone to register for a meeting as early as possible. He reported that 58 people were registered and had paid for the conference and that the conference will certainly break even. Also, 17 had attended the precongress workshop on plastination.

Report - Membership Committee:

For the membership committee Ronn Wade made a motion to accept 11 new members. The motion was seconded by Alex Lane and carried unanimously. So from this point on the ISP had 90 members that paid their 1996 dues.

Robert Henry notified the membership-dues-correspondents: Canada: Gilles Grondin; Europe: Andreas Weiglein; China: Hong-Jim Sui; Australia and New Zealand: Robbie Boyes.

Report - Journal Committee:

For the journal committee Robert Henry reported that an editorial board consisting of at least 1 human anatomist, 1 vet. anatomist, and 1 pathologist was needed. Gilles Grondin suggested that the executive appoint editorial board members after an inquiry of the membership. Peter Bore stated that peer-reviewing was absolutely necessary. Gunther von Hagens mentioned that he would serve on the editorial board. It was unanimously accepted that the journal should be enhanced to the best possible scientific standards.

Report - Certificate of Plastination Committee:

For the CPC Wolfgang Weber reported the work of this committee. Ronn Wade asked: What is the need for this certificate? If it is needed for getting better positions is there

a need for applicants to be an ISP member? What will be the way that the certificate is given? Wolfgang Weber stated that it would be a way to recognize technicians for their good and hard work as well as enhance their status within the University.

Gunther von Hagens mentioned that he brought up the topic in Graz, because he is the Plastinator who is often asked to give recommendations as to one's expertise. However, he feels there are many qualified to evaluate the various plastination techniques. Robert Henry suggested to move the issuing of expertises to the Institute of Plastination in Heidelberg. Wolfgang Weber mentioned that the requirement for application would be a letter by Gunther von Hagens certifying the applicant's expertise. Gunther von Hagens mentioned that the applicant must show a continuing interest in plastination, i.e. to be also a member of the ISP. He certainly wants to participate in the issuing of expertises, however, together with the ISP. Non-performing plastinators should be excluded (Robert Henry).

Alex Lane made a motion to accept the work of the committee in principal, and to work on it further as a joint venture of ISP (represented by Wolfgang Weber) and the Institute of Plastination (represented by Gunther von Hagens). The motion was seconded by Russell Barnett and carried unanimously.

Report - Alternative financing for ISP committee:

Report missing because no member of this committee was present.

Report - Nominations Committee:

Robert Henry opened the discussion about changing the terms of officers to four years instead of two. Gilles Grondin spoke in favor, Ronn Wade against - because any officer could be elected again if he is wanted and if he wants to. It was unanimously accepted to keep the two year term for the officers and the four year term of the journal editor according to the bylaws. The problem of an assistant editor and editor was discussed. Finally Gilles Grondin made a motion to follow the bylaws and to elect an editor including Wayne Lyons as nominee and to omit the assistant-editor. The motion was seconded by Pieter Nel and accepted unanimously.

The following nominees for the officer's election introduced themselves as present or were introduced by Robert Henry if not present:

President:	Dale Ulmer, Andreas H. Weiglein
Vice-President:	Harmon Bickley, Régis Olry
Secretary:	Tage N. Kvist, Peter Cook
Treasurer:	Ronn Wade, Larry Janick
Editor:	Robin Belcher, Gilles Grondin Wayne Lyons

V. Host of next international conference 1998

Both, Baltimore, Maryland, USA and Trois-Rivières, Québec, Canada applied for the 9th International Conference on Plastination in July 1998.

Elections

Finally the results of the elections were read as following:

President:	Andreas H. Weiglein
Vice-President:	Régis Olry
Secretary:	Peter Cook
Treasurer:	Ronald S. Wade

(all for the 1996-1998 term)

Journal Editor: Gilles Grondin (for 1996-2000 term)

Trois-Rivières, Québec, Canada was elected to host the 9th International Conference on Plastination and the 6th Biennial Meeting of the ISP in July 1998.

VI. Old Business

VII. New Business

Andreas Weiglein announced the 14th Scientific Meeting of the AACA, to be held in Hawaii, July 9-12, 1997 hosted by Marita Nelson.

Ronn Wade suggested to collect the dues every other year in the odd number year payable before march, 30 and to reduce dues for every member to 75. USD. Peter Bore suggested the possible use of credit cards. Bill Wise made a motion to accept the 75. USD dues payment every odd year. The motion was seconded by Edward Crabill and carried unanimously.

Robert Henry suggested that the ISP should consider hosting the conference banquet in upcoming international conferences as a mechanism to promote the ISP. Peter Bore mentioned that it would be beneficial to assist with registration and accommodation fees and sponsoring invited speakers. This was discussed and Robert Henry suggested to have a short term committee to handle needs for registration. Bill Wise mentioned that the alternative financing committee should try to get the money to help the whole society in financial problems.

VIII. Adjournment 5.30 pm

Respectfully submitted,

Andreas H. Weiglein, M.D.
Secretary

Editorial

Research Applications of Plastination

Pieter P. C. Nel

Department of Anatomy and Cell Morphology, University of the Orange Free State, Bloemfontein, South Africa

The organizers of the recent conference on Plastination that was held in Brisbane, Australia during July of 1996, asked the author to deliver a paper on Research Applications of Plastination. The idea behind the request was to address something which several people have found to be a problem. That is the fact that plastination activity worldwide to date, has been predominantly either developments of a technique or preparation and use of specimens for educational uses.

In most places in the world, university staff have their performance assessed mainly on the basis of research output and when one is seeking grant support for one's activities, there are very few agencies which give grants for developing educational materials. This is certainly creating difficulties for plastinators all over the world.

The following paper was prepared and delivered with the above as prompt.

Chairperson, Ladies and Gentleman

I would like to start off by thanking Peter Bore and other organizers of this conference, for inviting me to deliver this paper.

As you all know, the process of Plastination has, since its inception, taken giant strides and have been applied in a variety of fields. It has been used in the field of teaching; it has been used to create examples for display purposes; the past week we have seen several new applications where the process of plastination is used; and of course plastination has been used as a tool in **research,** and not only as a tool in *teaching.*

If we look at the latter - In preparing this talk, I obtained as many publications on plastination as I could lay my hands on. I can recommend this to anyone. It makes excellent reading to see how wide plastination has been used, and how diverse the process can be applied when researchers set their mind to a problem.

I would like to list some of the papers in which the process of Plastination has been mentioned over the years. I hasten to say that this is by no means a complete list. It was compiled with the sole purpose of giving an overall view of the application of the process of plastination and should not be seen as a complete list of all publications that were ever published on plastination. At the time of preparation of this talk I was not yet in possession of a copy of the exellent work done by Gilles Grondin and R6gis Olry and which they published as the Current Plastination Index. If I had had a copy at the time, it would have made my job much easier.

I start off in 1987, not in an effort to degrade any earlier publications on plastination, but only due to the fact that I think a timespan of nine years covers enough publications to enable anyone to reach a conclusion on the diversity of application of plastination, especially in research.

Publications on plastination are as follows:

1987:

Bickley and his co-workers on the preservation of Pathology specimens for *teaching* purposes.

Sloka an Schilt on the utilization of the postmortem examination with emphasis on audiovisual aids for *teaching* purposes.

Cooper and co-workers on the preservation of dissected anatomical detail in the human temporal bone, a *teaching* use of plastination.

Address correspondence to: Prof. Pieter P. C. Nel, Head: Anatomy & Cell Morphology, Faculty of Medicine, The University of Orange Free State, PO Box 339, Bloemfontein 9300, Republic of South Africa. Telephone: 2751405 35557 Fax: 2751430 9282 Email: gnanppcn@med.uovs.ac.za

In this year von Hagens, Tiedemann and Kriz published a paper on the current (at that time) potential of plastination. In that paper they refer to (amongst others) where plastination was (up to then) used in the field **of research.**

1988:

Fritsch on developmental changes in the retrorectal region of the human fetus. **Research** use for plastination.

1989:

Müller and co-workers on plastination of breast cancer growths for *teaching* purposes.

Bachert and Ganzer on experimental studies done on the relationship between the maxillary sinus ventilation and various obstructions of the nose and nasopharynx. A **research** use of plastination.

1990:

Dawson and co-workers on the use of plastination in the *teaching* of Pathology.

Ulfig and Wuttke on plastinating stained sections of the human brain for *teaching* purposes.

1991:

Use of plastinated specimens in the *teaching* of Forensic Pathology, Odontology and Anthropology was the subject under discussion in two papers by Hawley and co-workers.

1992:

Pond and co-workers on preservation of tissues for use in Anatomy and Histology *teaching.*

1993:

Eckel and co-workers shed some light on a new approach to morphological **research** with excised larynges.

Fritsch published a paper on the development and organization of the pelvic connective tissue in the human fetus where plastination was used in **research.**

1994:

Brizzi and co-workers on the organization of subperitoneal connective tissue in the female pelvis. Plastination was used here as a **research** tool to determine the basic Anatomy and Histology.

Several papers on plastinated fetal elbow joints by Reidenbach and Schmidt. Plastination was here used for L purposes.

The same year produced a paper by Grondin, Grondin and Talbot on the use of plastinated specimens for light and electron microscopy. **Research.**

1995:

Fritsch and Hotzinger reported on the tomographical anatomy of the pelvis, visceral pelvic connective tissue and its compartments that they worked on while using plastination as a tool. **Research** use of plastination.

O'Sullivan and Mitchell on plastination for gross anatomy *teaching* (low cost equipment).

Reidenbach on using plastination for determining the normal topography of the conus elasticus in order to determine the anatomical bases for the spread of laryngeal cancer. Thus a **research** use for plastination.

Satyapal also used the process of plastination in his study of the drainage patterns of the renal veins. **A research** use of plastination.

As can be seen from the few examples that I refer to here, the application of the process of plastination is very divers and covers a wide spectrum of applications, mostly of course in the field of medical *teaching.* This inevitably leads one to ask " ***Where and how else can the process of plastination be used as a tool ? "***

As we all know, it is very difficult to obtain money nowadays for anything else but for research. To me it therefore seems of utmost importance that the application of plastination as a **research tool** must be developed further.

In order to make this happen, the time is ripe to give structure to plastination as a separate field of research on its own.

We need to obtain answers to the following questions in as far as plastination is concerned:.

1. Which fields of research have up to now been uti lized? (e.g. Anatomical, Biological, Pathological, etc.).
2. What types of research is obtainable? (e,g. Basic, Developmental, Applied, etc.).
3. What are the possibilities of application of plastination in research?
4. What has been done up to now?
5. What research are we suppose to do?

Due to the fact that **research** has so many facets, it would be presumptuous of me to present a preconceived framework here today. In this respect it would be appropriate for a group of people, such as we are here today, (that is experts, not so experts, and users of plastination) to put our

minds together and come up with a development plan for research in the field of the use of plastination as a research tool.

I would therefore like to ask you to participate in small group discussions (think tanks) so that we can pool our thoughts on this issue.

All attendants at the conference were divided up into four groups and each group was asked to address the following and to come up with suggestions.

Questions 1 and 2 were included with the sole purpose of starting the thinking process going, and no answers were expected. Question 3 took up so much time that not a single group really got round to answering question 4. The answers to question 5 were combined with the answers to question 3 in the answers given by the rapporteurs.

WITHIN THE ALOTTED TIME, PLEASE DISCUSS THE FOLLOWING AND COME UP WITH SUGGESTIONS.

In as far as the use *of (the process of) plastination as a* **research** *tool is concerned:*

1. Which fields of research have up to now been uti lised? (Biological, Patholocical, etc.).
2. What types of research are obtainable? (Basic, De velopmental, etc.).
3. What are the possibilities of application of plastination in RESEARCH?
4. What has been done up to now?
5. Areas in which you would like to see plastination being used as a research tool.
6. What is the importance of the question of how and where can Plastination be used as a research tool?

POSSIBLE USE OF PLASTINATION IN RESEARCH:

The following suggestions regarding the possible use of the process of plastination in research, have been made by delegates at the International Conference on Plastination held in Brisbane, Australia during July 1996.

Delegates were of the opinion that the process of plastination can be a very useful tool in the following fields. During report back time each rapporteur gave some information on how their group actually thought that plastination could play a useful role in research. The following fields were identified as possible areas of application:

Anthropology
Archeological preservation
Developmental anatomy
- embryos: human and veterinary

Comparative analysis (study)
Developmental techniques - attachment of muscles
Degenerative Anatomy/Pathology
- muscular degeneration of prostate

Document preservation
Forensic science - soft tissue injuries
Geological research
Identification purposes for research
Lower back injury - sections can show disc injury
Orthopaedic research
- functional relationships
- changes in articular cartilage
- vascularisation of bone

Preservation of cells for later research
Preservation of textiles
Surgical research
Surgical techniques
Three dimensional reconstruction
- blood vessels of the brain

Transport of tissue for research
Trauma research
Variation of topography of organs
Volume analysis Water-proofing agent

It became quite clear that the process of plastination has the potential to be used in a very wide field of interest.

It is (and will become increasingly so) the responsibility of each and every plastinator to ensure that the process of plastination becomes known and is used in areas other than just Anatomy. The future (and survival) of plastination does not lie only in the bettering of the process itself, but will mainly be based on the use of the process in other fields of interest.

If we as plastinators do not become disciples for the use of plastination, the process itself will fall back into the category of being "just another means of preserving biological material" (as for instance the process of embalming has become).

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Specimen Preparation for Silicone Plastination

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Abstract

Specimen preparation is a very important step of the silicone plastination process, especially when using fresh tissue. If you plastinate specimens that have been poorly or inadequately prepared, the final product will be inferior no matter how well the specimen is impregnated with silicone. Minimal fixation may help assure a more natural looking specimen. Care must be taken to keep the specimen in its normal anatomical position. Loose portions of the specimen may be held in position with suture. Intravascular injection of colored silicone, gelatin, latex or epoxy may be used to highlight vessels. Hollow organs need to be flushed, cleaned, dilated and then fixed in a dilated position. Dilation of hollow organs will increase the flexibility of that organ by overcoming rigor. Intestinal specimens may be opened to remove ingest, sutured closed and then dilated. Ostia with strong sphincters must be held open with appropriate sized cannulas or tubing. All cut vessels of heart preparations must be closed by ligatures or inverted corks ligated in place, except for one vena cava and one pulmonary vein. These will have tubing ligated in place and used for dilating each side of the heart. The atrioventricular valves of the heart can be accentuated by holding them away from the chamber wall and semilunar valves enhanced by dilating with cotton or other packing materials. Joint capsules, distended and fixed with 20% formalin, aid in studying the internal anatomy of the joint. Plan the theme of the specimen and limit the focus of the specimen to fewer items especially musculoskeletal preparations. Holes drilled into the marrow cavity of long bones in less noticeable areas enhance defatting and prevent sticky/greasy specimens years later. Old long-term fixed brains whose white/gray differentiation has faded may be rejuvenated and made more useful by sectioning or prosecting and staining to highlight the gray matter. Specimens may be plastinated following histochemical studies for long term review or study. A pink color may be added to the surface of the specimen using Biodur stain in the last acetone bath. Dilation of hollow organs must occur during the curing process. Beautiful specimens do not just happen.

Introduction

When preserving biological specimens by any method, specimen preparation has always been a very important part of the preservation process. This is still the case when producing specimens to be preserved by the silicone plastination process, especially when using fresh tissue. If you plastinate specimens that have been poorly or inadequately prepared, the final product will be inferior no matter how well the specimen is impregnated with silicone.

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Discussion

Fixation

Specimens may be fixed prior to or after prosection. However, to minimize exposure to formalin vapors and to assure final specimen shape and desired position, fixation after prosection is desirable. A1-10 % formaldehyde solution may be used, as well as, other fixatives of your choice. Lower percentage formalin solutions may produce less bleaching of the specimen. However brains need to be fixed with a high (10-20) percent formalin for several months to prevent shrinkage during impregnation. Fixation is not always necessary for S10 plastination (von Hagens, 1985; Holladay, 1989). If tissue is not fixed, it may aid in preserving some of the natural specimen color. However, dehydration bleaches the specimen. Minimal fixation (low percentage and short time, 1-2 days) will yield a specimen which is more flexible and more natural looking. Fixation of hollow organs is necessary to maintain the shape and lumen of the

organ (figure 1). Logically, it is beneficial to keep the specimen in its normal anatomical position during fixation and the first dehydration bath.

Intravascular injection

Intravascular injection of silicone, gelatin, latex or epoxy may be used to highlight the vessels (Tiedemann, 1982; von Hagens, 1985; Oostrom, 1987; Oostrom and von Hagens, 1988; Riepertinger and Heuckendorf, 1993; Grondin and Olry, 1996). There are advantages for each of the above. Epoxy will fill even the smallest vessels; however it is brittle and will fracture when bent. To dilute the somewhat viscous epoxy mix and to extend its working time, up to 40% methyl ethyl ketone or acetone may be added. Where as, the others products remain flexible but may not reach the capillary bed. Occasionally, latex may remain tacky after impregnation. It should not be used with methylene chloride as it will swell up 2-3 times its volume and disrupt the surrounding architecture. To prevent E12 softening, E12 injected specimens should not be left in methylene chloride for more than a few hours of degreasing. By the addition of 0.3% each of two additional hardeners (S6 and S2), silicone mix (S10/S3) from your plastination kettle can be used to inject vessels. As well, 0.5% to 1% S2 alone or 3% SI alone may be added to the S10/ S3 mix and used for injection.

Dilation of hollow organs

In order to assure an adequate sized lumen, as well as proper shape, it is preferable to dilate all hollow organs. Dilation has to occur prior to fixation and needs to be maintained throughout the period of fixation. However, over dilation may distort the specimen as much as no dilation.

Hearts:

Several methods on dilation of the heart (Tiedemann and von Hagens, 1982; Henry, 1987; and Oostrom, 1987) have been described. To dilate the heart, it is necessary to close all cut vessels. However, an inflow to each side of the heart is required so that both sides of the heart can be dilated (figure 2). Obviously because of its comparatively thin wall, the right side of the heart requires less time and pressure to dilate than the left side does. Usually a dog or human heart takes 2-3 days to dilate the left ventricle. Key points are to cut the vessels of adequate length when the heart is removed. It is often easier to ligate and/or insert corks and tubing as the vessels of the heart are cut during removal. Blood and clots should be flushed from the heart prior to placement of the last cork into each side of the heart. If the vessels have been cut too short, there are ways to salvage the specimen (figure 2), but it may be difficult. The vessel may be sutured closed or if a vessel is too large, a cork or other round object can be sutured inside the vessel to occlude it. Even if the heart cannot be totally sealed, some degree of dilation may be accomplished. An important anatomical variation between animal and human hearts is while the human heart may only have 2 or 3 pulmonary veins to occlude, animals often have 4 to 6. Initially the heart may be gently dilated with tap water. A reservoir is preferable over hooking directly to the tap, as tap pressure may fluctuate to an ineffective low or dangerously high level. Neither of which is desirable and may damage the specimen. Once rigor has been overcome with hydrostatic pressure, the heart is ready for color injection followed by fixation under pressure. A recirculation pump is useful to return fixative back to the reservoir especially if' you are doing several specimens or if you have a leaky heart. Fixation by dilation should proceed for 1-5 days depending on the size of the heart. For example a human or dog heart is usually ready after 2 days. The atrioventricular (a-v) and semilunar (aortic or pulmonic) valves of the heart can be accentuated by holding them away from the chamber wall and dilating with cotton or other packing materials (Baptista and Conran, 1989) prior to fixation. However, the best time to expand and/or highlight valves is often after impregnation and during the curing process. At this time the aortic and pulmonic valves can be rounded to their closed state by placing small "balls" made from paper towels in their concave surface. A-v valves can be elevated away from the ventricular wall at the beginning of curing, by placing strips of paper towels between the ventricular wall and the a-v valve if windows have been cut to view the interior of the ventricles.

Occasionally, a prize or rare specimen may get damaged during initial specimen collection or preparation and the specimen cannot seemingly be dilated. However, a tear can be repaired by suturing or occluded using digital pressure until dilation or partial dilation is accomplished. Any number of items found around the laboratory can be used to stop leaks (figure 2).

Gastrointestinal organs:

Minimal fixation is important for maintaining shape of thinner walled hollow organs. Without such, the organ will collapse and often be distorted (figure 1).

Hollow organs need to be flushed, cleaned, dilated and then fixed in a dilated state. Dilation of hollow organs will increase the flexibility of that organ due to the thinner wall. Intestinal specimens may be opened to remove ingest and then sutured closed (Henry, 1990). If ostia are to remain patent, they must be held open using tubing or some cylindrical object (Janick, et al., 1996). Tubing works nicely because it will allow the dilating fluid into the next chamber. Dilation pressure should be carefully regulated. Over dilation will likely distort the anatomical presentation of the

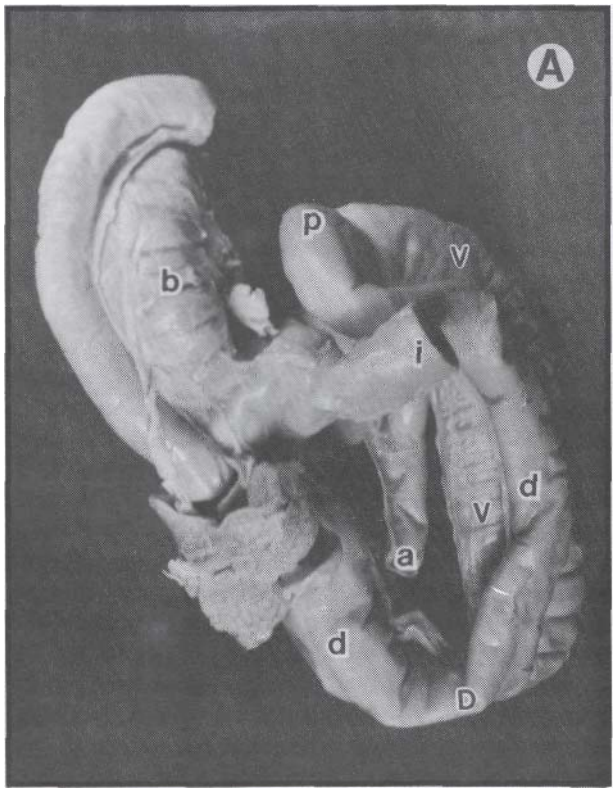

Figure la. Plastinated large intestines (ascending colon and cecum) from an equine foal (dorsal view). Dilation was carried out prior to and during fixation, as well as during curing. Note the relative normal anatomical appearance, a - apex of cecum, b - base of cecum, d - Dorsal colon, D - diaphragmatic flexure, i - ileum, p - pelvic flexure, V - ventral colon.

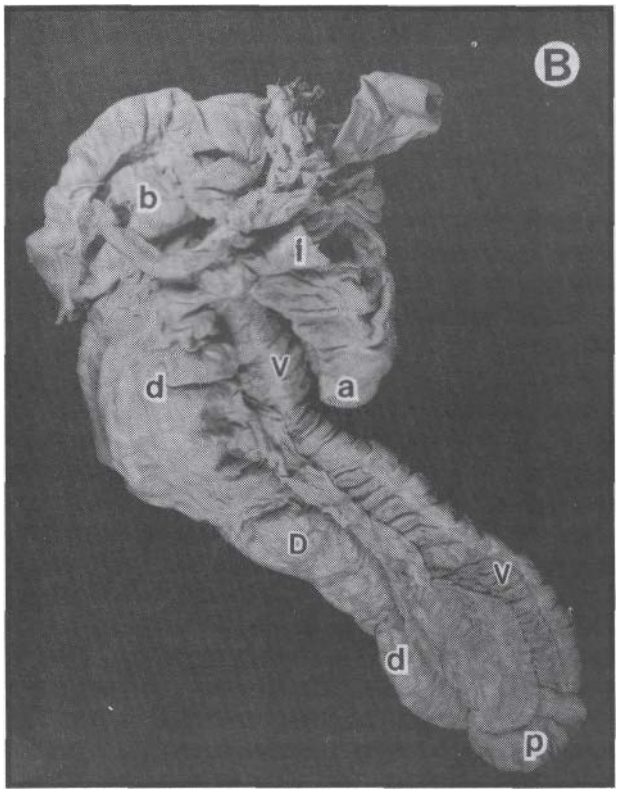

Figure Ib. Plastinated large intestines (ascending colon and cecum) from an equine foal (dorsal view). No dilation prior to or during fixation or during curing was performed, a - apex of cecum, b - base of cecum, d - Dorsal colon, D - diaphragmatic flexure, i - ileum, p - pelvic flexure, V - ventral colon.

tract with loss of interior architecture. A noted example is the loss of gastric mucosal folds, as well as, loss or distortion of the angular incisure of the minor curvature of the stomach and the cranial flexure of the duodenum. However, overdilation will overcome rigor, make the wall thinner and allow more flexibility of the specimen.

Lungs:

Lungs need to be dilated intratracheally to expand and conform them into a desired configuration. Excess blood should be flushed by alternatively filling the trachea with tap water and then allowing it to flow retrograde from the trachea. Only gentle pressure should be used to prevent rupture of the lung tissue. It is important to fix lung in a dilated state.

Female reproductive tracts:

Female reproductive tracts of large animals should be dilated to provide some flexibility. Except for the mare, most uteri are very difficult to dilate, probably because of the high content of smooth muscle. Introducing the dilatory fluid may be difficult because of a tightly closed cervix. Penetration of the cervix can be facilitated by inserting an insemination pipette through the cervix. Dilatory fluid simply may be placed through the wall of the uterus using a large gauge (14) needle. The vagina should also be dilated. Dilation is aided by suspending the reproductive tract by the vulva and simply filling the vagina and vestibule with the fixative.

Joint capsules:

Intact joint capsules may be distended with water and then fixed with 20% formalin to aid in studying the internal

anatomy of the joint and the extent of the joint space and capsule (Tiedemann, 1989). A principle that often applies to many specimens is to dilate the cavity with water first and then maintain that dilation with formalin injection.

Musculoskeletal specimens

Often specimens, especially musculoskeletal specimens, appear cluttered because too many items have been preserved. Plan the theme of the specimen and limit the focus of the specimen to fewer structures. It is beneficial to remove excess connective tissue and define muscle groups. Isolate and clear vessels and nerves of most loose connective tissue for best definition.

Osteology preparations

Osteology preparations or specimens with some bony portions should have holes drilled through their cortex and into the medulla to enhance defatting. This will help prevent sticky/greasy specimens years later which occurs if fat is retained. Holes may be carefully drilled in less noticeable places for esthetic purposes.

Color preservation

Color preservation is often a concern. Both fixation and dehydration bleach color from the specimen. Many things have been tried and reported to enhance color retention (Tiedemann, 1982; von Hagens, 1985; Holladay, 1989; Oostrom, 1987; Kessler, 1990). However, the inherent nature of fixation and dehydration maximizes color loss. Fortunately pink color may be added to the surface of the specimen in the last acetone bath using Biodur stain (von Hagens, 1985). However, only the surface is stained by this product. Therefore, it is desirable to cut windows in hollow organs before staining. In highly vascular organs, especially hearts and placentas (Tiedemann, 1982; von Hagens, 1985; Oostrom, 1987; Oostrom and von Hagens, 1988), epoxy may be injected into the vascular system. The epoxy will flow into the small arteries and capillaries producing a brilliantly colored but firm specimen. However, epoxy is brittle and will fracture if bent. Hence if a flexible specimen is desired another intravascular coloring agent (silicone, gelatin or latex) may be desirable.

Brain

Long term fixed brain slices may be stained with Astra blue, aldehydefuchsin or Darrow red to highlight the gray matter even in faded long-term fixed brains (Ulfig, 1990). Whole or partial animal preparations which have been used to demonstrate histochemistry (localization of the enzyme acetylcholinesterase) may be plastinated for continued long-term study of these specimens (Feeback, et al., 1990). S10 brain slices may be produced by slicing well-fixed brains and then dehydrating, impregnating and curing these slices. However, these tend to warp or curl and often small pieces may be lost if they are not held firmly between grids. A better method is to impregnate a well-fixed brain. Saw slices after S10 impregnation and long term curing. This method enhances white/gray differentiation (Weiglein, 1995), produces durable specimens and eliminates the possibility of lost pieces. To further protect these specimens, they can be embedded in epoxy using the flat chamber method (Weber and Henry, 1993). This process is in the experimental stages, but the initial results look favorable.

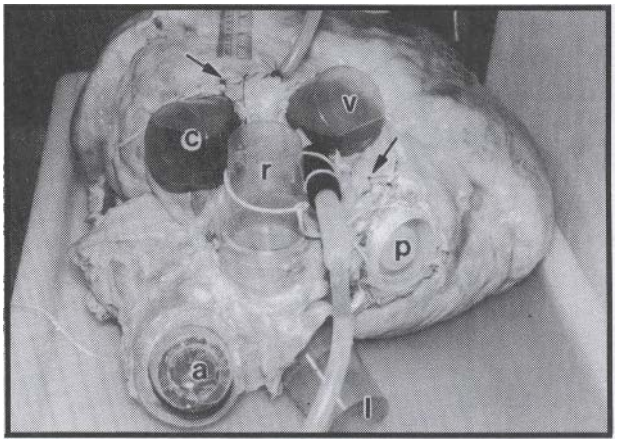

Figure 2. Preparation for plastination of a heart from a mature white rhinoceros. The heart had been lacerated both externally and internally and the great vessels had been cut extremely short. Defects were sutured (arrows). Since vessels were much larger than our largest corks and many vessels had been destroyed or cut too close to the heart, vessels were occluded using inverted laboratory cups and a barrel cap (bung), a - aortic arch, c - cranial vena cava, 1 - left pulmonary artery, r - right pulmonary artery, v - caudal vena cava, p - hole in the dorsum of left atrium where pulmonary veins had been cut and torn off. Large tube is in a pulmonary vein. Small tube is through a laceration of the right atrium.

Dehydration

It may be beneficial to dilate the organ in freezing acetone as the initial exposure to acetone. This freezes the organ in a dilated state and assures maximal dilation of the organ later on in the plastination process. Use caution when the organ is nearly full of cold freezing acetone, the frozen organ will not expand further and acetone may spray from the organ when it is full.

Curing

It is important to cure hollow organs in a dilated state (figure la), otherwise they may be nearly worthless (figure Ib) or have diminished value. Controlled laboratory air is a convenient method to dilate impregnated specimens. First the air is allowed to flow through the impregnated organ for several days to blow the excess polymer from the lumen of the hollow organ. After polymer flow has essentially ceased, a small amount (5-10 ml) of the curing agent (S6) is placed in a flask which has an inlet and outlet. The flask is placed in line between the air source and the specimen. The air flow is adjusted to dilate the impregnated specimen to its desired size. Upon commencing the use of S6, the out flow of the air from the specimen should be limited so that a low volume of air is passing through the S6 such that it is volatilized as slow as possible but yet keep the specimen dilated. This simply exposes the impregnated silicone to that volume of S6 for the maximal period of time and conserves S6. The air is allowed to continue to pass through the system and organ to keep the organ dilated. More S6 can be added later in the day and on subsequent days as desired until the polymer is cured and the organ maintains its shape when air pressure is discontinued. Excess polymer must be wiped from the organ several times the first day or two to minimize accumulation of polymerized silicone on the surface of the organ. It is helpful to enclose the specimen (a plastic bag works) during curing with dilation.

Using many of the above principals and procedures will insure that a useful and beautiful specimen will result.

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Baroque Anatomy Masterpieces as Models for Plastinated Specimens

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Abstract

The collaboration of artists and anatomists marked the evolution of anatomical illustration, and is a liaison which dates back as far as the sixteenth century. The most striking anatomical masterpieces were drawn and engraved as illustrations in noteworthy books, but could unfortunatelly not be preserved due to the lack of effective, long-term preservation methods. Plastination therefore finds in museography, potential new developments, and is capable of putting new life into the history of artistic anatomy. This process can exhibit three-dimensional plastinated specimens which have been inspired by some of the most impressive plates of previous centuries.

Introduction

Plastination is the process accepted to be the most promising preservation method for educational use in anatomy and related fields. Numerous publications and conferences emphasized its exceptional potential for teaching anatomy (for review, see Grondin and Olry 1996). However, a three-dimensional plastinated specimen is first, a specimen which must be dissected. The pedagogic features rely more upon skillful dissection than on the plastination procedure itself. The evolution of the promise of plastination, therefore, reminds us of the history of anatomical illustrations. The talent of drawers and engravers was often the basis for the renown of the anatomists by whom they were employed. We, therefore, feel that the baroque anatomical masterpieces of previous centuries, should effectively serve as models for future plastinated specimens.

Pietro Betrettini da Cortona

Pietro Berrettini (1596-1669), usually known as Pietro da Cortona after his birthplace, was perhaps the most influential painter of the Italian Baroque movement (Norman 1986).

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His anatomical plates, most of them probably engraved by Luca Ciamberlano in 1618, were published over 100 years after their completion by the Italian surgeon Caetano Petrioli (Berrettini 1741). A second and final edition was published in 1788 by the Italian professor of medicine and philosophy, Francesco Petraglia (Berrettini 1788).

The twenty-seven plates dealt mainly with the muscular and peripheral nervous systems, but plates XXI-XXVI appear to have been added later and drawn by another artist (Duhme 1981). On plate XII of the 1741 edition (figure 1), a kneeling eviscerated body holds a medallion in his right hand depicting the anterior cervical region which displays the nerves of the tongue and vicinity. In his Jeft hand, is held a bone which replaced a piece of wood, seen in the original drawing (figure 2). The ribs were resected along the midaxillary lirle, so that the intercostal nerves became evident. Brachial and lumbosacral plexi are depicted, and some muscles of the upper and lower limbs were removed to demonstrate the course of median, ulnar and femoral nerves. Though the accuracy of some muscles could be questionned, numerous nervous rami could be traced to their respective muscular masses. The intercostobrachial nerve (Hyrtl 1873), can be seen on the left side of the specimen, but its origin cannot be accurately determined as the thorax interestingly posseses thirteen ribs.

Claude Nicolas Le Cat

Claude Nicolas Le Cat (1700-1768) could be regarded

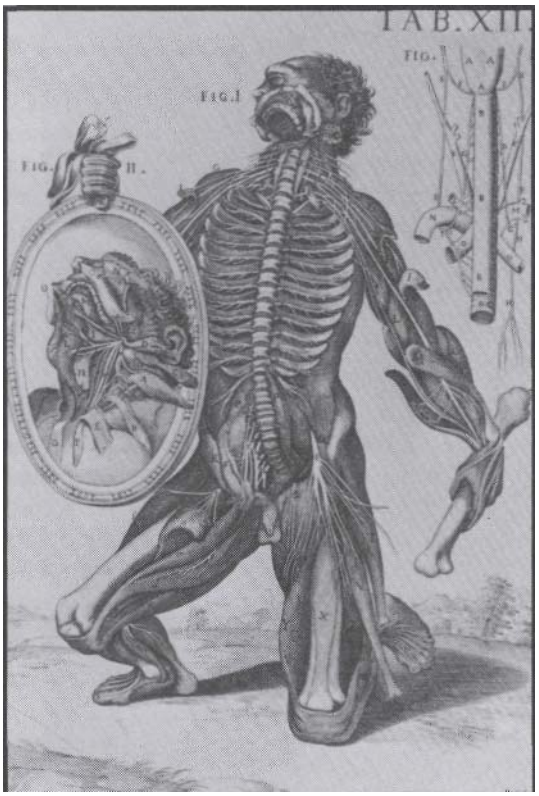

Figure 1. Berrettini's Plate XII, probably engraved by Luca Ciamberlano towards 1620 (taken from Norman 1986).

as one of the most extravagant ophthalmologists of the seventeenth century. Having once invited his fellow member "Chevalier" John Taylor (1703-1772) to dinner, he "served him a splendid lunch capped off with a covered dessert that turned out to be, when uncovered, a dissection of the nerves to the extraocular muscles which blatantly proved that they could not have been excised by Chevalier's method" (Rubin and Norman 1987). Le Cat's treatise (1740), part of a work in progress on physiology which never was completed, contains a very interesting view of the brain and nearby vascular, peripheral and autonomic nervous structures (figure 3). This plate, engraved by Herisset, exhibits the base of the brain, but the superior third of the face was preserved intact. The floor of the orbital cavities was removed so that the extraocular muscles and ciliary ganglia were revealed. Most of the cranial nerves are depicted, especially the trigeminal nerve, including the ophthalmic, maxillary and mandibular branches, and its voluminous ganglion. Surprisingly, the discovery of this ganglion is usually attributed to Gasser's pupil Anton Raymund Balthasar Hirsch in his study of the fifth cranial nerve published only twenty-five years later (Olry 1995). The superior cervical ganglia and many of their rami (including the internal carotid nerve) roughly compare to the description made by the celebrated Jacques B6nigne Winslow (Olry 1996). The main arterial trunks (internal carotid, external carotid, vertebral and basilar arteries) are present, and part of the course of the intracranial segment of the left internal carotid artery was severed so that both oculomotor and abducent nerves could be displayed.

Juan Valverde de Amusco

The Spanish anatomist Juan Valverde de Amusco (c.l525-c.l587) illustrated a book (1556) whose contents were derived from the Vesalian woodcuts (Choulant 1852; Roberts and Tomlinson 1992). However, his reputation as a plagiarist could be questionned as he corrected or improved many anatomical details in these plates (Guerra 1967). A plate, engraved by Nicolas Beatrizet after drawings by Caspar Beccera, is probably one of the most striking anatomical illustrations of the sixteenth century (figure 4). A

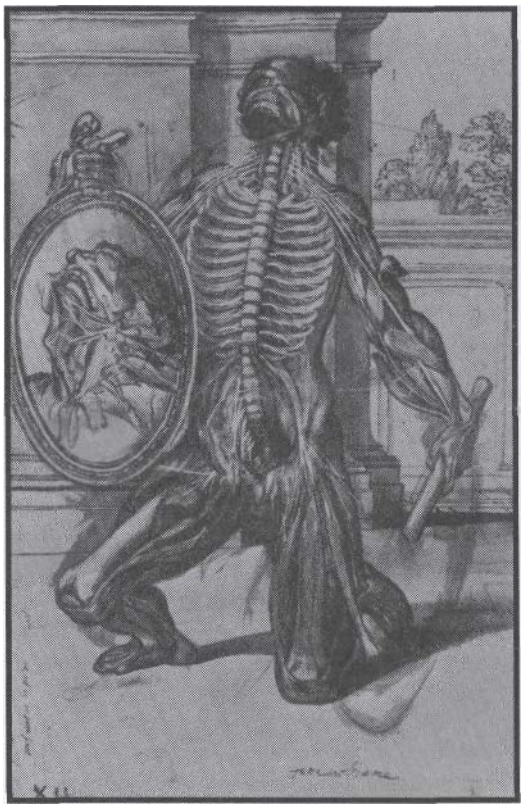

Figure 2. Original drawing for Berrettini's Plate XII, University of Glasgow Library, Hunterian Collection (taken from Norman 1986).

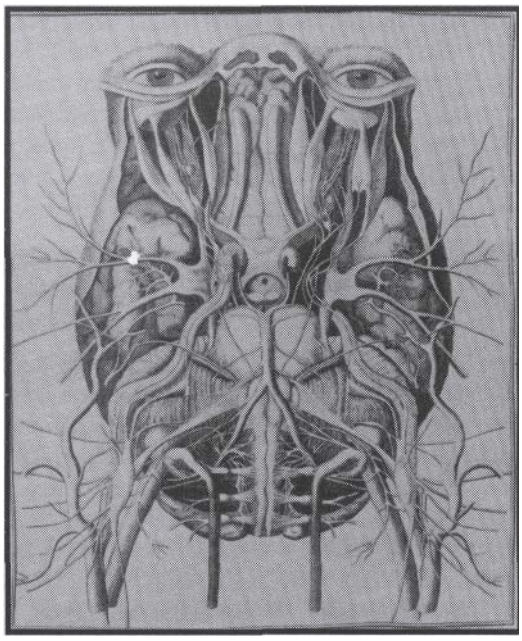

Figure 3. The brain and related structures in Le Cat's essay, engraved by Herisset (taken from Rubin and Norman 1987).

flayed man holds in his right hand, his own skin, and in his left hand a dagger which appears to have been used as the skinning knife. This plate resembles Vesale's plate XXVI, but the abdominal musculature is better depicted here. The other plates of Valverde's book also have a quite "surrealist" appearance: dissected torso clothed in armour, dissected man dissecting another man (in turn plagiarized by Jan Wouters in 1569), standing man, holding between his teeth, his own elevated abdominal wall so that the small intestine and greater omentum can be seen (Roberts and Tomlinson 1992).

Thomas Bartholin

Thomas Bartholin (1616-1680) descended from a renowned family of Danish anatomists (Bouchet and Picault 1956): his father Caspar Bartholin (1585-1629) was a professor of anatomy and rector of the Copenhagen University, and his uncle Ole Worm (1588-1654) is known as the discoverer of the so-called "wormian" or sutural bones (Olry 1994). For the 1655 revision of his father's classic anatomy text, Thomas Bartholin used a very surprising frontispiece, engraved by Jacob van Meurs (figure 5). The entire skin was removed from a body, except the head, hands and feet, which apparently still maintain their osseous skeleton, and the specimen (an "inside out" ecorche) was nailed to what appears to be a wooden frame. On the anterior aspect of the trunk was engraved the title of the book.

This strange frontispiece was introduced seventy years later in the Danzig edition of Johann Adam Kulm's famous handbook (Figure 6). It is noteworthy that the 1734 Dutch version of this book was one of the first Western medical texts translated into Japanese: Gempaku Sugita (1733-1817) and Ryotaku Maeno (1723-1803) edited the Japanese translation in 1774, and Sugita's pupil Gentaku Otsuki (1757-1827) published a revised and corrected edition in 1826 (Rubin 1991).

Discussion

Described in this article, are some of the most striking masterpieces of anatomical illustrations of previous centuries. Though some celebrated anatomists never wanted to acknowledge the necessity of including illustrations in their books (Jean Riolan, Xavier Bichat, etc...), most authors, as far back as the sixteenth century (for review, see Wolf-Heidegger and Cetto 1967), understood the importance of iconography. In order to increase the quality and the accu-

Figure 4. Valverde's «flayed man», engraved by Nicolas Beatrizet after drawings by Caspar Beccera (taken from Roberts and Tomlinson 1992).

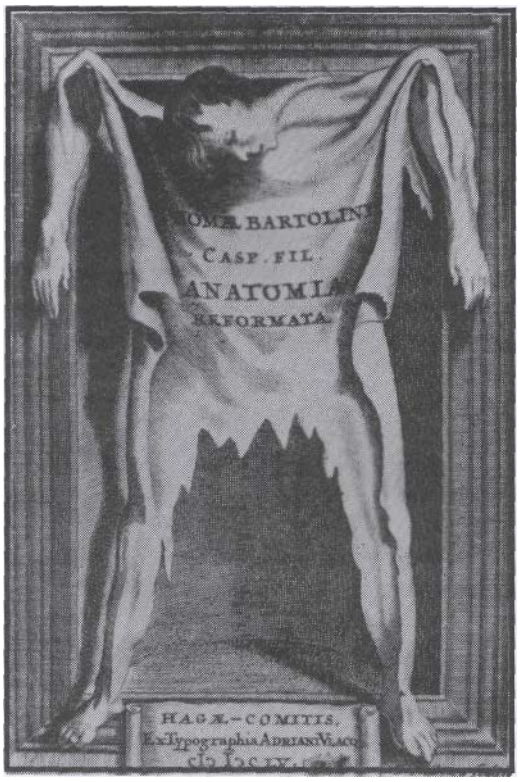

Figure 5. Frontispiece of Thomas Bartholin's treatise of 1655, engraved by Jacob van Meurs (taken from Norman 1982).

racy of their dissections, anatomists often employed the most renowned artists of their time whom they sometimes personally paid. Bernard Siegfried Albinus (1697-1770) expended twenty-four thousand florins for his illustrations (Corner 1964), and Jacques Gamelin (1739-1803) expended his own personal fortune for the publication of an atlas, which bankrupted him.

However, the successfull collaboration of Andre Vesale, an anatomist, and Joannes Stephan of Calcar, an illustrator (Titian's pupil), paved the way for a new trend in the history of anatomical illustration. Covert Bidloo (1649-1713) had his specimens drawn by the famous Gerard de Lairesse, artist of Prince of Orange Guillaume III; the frontispiece of Realdo Colombo's treatise was the work of the celebrated Venetian painter Paul Veronese; and the title page of Fran9ois Michel Disdier's masterpiece was drawn by Fran9ois Boucher, artist to the King of France, Louis XV.

The striking specimens described in this paper had been dissected by renowned anatomists and illustrated by no less renowned artists and engravers. Unfortunatelly, the lack of any effective preservatory methods doomed these masterpieces to a very short time span. Plastination, therefore, could prove to be the most recent development in the field of museography and breathe new life into the history of artistic anatomy, by preserving three-dimensional specimens inspired by the most celebrated anatomical plates of previous centuries.

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Figure 6. The same drawing introduced in Kulm's frontispiece of 1725 (taken from Wolf-Heidegger and Cetto 1967).

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A Shark Band Saw Blade Enhances the Quality of Cut in Preparation of Specimens for Plastination

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Words: Shark Band, Plastination, Bandsaw

Abstract

The popularity for use of band saws in preparing plastinated specimens has increased significantly over the past few years. This use has brought forth many modifications that have facilitated the production of even higher quality specimens. In this study, a Shark Band blade was evaluated and found to be superior over more commonly used (10 to 12 teeth per inch) blades. Trials were performed upon frozen tissues in preparation for S10 plastination, E12 sheet plastination, as well as for slicing cured S10 plastinated whole brains. The advantage of a Shark Band blade is, that by a reduction to only 3 teeth per inch, the creation and subsequent contamination of specimens by sawdust is significantly reduced. The minimal set and thickness (14 gauge / .014 inches) of the teeth and blade similarly promotes a smooth and very fine cut. The effects of this blade can be even further enhanced through an increase in the blades cutting speed. Unfortunately, the same design that facilitates the quality of the cut also greatly reduces the blade life. When cutting dense bone or enamel, the blade teeth are quickly dulled and taken out of set. This necessitates the replacement of the band after only a few cuts.

Introduction

A smooth flat surface on sliced anatomical specimens provides for greater clarity of detail and for an aesthetically more appealing end product. A handsaw is commonly used for cutting specimens. Several factors influence the quality of the cut. These factors include saw setup, blade setup, maintenance, and type of blade.

The saw must be set up properly with the blade perpendicular to the table and parallel to the fence. Blade guides should hold the blade in this position without distortion of the blade path. If possible, blade guides should be adjusted so there is no room for lateral blade movement within the blade guides. Some types of guides are not adjustable for lateral play and should be replaced as they wear. Most blade guides are adjustable for blade width. The front of the guide should be adjusted to the bottom of the blade gullet to prevent the guides from removing the set from the blade. On some saws, blade speed can be adjusted to match blade type. Faster blade speeds with the appropriate blade can maximize blade performance.

Proper placement of the blade on the machine helps to ensure the best possible cut. It should be centered on the pulley wheels so that it will run true. The pulley tires that cover the wheels should be clean and in good condition. Appropriate tension should be placed on the blade. Too much tension results in blade breakage and machine wear, while too little tension allows the blade to waver. Most owner manuals will have tension recommendations, but the best tension will depend on fixed characteristics, such as pulley diameter and blade length as well as variable factors, such as blade gauge (thickness), blade width, and type of material being cut.

Blade set produces a cut wider than the width of the back of the blade and prevents binding of the blade. The set of a blade is proportional to its thickness. The blades are set by bending the points of adjacent teeth in opposite directions out of the plane of the blade. The teeth points are bent

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so that the amount of material removed by the blade (kerf) is two to three times the blade width. A thinner blade requires less set and produces a smoother cut since the surfaces cut by adjacent teeth are closer to being in the same plane. Blade set is also important for making straight cuts. If the set is asymmetrical, the blade will tend to pull toward the side with the greatest amount of set.

Blades should be clean, sharp, and with appropriate set. Dull, dirty, or out of set blades will cause the blade to waver or bind. Dull blades or blades out of set can be reconditioned, but the cost is usually a substantial portion of a new blade cost. If material is sticking to the blade or it becomes greasy, blade performance will be diminished and the blade should be cleaned. Warm soapy water is generally sufficient to restore blade performance.

The type of blade is a major factor in the quality of the cut. Bimetal blades are commonly used. This type of blade has a soft metal back that helps reduce breakage as the blade is bent around the pulley wheels. Welded to this back are hardened teeth which stay sharp longer than the soft metal would. For most materials, wider blades and more teeth per inch produce smoother cuts. Narrow blades allow for tighter turns when cutting curved shapes. Tooth style can be standard, shark, or hook. Standard toothed blades have a triangular shaped tooth with a deep space (gullet) between each tooth. In shark tooth blades, the gullet is shallower. Hook tooth blades have a hook-like point that pulls the blade into the material.

Materials and Methods

The Shark Band blade (5/8 wide, 14 gauge, and 3 teeth per inch) (Holly Sales and Service, Craig Simms, 6310 Howard Lane, Elridge Industrial Park, Elkridge, Maryland, 21227, USA. Tel: 410 796 7474) and a commonly used blade (1/2 inch wide, 25 gauge, and 10 teeth per inch) (figure 1) were compared while preparing a whole human head for E12 sheet plastination. The head was frozen and sliced into sections approximately 2.5mm thick. Sections were then prepared for El2 plastination by removing sawdust, dehydrating and degreasing in acetone, impregnating the slices with E12 polymer, then casting the impregnated slices into a thin sheet of casting resin and cured (Weber and Henry, 1993). The final cured sections cut with each blade were then qualitatively evaluated for smoothness of cut and general appearance.

The Shark Band blade was also used to make other types of cuts commonly done in a plastination lab. A midsagittal section of a frozen fetal goat (figure 2) was sliced with the Shark Band blade and subsequently plastinated using the standard S10 technique (von Hagens, 1986). A whole equine brain that was plastinated using the S10 technique was sliced (figure 3) with the Shark Band blade after curing (Weiglein, 1996). These specimens were then qualitatively compared for smoothness of cut and general appearance with similar specimens previously prepared with the standard 10 tooth per inch blade.

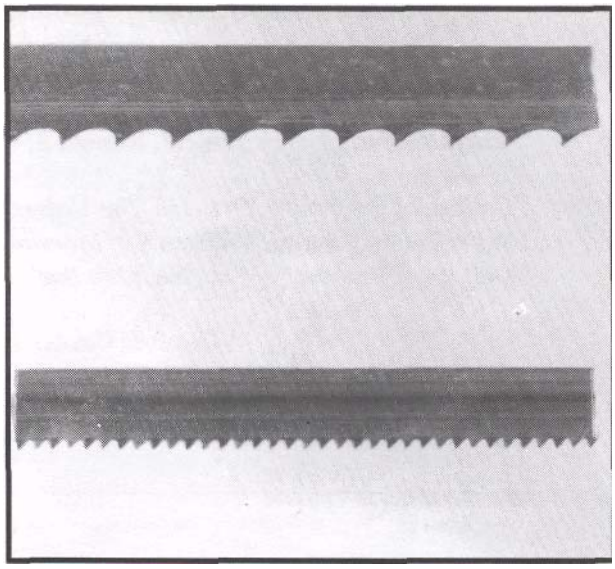

Figure 1. A Shark Band handsaw blade (top) in comparison to a standard 10 tooth/inch bandsaw blade (bottom).

The influence of blade speed on blade performance was also evaluated by qualitatively comparing the appearance of similar specimens cut at different blade speeds. The machine used did not have intrinsic speed adjustment, but adaptions were made which allowed for testing of different blade speeds. These adaptions could be implemented by either changing the saw motor or by changing the motor pulley diameter size.

Results

Cutting specimens with the Shark Band blade required less force on the specimen against the blade than the same cuts with a standard blade. The specimens cut with the Shark Band blade (figures 2-5) had less sawdust residue on the finished slices than specimens cut with the 10 teeth per inch blade. The surface of all specimens cut with the Shark Band blade had a smoother appearance than those cut with the other blade. Both frozen specimens and previously plastinated specimens consistently showed these results. Increasing blade speed with the Shark Band blade resulted in increased performance of this blade.

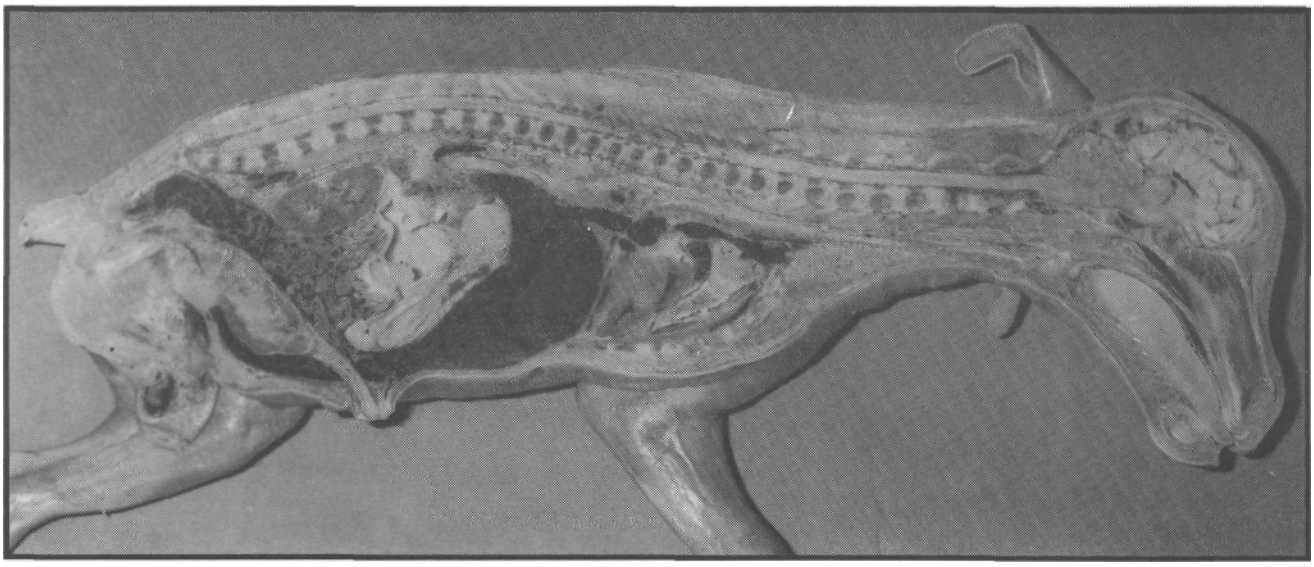

Figure 2. S10 Plastinated Fetal Goat sawed in half (before plastinating) using a Shark Band bandsaw blade.

With both blades, blade performance decreased with use as blades became dull and/ or lost set. More force was needed to feed the specimen into the blade and the ability to cut dense material may be lost. The blade was more likely to waver and cut at an angle to the direction of feed. These problems resulted in uneven or tapered slices. Performance loss was most evident when cutting dense bone or tooth enamel. This loss of performance was noticeably more rapid with the Shark Band blade than with the standard blade.

Discussion

The Shark Band blade produces a better quality of specimen than the standard blade. This improved quality of the cut is probably due to the thinness of the blade and to the increased length of the gullet. The length of the gullet is increased as the teeth per inch decrease. For many materials, an increase in teeth per inch produces a finer cut. For cutting anatomical specimens, this does not appear to be true. Sawdust produced when cutting frozen or plastinated anatomical specimens is often tacky and readily sticks to the blade. This can clog short gullets resulting in poor blade performance. The longer gullet of the Shark Band blade may remove the sawdust more readily and allow for a smoother, cleaner cut.

The set of a Shark Band blade may also play a role in its superior performance. The band is thinner than similar blades and is set narrower than other blades. This reduced set first reduces the overall amount of saw dust produced or, expressed in physical terms, reduces the work the blade has to perform doing the same cut. This, therefore, allows for both a faster blade speed and faster feed. In turn, the higher blade speed may help to more efficiently remove the saw dust. The reduced set likely contributes to the finer cut, while the narrow gauge likely reduces blade life.

In making anatomical preparations, the most important factors for smooth, clean cuts is a properly maintained and tuned bandsaw with clean, sharp and appropriately set blades. Choice of blade type also contributes to the quality of the preparation with the Shark Band blade providing a superior cut. This increased quality of the cut comes at the expense of reduced blade life as compared to more standard blades. Considering the cost and time involved in the preparation of plastinated specimens, the reduced blade life is a reasonable price for the increased quality of the specimens produced.

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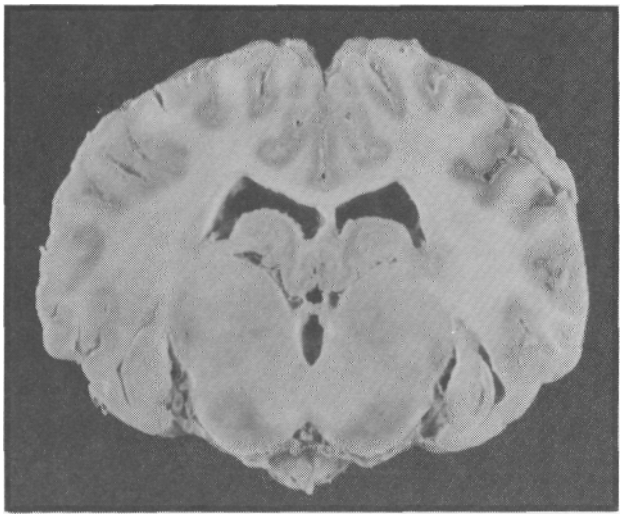

Figure 3. S10 Plastinated Equine brain sawed after being plastinated using a Shark Band handsaw blade.

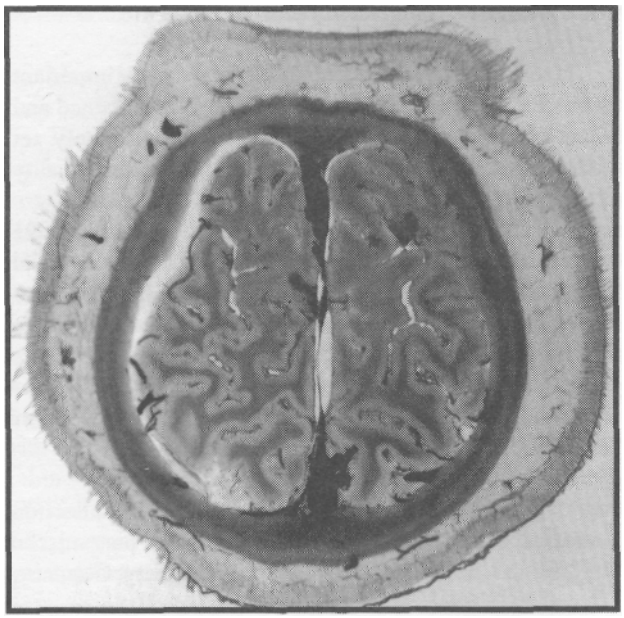

Figure 4. E12 Sheet Plastinated Horizontal slice of a human head sawed using a Shark Band bandsaw blade.

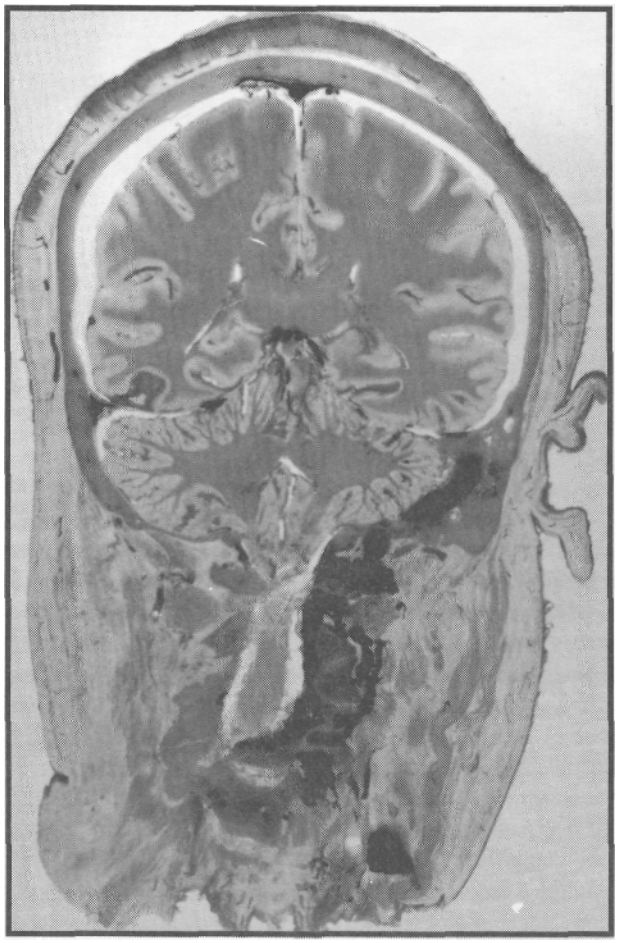

Figure 5. E12 Sheet Plastinated Coronal slice of a human head sawed using a Shark Band bandsaw blade.

Plastination of Stained Sections of the Human Brain: Comparison between Different Staining Methods

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Abstract

Human brain slices, 4-6 mm thick, were stained and plastinated. Five methods of staining were compared: Mulligan's, Le Masurier's, Roberta's, Braak's and Alston's methods. The gray matter stained grayish black, brilliant blue, reddish brown, bluish green and brickred, respectively. Shrinkage after staining was 2% in Braak's method and less than 1 % in the other methods. After plastination, the shrinkage was approximately 10% in all methods. Judging from staining cost, time spent and contrast between the gray and white matter, Alston's method was the best among the five studied. All stained, plastinated brain slices displayed anatomical details suitable for neuroanatomy study.

Introduction

Brain slices can be plastinated by both conventional P40 and S10 techniques (von Hagens, 1979; von Hagens, 1985/86; Ulfig and Wuttke, 1990). The disadvantage of the P40 technique, from our personal observation, is that the resultant semi-transparent plastinated brain slices require a light box to optimally visualize anatomical details. Brain slices plastinated by the S10 technique, however, require macroscopic staining to differentiate between the fiber tracts and neuronal components. When Ulfig and Wuttke (1990) stained brain slices with Astra blue followed by plastination, the finished product displayed good contrast between the fiber tracts and neuronal components, without using the light box. The latter specimens were also durable and convenient to handle. In the present study, brain slices were stained with different methods and plastinated using the S10 technique. The purpose was to find the most suitable method to prepare stained, plastinated brain slices for neuroanatomy instruction.

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Materials and Methods

Brain Specimens and Sectioning

Human brains were obtained at post-mortem from autopsy rooms at Chiengmai Hospital, Ramathibodi Hospital and Siriraj Hospital; all are associated with medical schools in Thailand. The patients died from non-neurological causes. The brains were fixed in 4% formalin for six months. Brains from 60 year-old or older subjects stain poorly (Roberts and Hanaway, 1969) and thus were excluded from this study.

The fixed brains were washed in running tap water overnight before being serially sectioned with a meet slicer. Brains were sectioned in three planes: coronal (4 mm), horizontal (6 mm) and sagittal (6 mm). The sections were laid on wet filter paper and stacked individually on stainless steel mesh trays. The trays containing series of brain sections were secured and the whole assembly was placed in 4% formalin solution for an additional eight hours, after which brain slices were washed with running tap water overnight before staining.

Staining

Five methods of staining were carried out as follows:

Mulligan's Method (Gregg, 1975)

A. 4 min in Mulligan's solution (40 g crystalline phenol, 5 g cupric sulfate, 1.25 ml 0.1N HC1 in 1 litre water) at 60-65 °C
B. 10 sec in ice water
C. I min in 0.4% tannic acid (W/V in water) at room temperature
D. 1 min in running tap water
E. 10-15 sec in 0,08% ferric ammonium sulfate at room temperature
F. 8 hr in running tap water

Le Masurier's Method or Prussian Blue Reaction's Method (Le Masurier, 1935)

A. 2 min in Mulligan's solution at 60-65 °C
B. 1 min in ice water
C. 2 min in 1% ferric chloride at room temperature
D. 5 min in running tap water
E. 3 min in 1% potassium ferrocyanide at room tempera ture
F. 8 hr in running tap water

Roberts's Method (Roberts and Hanaway, 1969)

A. 6 min in Mulligan's solution at 60-65 °C
B. 5 min in running tap water
C. 1 min in 2% potassium ferrocyanide at room tempera ture
D. 8 hr in running tap water

Braak's Method or Astra Blue's Method (Braak, 1978)

A. 1 hr shaking in performic acid (10 ml 30% H_2O_2 and 90 ml 100% formic acid) at room temperature
B. 1 hr in running tap water
C. 2 days shaking in Astra Blue t 0.1 g astra blue (Merk) and 1 ml 37% HC1 in 1 litre of water] at room tempera ture
C. 8 hr in running tap water

Alston's Method (Alston. 1981)

A. 20 min in Mulligan's solution at room temperature
B. 20 sec in xylene/polyclens* mixture (100:1 V/V) at room temperature
C. 10 sec in 2% sodium hydroxide at room temperature
D. 2 min in 2% potassium ferrocyanide at room tempera ture
E. 8 hr in running tap water

*Polyclens is a proprietary paint remover and also a powerful lipid solvent. It was purchased from Polycell Holding Ltd, Welwyn Garden City, Herts, UK.

The staining procedures in all methods, especially the Braak's method, were carried out in a ventilation hood. Formic acid used in the Braak's method produced offending fume that could be hazardous.

Plastination Procedure

Standard procedure for S10 plastination (von Hagens, 1985/86) was employed with slight modifications. The stained brain slices were dehydrated in 100% acetone at -25 °C for 2 days, with daily change of fresh acetone. The acetone:brain volume ratio was 10:1. The dehydrated specimens were immersed in S10/S3 (99:1 by volume) mixture in a plastination kettle for 2 days. Forced impregnation was started at the third day when the vacuum pump was turned on. Acetone bubbles were observed through the top glass-cover of the kettle and carefully adjusted; it took about two weeks to complete the impregnation step. Curing was accomplished by S6, with frequent wiping of the surface of the brain slices to prevent accumulated plastic on the surface.

Photographs were taken at each step after sectioning, after staining and after plastination, to calculate the degree of shrinkage following each step. A ruler was photographed with the brain slice at each step and two points of reference were selected from the photograph. A line was drawn between these two points and the degree of shrinkage was calculated by comparing the length of the line in the non-stained, stained and plastinated brain slices.

The plastinated brain slices were framed with two clear, rectangular, plastic plates, for protection and convenient handling.

Results

The finished brain slices are shown in figure 1. Comparison between colors, percent shrinkage, time spent and staining cost is shown in table 1. All considered, the Alston's method was the best since it gave good contrast between the fiber and neuronal components, required minimum staining time and was economic. The staining step caused slight shrinkage of the specimens. The Braak's method gave a slightly higher degree of shrinkage (2%) than the others (less than 1%). The shrinkage after plastination, approximately 10% in all methods, was more pronounced in the gray matter than in the white matter.

After plastination, the color was more intense and has remained stable for more than one year. After framing, the brain slices were convenient to handle and study (Figure 2). Their anatomical details including nerve tracts and nuclei were much clearer than fresh brain specimens. Total time

Table 1. Comparison among different methods of staining followed by plastination.

	Mulligan	Le Masurier	Roberts	Braak	Alston
Color of Gray Matter	grayish black	brilliant blue	reddish brown	bluish green	brick-red
Color of White Matter	white	white	white	white	white
Shrinkage After Staining (%)	0.6	0.7	0.6	2.0	0.4
Shrinkage After Plastination (%)	9ıo	9.0	8.2	10.0	8.0
Staining Time	7min	13min	12min	2 days	25min
Staining Cost per Slice (US$)	0.4	0.4	0.4	2.8	0.6

for plastination, excluding the fixation period, was approximately one month (table 2)

Discussion

This study suggests that Alston's method for brain slice staining is the best among the five being tried. Although contrast between the fiber and neuronal components were best achieved in the Braak's and Alston's methods, the later, however, was superior to the former in several aspects.

Firstly, the cost of staining in Alston's method was about 4.5 x less than that of the Braak's method (table 1). Secondly, several brain slices could be stained at the same time in the Alston's method; while only a few slices at a time could be stained in the Braak's method, that also required constant shaking. Thirdly, the staining solution of the Alston's method could be re-used, while that of the Braak's method could be used only once. Fourthly, the degree of shrinkage after staining, and also after plastination, was lower in Alston's method (table 1). And, finally, toxic fume of formic acid used in the Braak's method was a potential hazard even being performed in the ventilation hood.

The mechanism underlying the development of colors by the staining procedure is still controversial. Mainland (1928) and Blair et al. (1932) suggested that the color development was due to the difference between the texture of the gray and white matters and different penetrability of the chemicals into the brain tissues. The latter might be due to the fact that the white matter contains more lipid (myelin sheath) than the gray matter. By applying Mulligan's solution, phenol dissolved lipid materials of the white matter to produce a jelly coat covering its surface. If the white matter was damaged, the differentiation between the gray and white matter (the damaged areas) would not be distinct (Mainland, 1928; Blair et al., 1932). Good preservation of the brain is thus very important in order to reveal the anatomical details (Roberts and Hanaway, 1969). In Le Masurier's method, Sincke (1926) suggested that the color in Prussian blue reaction was developed from a chemical reaction between the

Table 2. Time used for all the methods

Fixation	> 6 months
Sectioning and Staining	3 days
Dehydration	5 days
Forced Impregnation	2 weeks
Curing	2 days
Framing	<1day
TOTAL	7 months

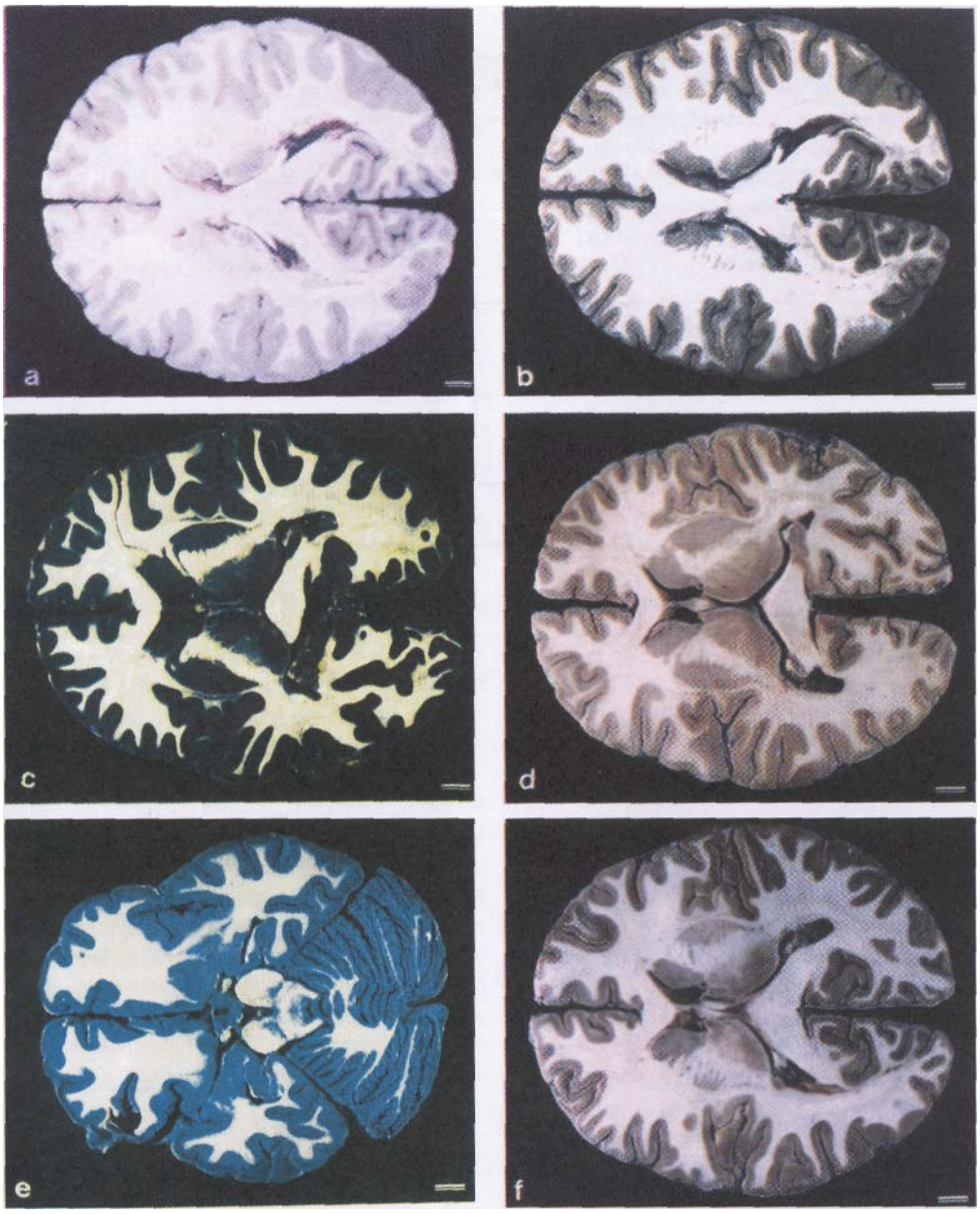

Figure 1. Comparison of plastinated brain slices, after staining with different methods, a - unstained brain section, b - Mulligan's method, c - Le Masurier's method, d - Roberts's method, e - Braak's method, f - Alston's method. Bar = 1 cm.

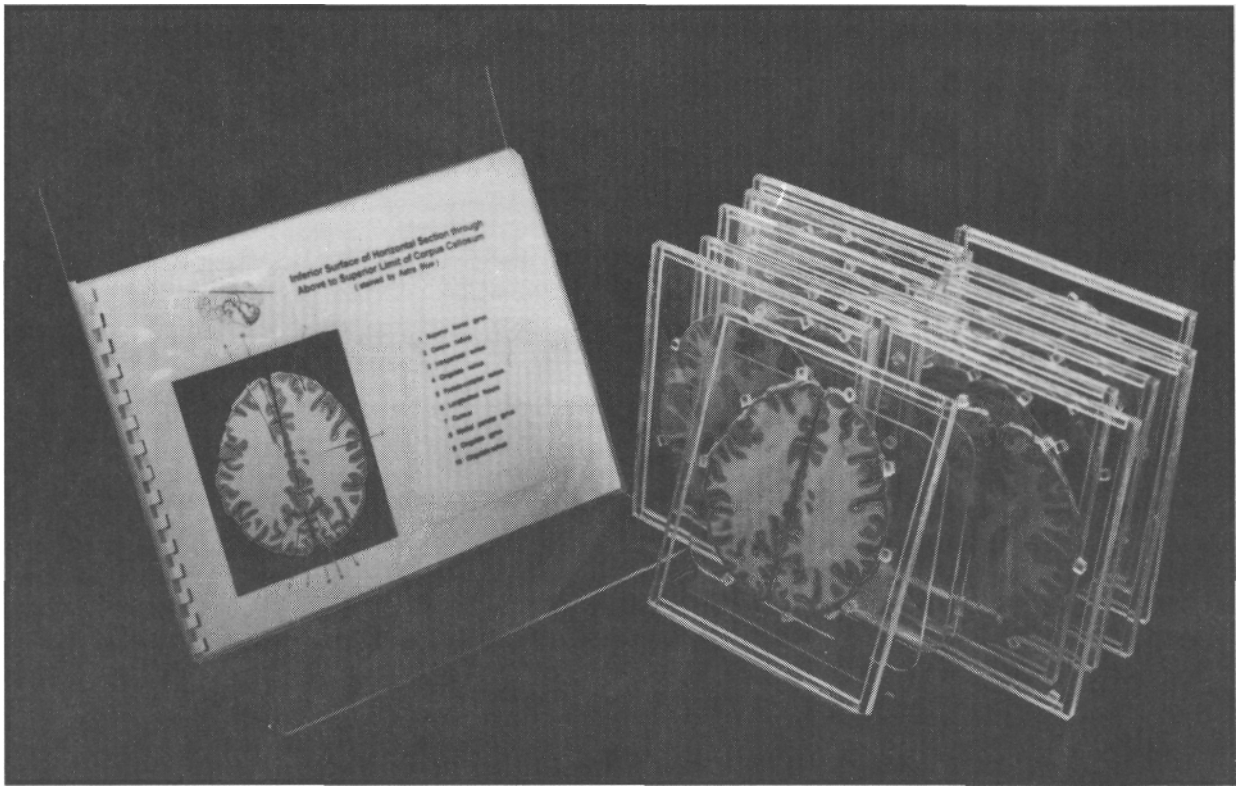

Figure 2. The plastinated brain slices after framing

staining agents and iron molecules present in the brain tissue. In Mulligan's method, a reaction of tannic acid with protein in the gray matter is proposed (Mulligan, 1931). Tannic acid might also react with polysaccharides which is rich in the brain tissue (Szabo and Roboz-Einstein, 1962; Sannes et al., 1978). Alston (1981) suggested that cupric sulfate in the Mulligan's solution probably interacted with the surface of the gray matter and potassium ferrocyanide then reacted with cupric sulfate to form cupric ferrocyanide.

The color developed in the Braak's method is most likely accomplished by a mechanism different than that of the Mulligan-related methods. The Astra blue, a mucopolysaccharide staining agent used in this method (Pioch, 1957; Fasske, 1957), probably stained mucopolysaccharide-rich area of the gray matter. Performic acid, also used in the method, reacts with cystine, tryptophan and methionine (Toennies et al., 1942). Cysteic acid was derived from oxidation of cystine by performic acid (Pearse, 1951; Lillie, 1952; Adams and Sloper, 1956). The concentration of cystine is increased in the gray matter during the later stage of myelination (Friede, 1966). The technique, however, took a relatively long period (2 days) and performic acid is toxic and difficult to handle.

The finding that the degree of shrinkage after plastination is more pronounced in the gray matter is probably due to the higher amount of water in the gray matter (82%) than in the white matter (72%) (Suzuki, 1981). The degree of shrinkage at approximately 10% is considered acceptable and did not cause any problems in learning neuroanatomy from these specimens.

Acknowledgment

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Plastination of Coronal and Horizontal Brain Slices using the P40 Technique

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(received November 12,1996, accepted January 22,1997)

Key words: *Polymer P40, Brain, Neuroanatomy teaching*

Abstract

The Biodur polymer P40 is a UV light cured polyester which is used for the production of thin brain slices. P40 may also be used for the production of transparent, plastinated, body slices. It was found that in the case of brains, thorough and even fixation is absolutely critical to the final quality of the slices and in particular to prevent the occurence of orange discolouration of the tissue. Brains were suspended in 5% formalin at +5°C over a period of 9-11 weeks with frequent changes of fixative. During this time, when the brains were firm enough, they were sliced to allow better penetration for the fixative. After fixation 3 slices were processed at a time. The slices were flushed in running water, dehydrated in -25°C acetone then immersed in P40 polymer at -25°C. Impregnation was undertaken in a vacuum chamber at room temperature. The P40 bath within the chamber was surrounded with ice packs to prevent the polymer wanning too quickly while acetone was being evacuated. Following impregnation the slices were cast individually in flat, glass chambers and then cured under UVA lights. After the sheets were removed from the chambers they were trimmed and the edges sanded and polished.

Introduction

The P40 method of plastination is a follow up to the P35 technique, used for the production of thin (4, 6 or 8 mm), opaque slices of brain tissue. Brain slices produced with these two techniques possess excellent instructional potential, giving distinctive differentiation of white and gray matter and beautifully highlighting blood-filled vessels.

In the first few months of experimentation with the P40 technique there was considerable frustration. Orange spots continued to appear in the cortex of the brain slices and this was, at first, thought to be due to over-heating of the glass chambers during the UV light curing process. After the introduction of a thermostatic control system and a fan to maintain the temperature in the chambers below the specified +35°C the orange spots still occurred. It was decided that there was no over-heating problem and that the problem could be due to active peroxidase in the tissue reacting with the catalyst in the polymer. Knowing that peroxidase can be largely inactivated by fixatives, a protocol for the fixation of coronal and horizontal human brain slices to be plastinated with P40 was established. Fixation of sagittal slices will be discussed in further publications.

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Materials and Methods

Fixation of Coronal Slices

A fresh human brain was suspended by the basilar artery in 5% neutral buffered formalin (NBF) at +5°C. After 1 week the fixative was changed to fresh 5% NBF, still at +5°C. The brain was sliced in half, in the coronal plane, after 2 weeks to allow penetration of fixative into the centre, and was immersed in fresh 5% NBF at +5°C. After another 2 weeks the brain was sliced on a bacon slicer into 5mm slices and stacked on filter paper in 10% NBF at room temperature. The fixative was changed to fresh 10% NBF after another 2 weeks. Three slices from this brain were plastinated 2 weeks later. Total duration of fixation was 9 weeks.

Fixation of Horizontal Slices

It is not practical to slice the brain in half during the fixation procedure as for coronal sections. The superior aspects of the 2 hemispheres would become separated and make further slicing somewhat difficult. For this reason, the brain was suspended in 5% NBF at +5°C and the fixative

changed after 1 week (fresh 5% NBF at +5°C). After 2 further weeks a sliver was cut from the top of the brain in the horizontal plane to allow penetration of the fixative. The brain was placed back into fresh 5% NBF at +5°C. Four weeks later four 5mm slices were cut from the top of the brain until pink, unfixed tissue, showed in the centre. The slices were stacked on filter paper in fresh 5% NBF at room temperature. The remainder of the brain was placed back into fresh 5% NBF at +5°C, and remained in fixative for another month. Eleven weeks after the commencement of fixation, the rest of the brain was sliced and placed into fresh 5% NBF at room temperature.

Flushing

After fixation, slices were further processed, 3 at a time. They were washed in tap water for 24 hours, then placed into a grid basket and into distilled water at +5°C overnight.

Dehydration

The basket of slices was placed into the first acetone bath (not less than 98% pure) at -25°C for 24 hours. The basket was moved around gently in the acetone for the first 5 minutes to free gas bubbles and hasten freezing thus avoiding ice crystal formation. The grid basket was turned 2 or 3 times a day, to release trapped gas bubbles. This step is essential to avoid the risk of white spots on the finished slices. The basket was placed into a second acetone bath at -25°C (99-100% purity) for 24 hours. One high grade acetone bath may be sufficient over 2 days, so long as the last bath stabilizes at no less than 99% pure acetone.

Immersion

The grid basket was placed into the immersion bath of P40 at -25°C for 3 days, with the basket raised slightly on one side.

Impregnation

The immersion bath was taken straight from the freezer and placed into a vacuum chamber, on the bench, at room temperature (Cook and Barnett, 1996). Ice packs were packed around the immersion bath, within the chamber, to keep the temperature low. Impregnation was undertaken for 24 hours and the rate of evacuation was determined by the gentle rising of strings of small bubbles to the surface of the polymer. Most of the acetone was evacuated from the slices by the time the ice packs had thawed. Impregnation is complete when bubbles cease to rise when the pressure is at 10mm Hg (room temp.). If impregnation is carried out at -25°C, the pressure must be brought down to at least 5mm Hg, but not less than l-2mm Hg. To prevent extraction of monomeric styrene from the impregnation bath, the pressure should not be brought lower than 10mm Hg (room temp.) or l-2mm Hg (-25°C) (von Hagens, 1994).

Casting

Each slice was cast in an individual flat chamber consisting of 2 standard quality glass plates 270 x 220 x 2 mm. Silicone tubing (9 mm) was sandwiched between the 2 glass plates to provide a gasket, and when clamped the gap between the plates compressed down to 8 mm. The flat chambers were placed on an oblique angle. A mylar sheet used for overhead projections was cut in half and placed halfway into the top of the chamber. The brain slices were slipped into the top of the chambers using the mylar as support slides. One 6 mm ball bearing was also placed into each chamber. The chambers were placed upright and filled with the remainder of the polymer from the immersion bath. Fresh P40 can also be used for filling the chambers. Immersion P40 will give a slightly cloudy appearance to the cast but is tolerable if only a small number of slices (3) are processed at a time. A greater number will lead to more contamination of the impregnation P40 with lipids. In this case it is advised that fresh P40 is used for casting. Air bubbles were removed with the aid of a wire and the tops of the chambers sealed. The chambers were then topped up and bubbles removed with a syringe inserted between a glass plate and the silicone gasket. The chambers were then placed in a horizontal position and a magnet used to roll the ball bearing around, to position the slices in the centre of the chambers (figure 1). After the slices were positioned, the ball bearing was rolled away to the side and left against the gasket.

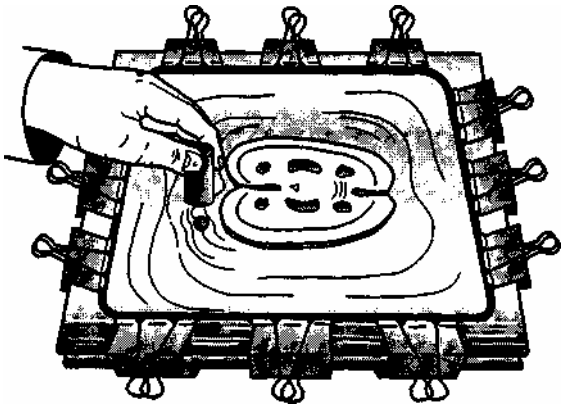

Figure 1. Magnet and ball bearing used to position the brain slice.

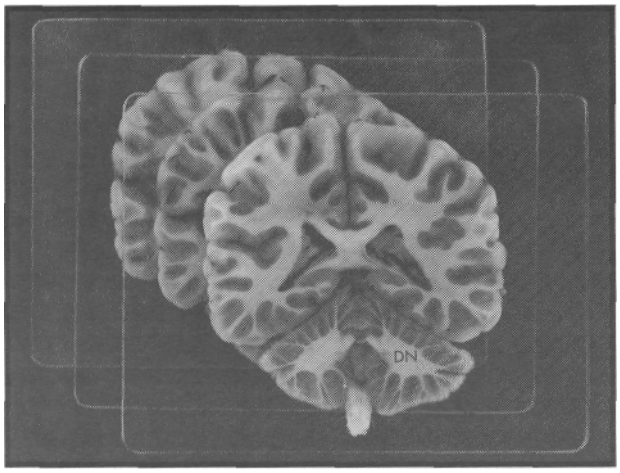

Figure 2a. P40 plastinated coronal slices of cerebrum and cerebellum: Blood vessels within the ventricles and cerebral cortex show in good contrast. Fine detail, such as the form of the dentate nucleus (DN) within the cerebellum, is well resolved.

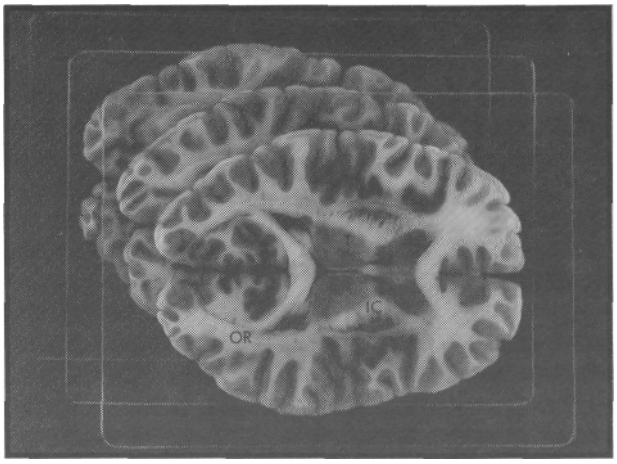

Figure 2b. P40 plastinated horizontal slices of cerebrum: Note the internal differentiation of the thalamus (T) showing its component nuclei and the excellent definition of the surrounding internal capsule (1C). The optic radiation (OR) is also well defined.

Curing

The chambers were laid flat between U.V. Lights. Two 40 watt 350 blacklight UV tubes were placed 200 mm above the chambers and another 2 tubes 160 mm below the chambers. The tubes were 110 mm apart. The temperature rose during the first hour of jellation. A fan blowing across both surfaces of the chambers was switched on when the surface of the chambers reached +27°C, approximately 30 minutes after commencement of polymerisation. After 48 hours the lights were switched off and the clamps and gaskets removed. The edges of the casts, between the glass plates, were mopped to remove the sticky resin inhibited by the silicone gaskets. The resin-glass border was scored with a scalpel to allow easy release of the glass plates (this must not be omitted otherwise damage to the glass plates and cast may occur). The glass plates were removed and masking tape was applied to the circumference of the cast to seal the sticky edge until it was trimmed off.

Finishing

The casts were sawed into rectangles, corners rounded with a grinder, and edges then sanded and polished.

Discussion

Compared to the P35 technique the advantages of the P40 technique are:

1) The polymer used for immersion can also be used for impregnation and casting.

2) Double glass chambers containing expensive safety glass are used for the P35 technique (Weber and Henry, 1992), whereas only single float glass chambers are required for the P40 technique.

3) There is no need for a ventilated heat cabinet as with the P35 method. P40 is cured by UVA light only (Weiglein, 1996).

The disadvantages of the P40 technique are:

Brains that have been fixed in conventional 10% formalin have proved excellent for both the S10 and the P35 techniques. By contrast, slices taken from these brains and processed with P40 are far from satisfactory, displaying orange spots in the cortex of the brain. It is suspected that the orange spots are due to the presence of active peroxidase in the tissue, which reacts with the catalyst in the P40 polymer. The peroxidase can be largely inactivated by fixatives, and for this reason, very thorough and even fixation is vital for success with the P40 technique.

The brain slices were impregnated at room temperature due to the convenience of having a second vacuum chamber and pump, in the lab. The use of this second chamber avoided any interruption of our silicone plastination pro-

gram, performed in the vacuum chamber at -25°C, while experimenting with the P40 technique.

Conclusion

Compared to the P35 method, the P40 technique offers comparable results but has the advantage that it is less expensive. The P40 plastinated brain slices yield very fine anatomical detail and are an excellent aid for use in teaching and research (figure 2).

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Note from the Editor

Vacuum and Pressure can sometime be quite difficult to grasp and it is always important to be very explicit. When Mr Barnett talks about "pressure" in his paper, he always refer to the residual pressure in the impregnation chamber, as indicated by the Bennert Manometer that most of us have in our plastination laboratories. Often we have seen plastinators talking about the "pressure" in the chamber, the "vacuum" applied to the chamber and even the "negative pressure".

To avoid confusion, the authors should always express the "residual pressure in the impregnation chamber" while describing the impregnation process in their publications.

A Safe Method of Sawing Cured Sheet Plastinated Sections

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(received October 2,1996, accepted January 28,1997) ***Key words:*** *Polymer E12, Polymer P35, Polymer P40, Equipment, Safety*

Abstract

Occupational Health and safety legislation now requires a greater degree of worker responsability and where necessary, modified work practices to conform to safety guidelines. Employee safety in the management of the plastination laboratory may in some instances result in new hazard control measures being instigated.

This paper discusses an effective means of reducing worker exposure to fine dust particles and fumes released during the sawing process of cured epoxy (E12) sheets and polyester (P35/P40) sheets to the lowest practicable level by modifying the process parameters to isolate portable sawing equipment in a suitable fume extraction facility.

Introduction

With the recent introduction into the pre-clinical gross anatomy and radiology course of computerised tomography (CT) and magnetic resonance imaging (MRI) correlated serial sectioned sheet plastinated specimens (Cook and Barnett, 1996), serious consideration was given to the issues of safety in the work place for the preparation of E12 body, head, and extremity slices and P35 / P40 brain sections. The inherent health hazards of working with epoxy resins and polyester resins has been of primary concern since this Department commenced preparation of sheet plastinated specimens in 1990. A major problem is the elimination of potentially toxic epoxy and polyester dust and fumes during the final sawing out and sanding of the cured sheets.

The use of uncured polyester (von Hagens, 1994), and to a lesser extent, epoxy resin (Alam, 1980) necessitates adequate fume extraction and ventilation in the workspace, as the styrene monomer component within the polyester resin in particular is highly aromatic and toxic and may be both harmful and extremely unpleasant to breathe.

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Materials and Methods

The University of Auckland extensively utilises the E12 sheet plastination method for preparing 2.5 mm thick transparent body and extremity slices in an epoxy resin using the standard flat chamber technique (Weber and Henry, 1993). The P35 and P40 methods are used to prepare 4 mm brain sections in a polyester co-polymer using the standard flat chamber method (von Hagens, 1990).

More so than with the silicone based (S10) plastination techniques, sheet plastination requires a greater degree of caution during the preparation, production and finishing for each of the El2, P35 and P40 methods. As with all plastination techniques, gloves should always be worn while handling all polymers, accelerators and hardeners. The literature states that skin and eye contact with epoxies and polyesters **must** be avoided (von Hagens, 1984). Suitable ventilation and fume extraction is essential. Care must be taken when removing cured resin sheets from glass flat chambers due to near razor sharp edges on resin sheets.

The problematic aspect of the sheet plastination procedures not previously addressed is the final stage following impregnation and curing where the excess polymerised resin is carefully cut away from around the cured epoxy or polyester tissue section, which has been dismantled from the glass flat chamber.

The use of a conventional handsaw fitted with a fine toothed blade was found unsatisfactory due to the displacement of the potentially hazardous dust particles which settle everywhere in the vicinity of the bandsaw and may be inhaled by the technician. Furthermore, a bandsaw may not always ensure straight cuts, due to the flexibility of the blade.

The best cutting results are achieved with a bench circular saw which makes smooth, accurate cuts needing no further sanding or grinding which is required for the bandsaw cuts. However, the very high speed of the circular saw creates enormous amounts of very fine resin dust which in no time at all covers the whole room and makes those in it resemble snowmen!

Additionally, the fumes created by the friction of the high speed circular saw blade upon the polyester (P35) resin are debilitating making the workroom and adjoining rooms unusable for up to 2 hours following the procedure. A more acceptable method was imperative.

Fully appreciating our concerns, particularly with use of polyester (P35 / P40) resins, the University of Auckland Works department requisitioned and had installed in the plastination laboratory a large 1600 mm x 660 mm fume extraction cabinet vented outside of the building via the roof in accordance with modern building regulations.

Following some initial investigations with tool manufacturers, and specialist saw fabrication shops, a small portable Hitachi circular saw weighing only 2.6 kg designed for ceramic tile cutting was located (figure 1). In addition to the circular saw a Dols tile cutting system was purchased, consisting of a specially designed sliding carriage and channel saw fitted atop a small, portable cutting table.

The whole unit measures 500 mm x 600 mm and features rip guide, mitre guide, and clearly marked cutting sweep in millimetre increments. The blade diameter is 110 mm.

The integral saw and cutting table unit (figure 2) is lightweight yet sturdy enough to ensure accurate cuts with ease while the portability of the unit allows for quick set up within the fume hood. Toxic fumes are completely removed and the large volume of dust and resin flakes trapped safely within the fume hood by a mesh screen temporarily covering the extraction vent. The considerable accumulation of resin flakes and heavy dust is then removed by vacuum cleaner and disposed of in the closed vacuum cleaner dust bag efficiently preventing any contamination of the laboratory environment.

Finishing touches are completed by means of a belt sander mounted upside down on a special purpose built frame within the fume hood. Each sheet of resin embedded tissue is lightly wet sanded to remove rough edges (figure 3).

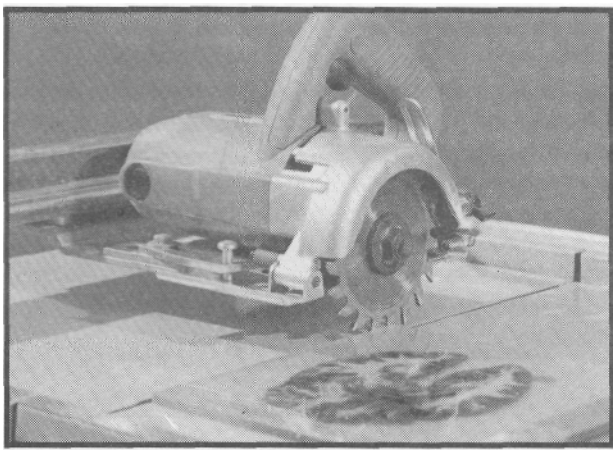

Figure 1. A lightweight (2.6kg) ceramic tile cutting circular saw.

Finally the individual sheets are washed in warm soapy water to allow the tension within the sawed, sanded sheet to relax. This is followed by drying and application of Brasso metal polish and finally a suitable wax finish such as that used to polish car paintwork, such as Simonize Speedwax as desired. The finished sheet plastinated sections are well protected from scratching due to rough handling by over-enthusiastic students (or lecturers). Polyester sheets are more easily scratched and damaged than are epoxy sheets.

Conclusion

With occupational health and safety being an imperative issue at many Universities, many aspects of the various plastination techniques available may require scrutiny in accordance with OSH regulations and safe work practices should be adopted. For the budding sheet plastinator these recommendations may be worth serious consideration. The cost of the cutting equipment is not exorbitant ($NZ 700) and should be within reach of the budget of most departments.

Employment of the methods outlined above results in the elimination of dust and toxic fumes and contributes to the production of a superlative finished specimen.

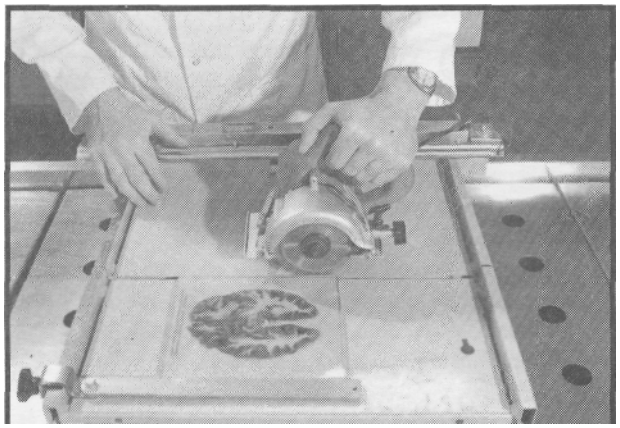

Figure 2. The use of a portable saw and cutting table enabled the safe and efficient sawing out of the finished sheet plastinated specimen.

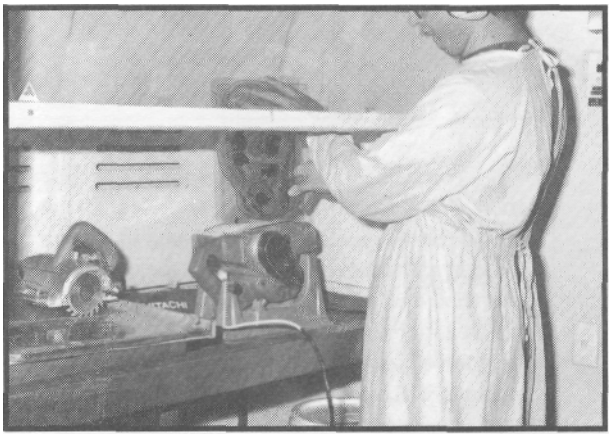

Figure 3. The entire cutting and finishing of sheet plastinated specimens is able to be efficiently carried out within the fume extraction hood.

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Current Plastination Index - Updating

Gilles Grondin and Régis Olry

You will find in the following pages the references that were brought to our attention since the publication of the Current Plastination Index. In our desire to keep you informed with all the recent publications about the plastination technique and its various applications, we will do all the efforts to keep our Index up-to-date by publishing in the Journal the complete list of the new publications about plastination. It is obvious that we need everyone's assistance to perform this task. We therefore invite each and everyone of you to inform us of their publications about plastination and want to thank our actual collaborators for their precious help. If anyone of you has not yet received his copy of the Index, just send us a note with your complete postal address and we will mail you one copy.

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Follow the "anatomy" link will take you to the plastination page.
Follow the "multimedia" link will take you to Piglet 95 project.

Plastination Workshop
and
5th Interim Conference on Plastination

June 29 - July 3, 1997
University of Tennessee
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The standard silicone plastination technique, the standard epoxy plastination technique of body slices, and the standard polyester plastination technique for brain slices will be presented in a hands on workshop format. The registrant will gain hands on experience in all three areas of plastination. Each registrant will produce at least one specimen using each technique.

Registration fee is: $185.00 for nonmembers (after May 20, 1997 add $15.00 late fee)
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for the **workshop and conference.**

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Accommodations: Conference Hotel - $60 - 75.00 per room
Dormitory - $15.00/person **single,** $12.00/person **double occupancy**

International Faculty

Hosted by: R. W. Henry and Larry Janick
College of Veterinary Medicine
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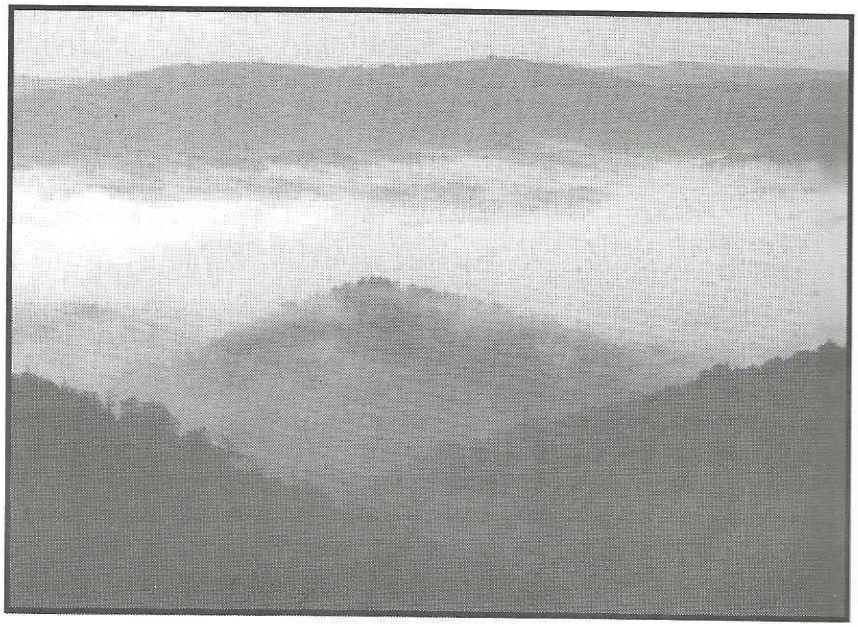

Beautiful Smoky Mountains

POSITION NOTICE

Gross Anatomy Teaching Support Specialist position in the Department of Anatomy, College of Veterinary Medicine at Cornell University to support the teaching and research activities of the faculty.

Responsibilities include:

Co-ordination of materials and space within the gross anatomy teaching facility
Maintenance of chemicals and supplies
Facility maintenance
Specimen preparation (embalming cadavers, bony materials, fresh specimens)
Specimen maintenance
Management of an operating plastination facility
Handling of live animals in the teaching setting.

Expertise in plastination is desirable.

Supervisory duties include direct supervision of a half-time laboratory attendant position and part-time students employees. This person must maintain the University standards for the use of controled substances and the control of exposure to toxic chemicals used in the performance of these duties.

Salary is commensurable with experience.

Starting date as early as May 15, 1997 or until the position is filled.

Submit resume with names of references to:

Dr. Linda Mizer
Department of Anatomy
College of Veterinary Medicine
Schurman Hall
Cornell University
Ithaca, New York 14853-6401

Phone: 607-253-3557
Fax: 607-253-3541
E-mail:lam6@cornell.edu

Cornell University is an Equal Opportunity-Affirmative Action employer.

Ninth International Conference on Plastination
July 5-10, 1998
Trois-Rivières, Québec
Canada

Neuvième conférence internationale sur la plastination
5 au 10 juillet 1998
Trois-Rivières, Québec
Canada

The 9th International Conference on Plastination

and

Sixth Biennal Meeting of the International Society for Plastination

will be held July 5 to 10, 1998 at the Université du Québec à Trois-Rivières, Trois-Rivières, Québec, CANADA.

Program Outline

Sunday July 5	PM	Registration; Welcome reception
Monday July 6	AM	Plastination with Silicone, Principles and Techniques
	PM	Plastination with Epoxy, Principles and Techniques
Tuesday July 7	AM	Plastination with Polyester, Principles and Techniques
	PM	Plastination Laboratoty design and Equipment
Wednesday July 8	Free day	- visit to the University - visit to the plastination laboratory - conference dinner
Thursday July 9	AM	New developments in Plastination Plastination applications in Teaching
	PM	Plastination applications in Research ISP meeting
Friday July 10	AM	Plastination applications in Research Group discussions - "Ask the Experts"
	PM	Special techniques - vascular injection - casting
		Close

PAPERS

The organisers invite you to pass on your experiences and ideas by presenting a paper to the conference. We propose to schedule papers with 15 minutes for presentation and 10 minutes for discussion.

POSTERS AND EXIBITS

During the whole week, a room will be available for posters and exibits display. Participants are encouraged to bring examples of their own work.

ACCOMPANYING PERSONS PROGRAM

Many half-day or full-day tours will be made available during the conference week.

FOR ADDITIONAL INFORMATION:

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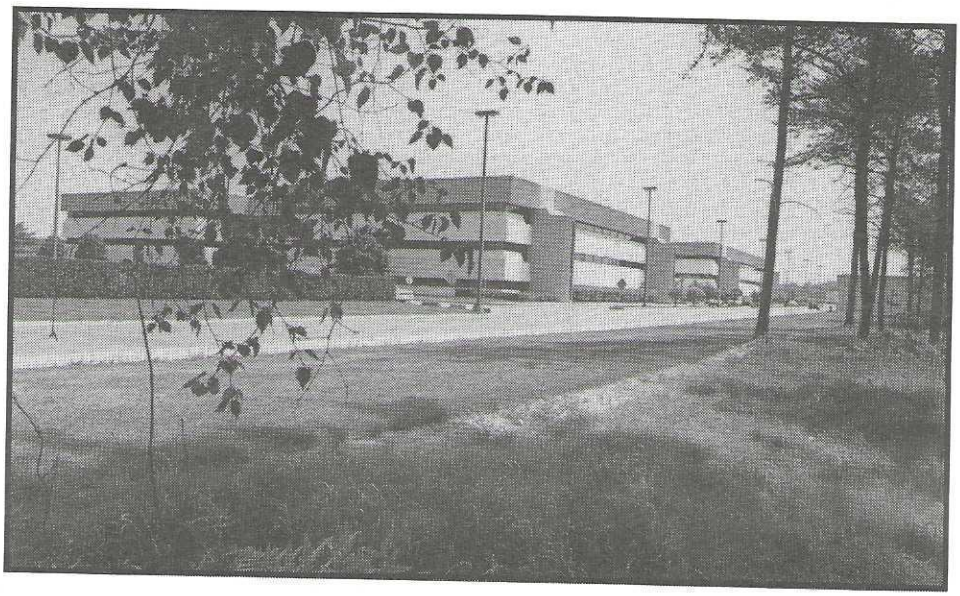

Université du Québec à Trois-Rivières

RESURRECTION OF AN ANCIENT ART:

MUMMIFICATION

"RESURRECTION OF AN ANCIENT ART: MUMMIFICATION"
(48-minutes video on the details of mummifying a human body)

In 1994 Dr Bob Brier, Egyptologist at Long Island University, and Ronn Wade of the Medical School, University of Maryland, prepared the first mummy made in 2000 years using ancient Egyptian techniques and following instructions outlined in pharaonic texts. Tools and unguents used were as close as possible to those used by the Egyptians.

This educational video shows the making of some of the equipment, the purchase of frankincense and myrrh in the spice markets of Cairo and the gathering of natron at the Wadi Natroun in the Egyptian desert. Also shown are canopic jars, ushabti, and linen bandages necessary to the ritual preparation of a royal mummy.

Some surgical procedures, including removal of the brain through the nostrils and major organs through a small abdominal incision, are shown. Brier and Wade examine the body after 35 days of drying, perform biopsies, assay for bacterial growth, anoint the mummy with traditional oils and aromatic resins, and wrap the body in the first of several layers of linen inscribed with ritual spells written in hieroglyphs. A final wrapping three months later carefully imitates that of the mummified Thutmose III, Pharaoh of 1500 B.C.

A review of what was learned from this experimental mummification completes the video.

This unique video may be ordered from:

Ronald S. Wade
Anatomical Services Division
University of Maryland School of Medicine
BRB Room B-024
655 West Baltimore Street
Baltimore, MD 21201-1559

Cost: $24.00 (U.S. currency) plus:

$3.00 shipping and handling - United States only
$4.00 shipping and handling - Other Americas
$6.00 shipping and handling - Europe
$8.00 shipping and handling - Asia & Africa

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Please note: The sales revenue will go to the University of Maryland Mummy Research Fund.

Purchase price refundable if you are not satisfied.

ORDER NOW!

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.

Henry R, Haynes C: An Atlas and Guide to the Dissection of the Pony, 2nd Ed. Edina, MN: Alpha Editions, pp 25-88, 1989.

von Hagens G: Heidelberg Plastination Folder: Collection of all technical leaflets for plastination. Anatomische Institut 1, Universität Heidelberg, Heidelberg, Germany, 1985.

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