LET'S FACE IT!

The 7th Scientific Meeting of the International Association for Craniofacial Identification

Melbourne, Victoria, Australia
30 September—4 October 1997

Report on Interstate travel

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Report—Department of Maritime Archaeology, Western Australian Maritime Museum, No. 133

Contents

Acknowledgements

My thanks to Jeremy Green, Head, Department of Maritime Archaeology; Graeme Henderson, Director, Western Australian Maritime Museum; and Dr Ian MacLeod, Acting Executive Director, Western Australian Museum, for supporting my application to attend the 'Let's Face It! conference; and, to Andrew Reeves, Executive Director, Western Australian Museum, for endorsing my participation.

Funding was made available from the Commonwealth Historic Shipwrecks Program Grant for 1997/98. This annual source of funding from the Commonwealth Department of Communications, Information Technology and the Arts, is provided to assist with work relating to shipwrecks protected under the Commonwealth *Historic Shipwrecks Act 1976* and is gratefully acknowledged.

I would also like to thank the organisers of the conference for the excellent programme, and the participating delegates for their most informative presentations. Lastly, I thank Dr Stephen Knott for participating at short notice in a joint presentation to the conference on the '*Batavia* Disaster' and recent work undertaken on the *Batavia* collection.

Itinerary

Monday 29 September	Travel: Fremantle to Melbourne.
Tuesday 30 September	IACI Conference: Oral Presentations. Reception and Dinner at Albert Sailing Club, Albert Park, Melbourne. Host: Tony Hill.
Wednesday 1 October	IACI Conference: Oral Presentations; Posters and Demonstrations. Oral Presentation: *The* **Batavia** *Disaster*. Ms Myra Stanbury, Curator, Western Australian Maritime Museum and Dr Stephen C. Knott, Dental Surgeon, Perth. IACI Annual General Meeting and Dinner.
Thursday 2 October	IACI Conference: Yarra Valley Tour.
Friday 3 October	IACI Conference: Workshops. Facial Drawing. Conference Dinner: Emu Bottom Homestead, Sunbury.
Saturday 4 October	IACI Conference: Workshops. Three-dimensional facial reconstruction.
Sunday 5 October	Museum of Victoria visit.
Monday 6 October	Heritage Victoria, Collins Street, Melbourne. Meeting with Shirley Strachan, Manager, Maritime Heritage; Ken Gurney, Heritage Legislation; and maritime archaeology staff. Travel: Melbourne to Fremantle.

Introduction

The human osteological material recovered from land sites associated with the victims of the Dutch shipwreck disasters *Batavia* (1629) and *Zeewijk* (1727) has the potential to provide a wealth of scientific, social and personal information about the people working and travelling on board Eastindamen in the 17th and 18th centuries, and the stresses and traumas related to shipwreck survival.

The hardships of long-distance voyaging were no less for the passengers on board Eastindiamen than for the crew—cramped and unhygenic conditions, poor nutrition, lack of fresh water, shipboard diseases, work-related stresses and accidents, harsh disciplinary regimes, and so on. All these factors could influence the health status of persons with manifestations possibly being evident post-mortem.

With regard to the *Batavia* disaster, we have the added issue of survivors who were mortally slain by perpetrators from within the shipboard community. The acts of violence which eventuated in death are evident on certain individuals in the collection and modern forensic techniques may allow more detailed interpretations of these traumas to be made. This evidence, together with other physical anthropological data, and information contained in written journals, has the potential to assist in the identification of the victims. Various hypotheses have been proposed by historians in the past (e.g. Drake-Brockman), but only recently has the question of identification based on physical anthropological and scientific evidence been addressed.

Provided the relevant osteological material is available for a particular individual, the determination of age and sex is relatively easy to assess. Where a skull exists, however, the level of identification can be made far more realistic: a variety of modern techniques are currently in existence and/or are being developed worldwide to enable the facial features of an unidentified individual to be reconstructed with a high level of accuracy and probability. While the outcomes of these techniques are predominantly aimed at positively identifying the victims and perpetrators of modern crimes, the applications have broad and demonstrated uses for archaeological and museum osteological collections.

It was with the aim of learning and gaining some practical experience of available techniques which could be potentially applied to osteological collections held by the Western Australian Museum for purposes of interpretation and exhibition that I sought permission to attend the conference **'Let's Face It!'**, held in Melbourne from 29 September to 4 October 1997.

The conference was the Seventh Scientific Meeting of the **International Association for Craniofacial Identification**, whose members are drawn from various specialist disciplines and whose interests lie in the fields of forensic medicine and pathology; forensic anthropology and palaeopathology; dentistry and dental technology; police homicide and crime investigation; mortuary and funerary practice; archaeology; and others.

Current issues concerning osteological collections

In recent years, questions have been raised concerning the use of human osteological collections derived from archaeological investigations as objects of scientific enquiry, and as objects of museum collections and display. Many of the arguments have evolved out of criticisms levied at museums and other institutions concerning attitudes to the rights of indigenous people and the restitution of human remains to the actual and cultural descendants, legal owners and/or other claimants in the countries of origin. Debates concerning repatriation versus scientific research have been aired in numerous worldwide forums and have given rise to the drafting of various documents setting out principles, guidelines, ethical considerations, and so on (see *Museums Journal*, July 1994).

Apart from the recently adopted *ICOMOS International Charter on the Protection and Management of Underwater Cultural Heritage* which states as one of its 'Fundamental Principles' that 'Investigation must avoid unnecessary disturbance of remains or venerated sites' (see ICOMOS, 1997, Article 1—Fundamental Principles: 26) no specific Australian legislation or guidelines or international conventions exist to govern the treatment of human remains located at maritime heritage sites. In line with some of the global concerns, however, the Australian Commonwealth Department of Communications, Information Economy and the Arts has recently prepared a draft set of principles and guidelines for the treatment of human remains from underwater cultural heritage sites protected by the *Historic Shipwrecks Act 1976* which was tabled for discussion at the recent Commonwealth/State Practitioners' Meeting held at the Western Australian Maritime Museum, Fremantle, on 12 September 1997.

Given that the future of human osteological collections deriving from Commonwealth protected shipwreck sites is currently uncertain, there is an urgent need to investigate potential ways of gathering as much scientific, forensic and other information as possible from the collections in storage and on display so that this infomation can be used for future exhibitions.

The scientific value of osteological collections in storage

The human skeletal material deriving from the *Batavia* and *Zeewijk* has been collected over a period of time dating from the 1890s to the 1990s. Until quite recently, scientific investigation of the material has been minimal, and there is limited documentation. In 1995, a physical anthropological/archaeological study was undertaken of the *Batavia* collection by Bernadine Hunneybun, as partial fulfilment of a Bachelor of Science (Honours) degree at the Centre for Archaeology, University of Western Australia (Hunneybun, 1995). The study sought to identify the age and sex of the individuals; to investigate the presence of trauma and pathology; and, based on analysis of historical accounts, give a tentative identification of the individuals. To this end, the study was very successful and laid the basis for future investigation.

Many of the scientific techniques utilised in the study would not have been available many years ago and highlights one of the arguments in favour of retaining osteological material in museum collections. New scientific techniques for extracting information from stored osteological material are continually being developed (e.g. DNA analysis) and have allowed new information to be gathered from quite ancient material. Not only has this information led to a greater understanding of past cultures, but has also produced valuable information of importance to contemporary societies through research activities in fields such as epidemiology and palaeopathology.

For example, the scientific potential of the Spitalfields project, begun in 1984 (see Cox, 1996) is significant. The 17–18th century osteological material derived from the crypt of St Mary's chuch, Spitalfields, London, has led to two scientific studies of relevance to modern medicine—an investigation of osteoporosis and rickets (vitamin D deficiency), which is now returning due to reduced sunlight and colder winters in Europe.

The study undertaken by Hunneybun was limited by the constraints imposed on student access to relatively expensive scientific techniques (e.g. SEM analysis, CT scanning, DNA analysis...). The study, therefore, was not exhaustive and the potential remains for new information to be gleaned from existing collections.

Review of conference proceedings

The keynote addresses and oral presentations covered a broad range of issues, some focussing on the management of mass disasters (e.g. the Port Arthur massacre, Tasmania; the Everglades Jet disaster, Miami) and the problems of identifying badly disfigured victims, and others on developmental techniques for craniofacial reconstruction and identification.

Professor Per Holk, Norway, gave an interesting review of 'The Face in History', emphasising that 'the face is man's second fingerprint'. Throughout history, the face—and its 'adornment' the nose—has had different social and cultural meanings; from being man's first language (facial expressions) and the 'silent communication' between mother and child, to a means of identifying personality, spiritual nature, intelligence, race or ethnicity.

In some way this reinforced the underlying concept that putting a face to unidentified persons was a necessary objective both as a 'lead to identification' and out of respect for the individual's human right to identity. The issue of human rights, particularly with regard to the detection and recording of abuses was discussed in a paper presented by Dr David Ranson, Victorian Institute of Forensic Medicine.

Of more specific interest were the papers by Dr Neils Lynnerup (Denmark) and Mr Richard Neave (Manchester University) whose work had involved both modern forensic material and ancient archaeological remains (see Neave & Prag, 1996). Lynnerup described a method of 'Skull reconstruction by stereolithography' which has applications for archaeological burials. The technique has been used on mummies from the Danish Museum of Antiquities and the British Museum collections, and skeletons excavated from 7000 year old Sumerian village sites in Syria. The specimens are first subjected to non-destructive CT (Computer Tomography) scanning. Using a program called 'Analyse', the 2mm thick scan slices are stacked and the computer generated data used to make solid models. A photopolymer (liquid plastic resin) when hit by a laser beam will solidify. [The experiment used CIBA Giegy Polymer.] A solid 1:1 model of a skull (with hollow spaces hollow) can be very quickly made without having to excavate the body. Computer surface scanning can be used to put on facial tissue. The cost for replicating a skull in this way is approximately $2000. [The liquid polymer is expensive.]

Mr Richard Neave has been carrying out craniofacial reconstruction using clay modelling for some years and has an established reputation in this field. Work he has done for the United Kingdom Police Force can be gauged from the fact that his reconstructions of the faces of unidentified murder victims have led to their identification, and so eventually to successful prosecutions.

The CT scan method (Lynnerup) and clay modelling method have been used on British Museum collections to test hypotheses concerning the validity of cemetary paintings and paintings superimposed over the skulls of mummies. In the first case, they were able to demonstrate a similarity between the reconstruction and the cemetary paintings, thus supporting the hypothesis that the painting represented the deceased. In the case of the mummy, opened by the British Museum in the 1950s, the CT scan reconstruction did not turn out like the clay model, and neither reconstruction looked like the painting.

A clay bust of 'Camilla', a female recovered from a late Roman fourth century AD Christian cemetary, outside the walls of Roman Colchester, was made by Richard Neave and is displayed alongside her skeleton in the Colchester Museum. The skeleton is displayed in an open grave, in dimmed light, in much the same fashion as the *Batavia* skeleton in the *Batavia* Gallery. [This exhibit was seen by Stanbury in August 1996 during a visit to the Colchester Museum.]

Dr Michael Evenot (France), presented a fascinating historical case study on the 1897 fire and explosion of the Bazar de la Charité, in the Rue Jean Goujon, Paris, to commemorate the 'Centennial of scientific ID in mass disasters'. Important people living in the Rue Jean Goujon area would frequent the Bazar. One hundred and ninety women died in the fire and 30 cadavers were recovered. Identification of the victims was in part solved by artefacts recovered from the remains, many of which have only surfaced in recent years from sources in the USA and elsewhere. A medallion with a face, commonly worn by women at this period, belonged to a lady from the Royal family. Other objects gave rise to confusing evidence; a ring identified as belonging to another lady led to the belief that she had also perished until she was found to be alive and well at home. The ring had been taken to the Bazar to be sold by the lady's 'man friend' and she was not actually there!

A number of papers discussed the problems of determining tissue thicknesses (Prof. Richard Helmer, Germany) and ways of accurately mapping the complex curvatures or 'crest lines' of the face by Fourier Analysis (Sheridan, 'Fourier shape descriptors and the human facial profile') and algorithms (Dr Gerald Quatrehomme, France). Others demonstrated methods for 'Computerised facial reconstruction using Open Inventor' (Dr Martin Evison, Sheffield, UK), and other commercially available programs such as Adobe Photoshop and drawing programs (Dr Alex Forrest and John Garland, Queensland). The progam 'Open Inventor' uses CT and

MR scans to create computerised simulation models which can get an image to the public as reliably and quickly as possible. [This can be viewed on the WWW.]

Preliminary three-dimensional investigations of the orbital region of the skull appears to demonstrate a sex differential (square shape for males—round shape for females) which could be a useful and quick guide to sex determination (Dr Michael Becker, Germany).

Methods of craniofacial reconstruction

In summary, the various methods range from:

- 2D–3D
- Forensic artists
- Identikits
- Clay modelling (Helmer/Neave/Taylor)
- CT scan and clay modelling
- CT/MR scanning
- Video/photo superimposition
- CT scan/Silicon graphic machines (Evison)
- Fourier Analysis/algorithms
- Computer graphics/paint programs

Panel discussion: 'Computers, anatomists and sculptors'

A panel discussion (Richard Helmer, Richard Neave, Alex Forrest, Ronn Taylor) at the end of the oral sessions allowed issues concerning the quality, reliability and authenticity of various reconstruction methods to be discussed. I was able to seek the panel's opinion concerning the value of craniofacial reconstruction with respect to material in the Museum's collection.

QUESTION:

'Given the absence of supporting evidence which may provide clues as to an unidentified individual's identity (e.g. paintings, clothing, jewellry, medallions…), and given that present methods of craniofacial reconstruction do not demonstrate 100% reliability or repeatability and may, therefore, not be considered 'authentic', is it valid to reconstruct the facial features of an historical individual? Putting a face to history may bring historical figures to life, but if it is not the right face are we at risk of presenting a false image or false information?'

ANSWERS:

AF Reconstructions provide leads to identity. A defensible summary of the techniques used and their reliability should be included in the interpretive material i.e. the probability of this being a true likeness of the individual is…

RN Make two reconstructions of the same skull to test the results of two independent operators or different techniques.

RT Having seen the *Batavia* skeleton at the WA Maritime Museum, my first thoughts were that the exhibit could be greatly improved by having a craniofacial reconstruction; it is an ideal case given the associated story...

RH Yes, definitely. The likeness of reconstructions done by myself on historical osteological material has been very successful and the appearance substantiated by contemporary pictures of the individual. [Photographs of the reconstruction and pictures of the individual were seen and the likeness verified.]

Poster and demonstration session

A number of poster presentations were on view (see conference programme). Of particular interest was the presentation by Ronn Taylor et al. on the 'Anatomical reconstruction with computer enhancement as an aid to identification of an unknown person' and the accompanying display showing stages in the three-dimensional replication of osteological material.

Slides and photographs of a facial reconstruction of a 2000 year old Egyptian Mummy were also displayed (see Appendix 4). This exhibit is on display at The Australian Institute of Archaeology, Ancient Times House, Little Bourke Street, Melbourne.

Workshops

FACIAL DRAWING

Craniofacial reconstruction is both an art and a science. From an artist's perspective, Richard Neave outlined the basic form and proportions of human faces and ways in which an artist's sketch can very quickly be achieved. He pointed out that the nose was not so important for recognition as we recognise people from the Front View, rather than in Profile. The eyes are the main characteristics of the face and are the most difficult to reconstruct (Helmer, Holt). Positioning the eyes on clay reconstructions and making them look normal requires some expertise.

Adrian Patterson from the Victoria Police Criminal Investigation Department then demonstrated computerised drawing techniques using 'Vision Control' and 'F.A.C.E.', programs developed as a replacement for 'Identikit'. The packages have been developed using commercially available Adobe Photoshop and Paintbrush programs. Vision Control consists of a collection of face shapes, facial features, hair styles etc. which can be compiled into a pictorial image as witnesses give their oral descriptions. The image is then transferred into a Paintbrush program where skin shading and other attributes can be added to provide an artistic picture for relaying to media etc. The process can take as little as two hours to produce an acceptable picture and the results in terms of identification of perpetrators has been extremely successful.

THREE DIMENSIONAL FACIAL RECONSTRUCTION

> 'Three dimensional reconstruction of the face from a skull may be carried out to assist in the identification of human remains and is used when other more reliable methods have failed or are impossible. It is a valuable technique, but has definite limitations. It is not

suggested that facial reconstructions will be identical to the ante-mortem appearance. Rather a likeness or caricature may be produced which, if seen by an acquaintance of the deceased, may lead to an identification.

The three dimensional reconstruction may not be the endpoint in producing an image of the deceased. Alteration of te final reconstruction image, via computer software, enables further characterisation particulalry with regard to hair style/colour/length, ear/nose/eye shapes and sizes, and ageing effects, in a more efficient and rapid manner than traditional three dimensional methods.

...a successful reconstruction can only be carried out if the person is familiar with the normal human anatomy of the skull and attached soft tissue, the dental occlusion, sculpting, and split mould techniques of duplication' (Taylor et al., Three dimensional facial reconstruction: see Appendix 2).

Workshop participants were provided with a plaster duplicate of the skull of a 35 year old female who had been murdered by her husband. No other details about the person were provided. Average soft tissue thicknesses were marked on the duplicate by matchsticks. Sculpting tools and clay were provided.

Following demonstrated techniques, relayed to each area of the laboratory by overhead video, the muscle layers of the face and neck were first reconstructed in an anatomical manner. The eyelids, nose and lips were formed and then final fleshing out carried out (i.e. strips of clay were rolled out to uniform skin thickness and systematically placed over the skull. Ears were then added.

Photographs were taken (in front and profile views) of each person's reconstruction at the muscle laying stage and on completion. At the end of the day, participants were shown photographs of the victim with which to compare their sculptures. Throughout the class there was considerable variation, some sculptures reflecting some of the real life features of the victim and others being quite dissimilar! Structures such as the lips, nose, ears and eyes were particularly difficult to form and considerable variation was exhibited in these characters.

For the majoritiy of participants, including myself, this was their first attempt at facial reconstruction. Variation in the end results, therefore, was to be expected given the constraints of inexperience and time. An expert sculptor would normally take from three to five days (or sometimes longer) to complete a reconstruction.

Conclusions

The oral presentations, poster demonstrations and workshops which comprised the '7th Scientific Meeting of the International Association for Craniofacial Identification, Let's Face It!' provided an opportunity to gain experience of the work being undertaken in this field both throughout Australia and internationally, and assess its relevance to the investigative research initiated for the human osteological material from the *Batavia* (1629) and *Zeewijk* (1727).

Several of the Australian and international participants had had experience with museum osteological collections and were all extremely positive about the value of the techniques for historical material and believed that the results could greatly enhance interpretation for the public. All agreed that the public should be made aware that the eventuating characterisation may not be 100% accurate. Nevertheless, the interest generated by the procedures involved in achieving a result should be sufficient to overcome the lack of total accuracy. The fact that the techniques have a modern application in the fields of forensic science and criminology would provide an added focus for display interpretation, bringing together history and modern science.

The workshops clearly demonstrated that the procedures currently in use would incur minimal handling (and thus potential damage) of the original material: once a mould of the skull is produced, a three-dimensional duplicate can be made from plaster or other material; reconstruction work may then be carried out on this model, the original being used purely to check accuracy of features and dimensions (see Appendix 2). Once a duplicate (or replica) skull/skeleton is made, there is no time constraint on future reconstruction work. If the original material needs to be reinterred, a good replica enables essential visual information to be retained.

The School of Dental Science, University of Melbourne, have expressed interest in assisting in whatever way they can with the investigation of the Dutch skeletal material. Mr Ronn Taylor, who currently carries out the duplication and forensic sculpting work in Victoria, had recently visited the WA Maritime Museum and viewed the *Batavia* skeleton on exhibition in the *Batavia* Gallery. Given the associated story, he was firmly of the opinion that giving the individual a visual identity would give the account a more human dimension. Two dental experts from Western Australia who have been involved in the preliminary work on the *Batavia* material with Drs Juliette Pasveer (University of Groningen, Netherlands) and forensic pathologists from the QEII Path Centre were also present at the conference: Dr Stephen C. Knott, Dental Surgeon (and Forensic Dentist for the Path Centre of QEII Medical Centre, Perth) and Mr Michael Standish, Dental Laboratories Pty Ltd, Perth. Both are keenly interested in developing the techniques of craniofacial identification in Western Australia and have already undertaken some experimental work in this area. Curtin University of Western Australia have also been developing a three-dimensional computer modelling program which is being trialled by experts in the UK (Neave).

The potential for developing a core team to develop the techniques in Western Australia with advice from Australian and overseas experts has great possibility. The use of the *Batavia* material in this developmental process would not only benefit the Museum through its public appeal, but would also be seen to be assisting scientific development in a new but expanding area of research.

Offers of assistance with regard to the reconstruction procedures were forthcoming from Richard Neave (Manchester) and Ronn Taylor (Melbourne); and specific research areas of study, particularly in the area of teeth microwear, from Professor John G. Clement (University of Melbourne); and Dr Gregory A. Doran (Dental Surgeon, Sydney) both of whom have contacts and/or students involved in the research of occlusal surfaces. Dental moulds have recently been taken from two of the *Batavia* individuals by Knott and Standish and are currently being examined in the Netherlands (Pasveer) for microwear patterns that may provide information about dietary and stress factors.

In summary, the conference provided a greater depth of understanding about the procedures for craniofacial reconstruction, its potential for enhancing the interpretation of exhibits and for demonstrating the value of historical material as a contribution to modem scientific research, especially where data is unavailable from living persons (e.g. CT/MR scans in specified orientations) for use as comparative control material. While the procedures may not necessarily be suitable to be carried out in view of the public (i.e. in the museum gallery) either because of ethical or technical difficulties, they could certainly be filmed over a period of time to produce a documentary style video film.

It is recommended, therefore, that a detailed proposal be prepared outlining the various phases envisaged for this work to be undertaken, the potential outcomes and estimated costs.

Reading

Cox, M., 1996, *Life and death in Spitalfields 1700 to 1850*. Council for British Archaeology, York.

Department of Communication and the Arts, 1997, Principles on the treatment of human remains at underwater heritage sites. Draft document.

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Museums Journal, July, 1994 (Articles by Southworth, et al.).

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Pasveer, J., 1997a, Proposal for the study of human skeletal remains from the Abrolhos. Unpublished document, WA Maritime Museum.

Pasveer, J., 1997b, Preliminary results of the investigation of the human skeletal remains excavated on Beacon Island, associated with the mutiny of the *Batavia* in 1629. Recommendations for further research. Paper presented to the Australian Institute for Maritime Archaeology 17th International Maritime Archaeology Conference 'The Maritime Archaeology of Long Distance Voyaging', 6–12 September, Fremantle, Western Australia.

Taylor, R., et al., 1997, Three dimensional facial reconstruction. School of Dental Science, Oral Medicine and Surgery Unit, The University of Melbourne, Faculty of Medicine, Dentistry and Health Sciences.

Appendix 1: Conference Programme

Welcome and opening: 09:00 - 0930

1	Dr John Clement	
2	Dr Martin Tyas	On behalf of the University of Melbourne and the School of Dental Science
3	Prof Dr Richard Helmer	IACI President

Conference keynote speaker: 09:30 - 10:15

Dr Tim Lyons — State Forensic Pathologist. Tasmania

Oral presentations 1: Tuesday 30th Sept 10:45 - 12:30

Chair: Dr Mineo Yoshino
Secretary: Dr Pamela Craig

1	Prof Dr. Richard Helmer	Identification of unrecognisable persons by combined features of face and body	Germany
2	Dr Michel Evenot	Facial then dental ID: a multidisciplinary approach	France
3	Dr Neils Lynnerup	Skull reconstruction by stereolithography	Denmark
4	Mr Jason Ceddia	DAVID2 A computer system for victim identification using dental records	Australia

Oral presentations 2: Tuesday 30th Sept 13:30 - 15:15

Chair: Prof Dr Richard Helmer
Secretary: Dr Tony Hill

1	Dr David Ranson	Forensic medicine & human rights from Nuremburg to the present day	Australia
2	Dr Mineo Yoshino	Computer-assisted cranio-facial superimposition system	Japan
3	Dr Michel Evenot	Centennial of scientific ID in mass disasters	France
4	Dr Charles Sheridan	Fourier shape descriptors and the human facial profile	Australia

Oral presentations 3: Tuesday 30th Sept 15:45 - 17:30

Chair: Dr John Clement
Secretary: Dr Charles Sheridan

1	Ms Joyce Baker	Osteological identification of the sub adult in mass disaster situations	USA
2	Mr Sachio Miyasaka	Anatomical relations of skull morphology to facial features by cephalometry	Japan
3	Dr Velta Volksone	Identification methods of a person in case of postmortem body dis[illegible]	Latvia
4	Prof. Yuwen Lan	TLGA-213 Seal auto identification system	PRC

Lead speaker: 09:00 - 09:30

Welcome	Dr John Clement
Prof. Per Holck	The Face in History

Posters and demonstrations: 09:30 - 10:15

See separate sheet for details

Oral presentations 4: Wednesday 1st Oct. 10:45 - 12:30

Chair: Mr Jason Ceddia
Secretary: Mr David Thomas

1	Dr Martin Evison	Computerised facial reconstruction using Open Inventor	UK
2	Dr Gerald Quatrehomme	Computer assisted 3D facial reconstruction method	France
3	Dr Nerile Oakes	Facial feature location using exemplars	Australia
4	Dr Alex Forrest	Advances in digital imaging in craniofacial identification	Australia

Oral presentations 5: Wednesday 1st Oct. 13:30 - 15:15

Chair: Dr Chris Briggs — Dept. Anatomy, Melbourne Uni
Secretary: Ms Joyce Baker

1	Mr Satoshi Kubota	Anthropometry of face in Japanese adult using 3D measuring apparatus	Japan
2	Dr Michael Becker	Determination of sex by 3D investigation of the orbital region	Germany
3	Mr Glenn Porter	Facial comparison from ID photographs	Australia
4	Mr Ronn Taylor	Issues in forensic sculpting	Australia

Panel discussion: Wednesday 1st Oct. 15:45 - 17:30

"Computors, anatomists and sculptors"

Panel	Prof. Dr Richard Helmer	Germany
	Mr Richard Neave	UK
	Dr Alex Forrest	Australia

Chair: Dr Chris Briggs, Dept. of Anatomy, University of Melbourne
Secretary: Mr David Thomas

Poster and demonstration session Wednesday 1st Oct. 9:30 - 10:15
Posters will be available for viewing at other times
(Attendees presenting posters should set these up on Tuesday morning)

P1	Dr Tim Lyons	Port Arthur massacre: Craniofacial identification issues	Australia
P2	A/Professor Jianguo Meng	Physical and chemical identification of video tape	PRC
P3	A/Professor Jianguo Meng	Identity identification on tape with machine in video-recorded material	PRC
P4	A/Professor Jianguo Meng	Video materials identification	PRC
P5	A/Professor Jianguo Meng	Identification technology of photography	PRC
P6	Dr Kanokwan Tangchaitrong	Fourier analysis of profiles of young twins	Thailand
P7	Dr Pam Craig et al	Mass disaster issues pertaining to the Kew Cottages fire	Australia
P8	Dr Jodie Leditschke	Human or Not: Some Unusual Cases of Identification	Australia
P9	Mr Ronn Taylor et al	Anatomical reconstruction with computer enhancement as an aid to identification of unknown persor	

Demonstrations and videos

D1	Jason Ceddia et al	Data bases in identification - D.A.V.ID	Australia
D2	Dr Martin Evison	Computer based facial reconstruction	UK
D3	David Thomas et al	Fourier analysis for quantification of facial shape	Australia
D4	Dr Alex Forrest et al	Forensic imaging in identification	Australia

Trade displays

T1	Electric Alchemy
T2	Gunz Dental Supply Co
T3	Hodder Headline
T4	Robert Nelson
T5	Northcote Pottery
T7	Halas Dental Ltd
T8	Kodak Professional (Vantar Photographics)

Workshops

Forensic facial photography: Friday 3rd October 08:30 - 16:00
Dr John Clement (Head, Forensic Odontology Group, School of Dental Science)
Mr Chris Owen (photographer, School of Dental Science)
Ms Karen Byrne (photographer, Victorian Institute of Forensic Medicine)
Dr A J Hill (forensic odontologist)

Forensic facial drawing: Friday 3rd October 09:00 - 13:00
Senior Sergeant Adrian Patterson (Victoria Police artist)
Mr Richard Neave (Dept of Art in Medicine, University of Manchester)

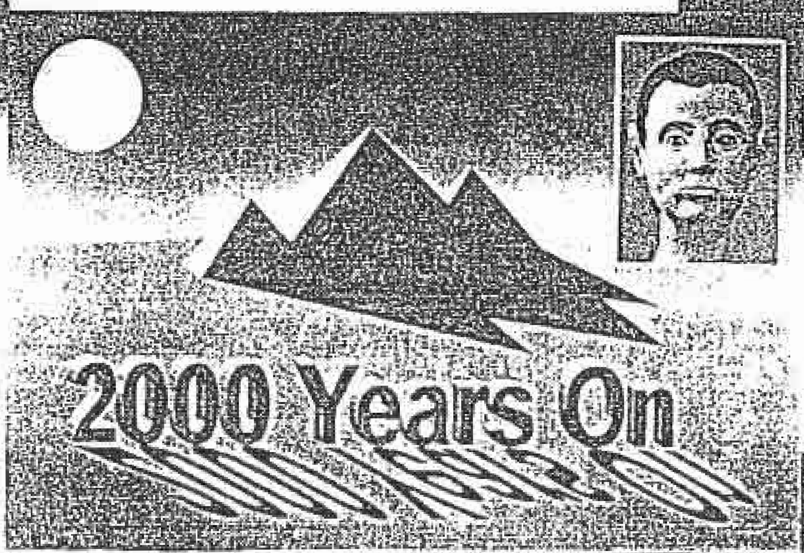
Reconstruction of facial features of the deceased. Friday 3rd October 14:00 - 17:30
Presenter(s) to be announced

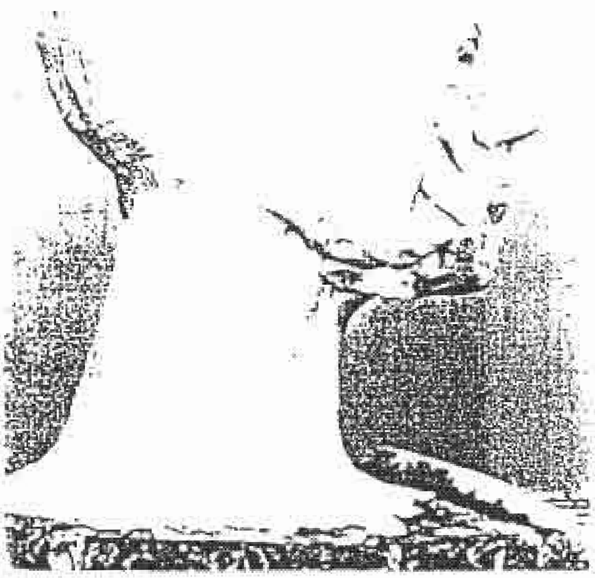
Making an impression: Death masks and bitemarks: Friday 3rd October 11:00 - 13:00
Mr Ronn Taylor (Forensic sculptor, School of Dental Science)
and others

Forensic facial approximation by sculpting: Saturday 4th October 09:00 - 17:00
Mr Ronn Taylor (Forensic sculptor, School of Dental Science)
Mr Richard Neave (Dept of Art in Medicine, University of Manchester)
Ms Denise Smith (Dept of Art in Medicine, University of Manchester)

Appendix 2: Facial reconstruction of a 2000 year old Egyptian mummy.

By Ronn Taylor, Forensic Sculptor, School of Dental Science University of Melbourne.


2000 Years On



Appendix 3: Certificate of attendance.

THE UNIVERSITY OF MELBOURNE
Australia

THIS IS TO CERTIFY THAT *Myra Stanbury*

HAS ATTENDED THE *7th Scientific Meeting of the International Association for Craniofacial Identification*

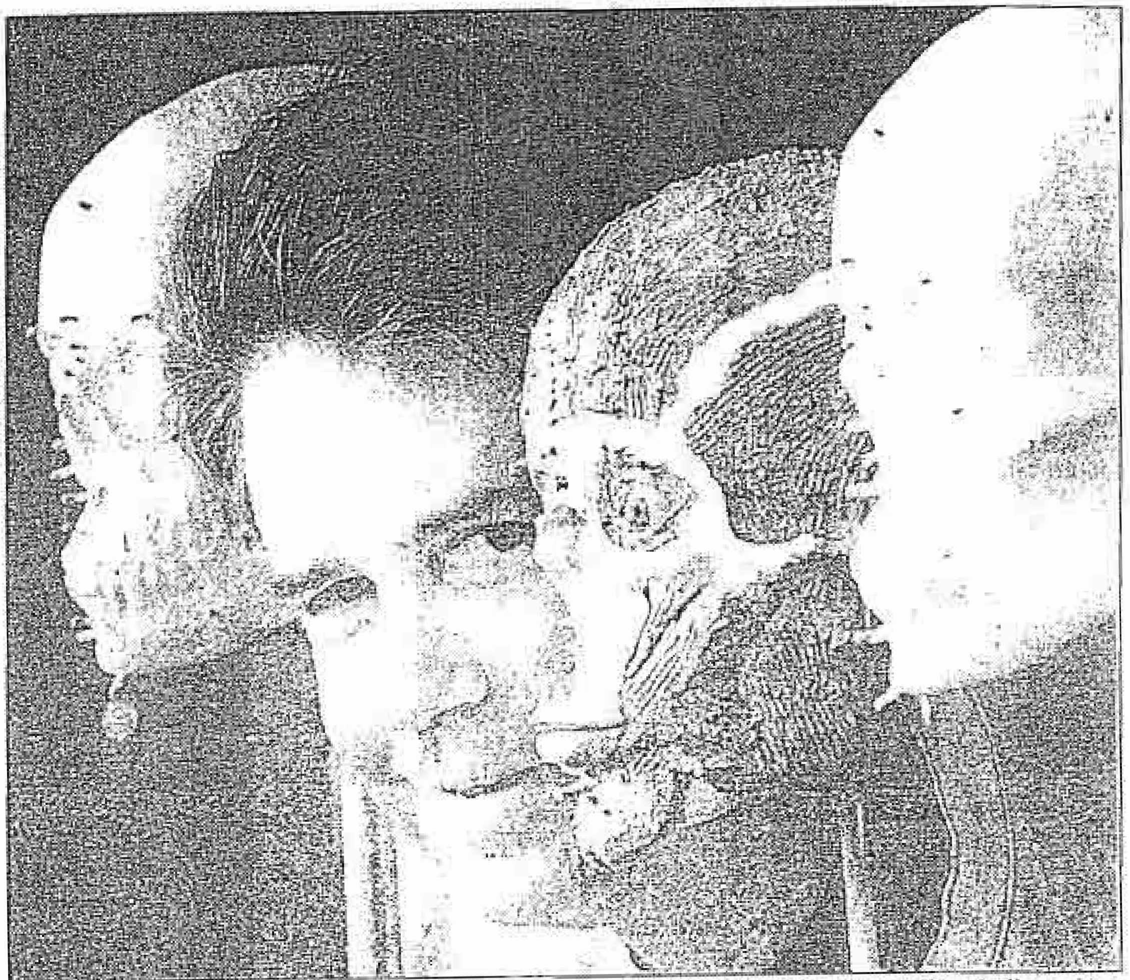
AND IN EVIDENCE WHEREOF THIS CERTIFICATE OF ATTENDANCE IS AWARDED

October 1 1997

J.G. CLEMENT
CHAIRMAN
LOCAL ORGANISING COMMITTEE

Appendix 4: Workshop manual for three dimensional facial reconstruction.

THE AGE
SATURDAY 4 OCTOBER 1997



A name to a face: Twenty-two people today race to reconstruct a face from the skull up. In a photo-finish, faces will be compared with an original made by Mr Ronn Taylor. Picture RAY KENNEDY

Let the Forensic Olympics begin. First up, a skulling competition (expect a photo finish)

Tania Ewing

A Melbourne laboratory will host a macabre contest today, when 22 death professionals sculpt and mould clay on to skulls in the largest ever forensic sculpture workshop.

The contest will decide who is the world's best at reconstructing the faces of dead people whose bodies remain unclaimed. The workshop is part of an international conference in Melbourne on craniofacial identification.

Hosted by the university's Dental School and the Victorian Institute of Forensic Science, it brings together an exotic range of professions dealing with the dead: coroners, medical examiners, embalmers, police, mortuary staff, funeral directors and artists from 16 countries.

Mr Ronn Taylor, a forensic sculptor with the Victorian Institute of Forensic Medicine, is called on at least once a year to reconstruct an unidentified face: "We are the last resort." He uses clay to build muscle fibres and skin on to the skull. It can take 50 hours. The model is given to the media in the hope someone can put a name to the face.

The competitors will work on copies of a skull that Mr Taylor has already reconstructed. His work led to an identification, so a photo of the real face will help choose the winner.

"I expect that about one in four will get the face close to that seen in the photograph," he said. Much of the preparation and measurements will already be done, to cut the reconstruction time.

Professor John Clement, associate professor in oral anatomy at Melbourne University, said children's faces were almost impossible to rebuild. "There is almost no database on children's soft tissue measurements," he said.

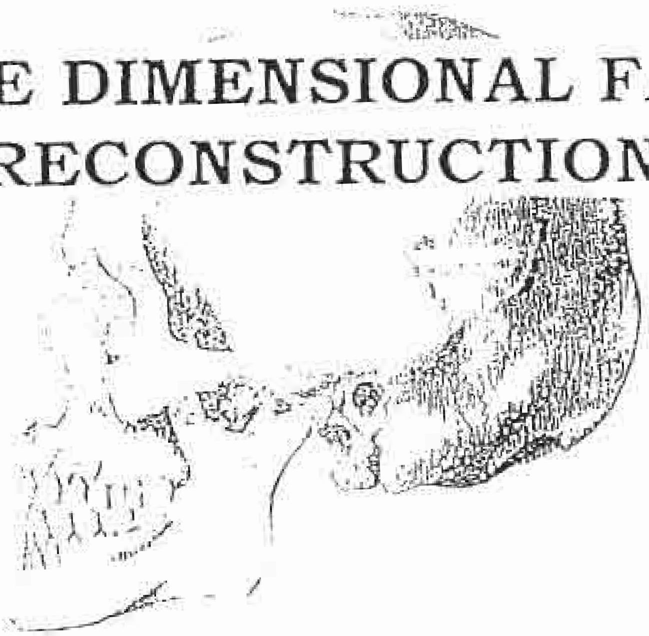
To address this, he has been studying the faces of children for five years, photographing hundreds each time they visit the Dental School, allowing him to collect data on how their faces change with age.

The information will contribute to a computer program that will allow photographs of missing children to be updated.

Professor Clements calls forensic reconstruction a unique science because it combines diverse professions. "We do what we do because everyone has the fundamental right to have an identity in death as they do in life," he said.

THE UNIVERSITY OF MELBOURNE
FACULTY OF MEDICINE, DENTISTRY AND HEALTH SCIENCES

THREE DIMENSIONAL FACIAL RECONSTRUCTION



SCHOOL OF DENTAL SCIENCE
ORAL MEDICINE AND SURGERY UNIT

THREE DIMENSIONAL RECONSTRUCTION OF THE FACE

INTRODUCTION

Three dimensional reconstruction of the face from a skull may be carried out to assist in the identification of human remains and is used when other more reliable methods have failed or are impossible. It is a valuable technique, but has definite limitations. It is not suggested that facial reconstructions will be identical to the ante-mortem appearance. Rather a likeness or caricature may be produced which, if seen by an acquaintance of the deceased, may lead to an identification.

The three dimensional reconstruction may not be the endpoint in producing an image of the deceased. Alteration of the final reconstruction image, via computer software, enables further characterisation particularly with regard to hair style/color/length, ear/nose/eye shapes and sizes, and ageing effects, in a more efficient and rapid manner than traditional three dimensional reconstruction methods.

The reconstruction method detailed in this manual is the technique used by one of the authors. Variations to many aspects of it are possible (see Reich 1986, and Krogman and Işcan 1986), but a successful reconstruction can only be carried out if the person is familiar with the normal human anatomy of the skull and attached soft tissues, the dental occlusion, sculpting, and split mould techniques of duplication.

PRELIMINARY COLLECTION OF DATA

Although the skull is the basis of the reconstruction, as much information about the human remains and associated personal effects should be collected. This is extremely important as details of race, sex, age, and build can often be obtained by thorough examination of the skeletal remains, teeth, clothing and jewellery. Much of this information may be provided to the person carrying out the reconstruction by other specialists (eg police, forensic pathologists, anthropologists and odontologists) and can profoundly influence the final reconstruction and thus should be avidly sought

EXAMINATION OF SKULL

Close examination of the skull can reveal important details that may affect the reconstruction eg prominence of supraorbital ridges, zygomas, profile (especially prominence of chin) squareness of the mandible, symmetry of nasal bones, and ruggedness of muscle attachments. Bony pathology will also influence the soft tissue reconstruction

The dentition and/or dentures should be closely examined as they give clues to articulation of the mandible with the maxilla, possible loss of vertical dimension due to excessive wear of occlusal surfaces, abnormal posturing of the mandible and soft tissue support (particularly lip support).

PREPARATION OF SKULL FOR DUPLICATION

Although the reconstruction may be carried out directly on the skull it is preferable to duplicate the skull in plaster and carry out the reconstruction on a plaster model. Advantages of this include:

1. *damage to skull is avoided*
2. *the skull is available as a reference during the reconstruction*
3. *if the skull is available for a limited time, duplication can be carried out relatively quickly*
4. *multiple models can be made*

The skull is usually provided in a clean dried state, but if not all debris and remaining soft tissue should be removed. If the skull is incomplete, damaged or fragmented, these defects need to be repaired with wax. Dental wax is very useful, both in filling defects and joining fragments, as it can be readily shaped and removed (figure 1)

The mandible needs to be rearticulated with the remaining skull. This is relatively simple if natural or artificial teeth are present. The mandible is simply waxed together to the maxilla and glenoid fossa (place wax here to simulate the disc) with the teeth in correct occlusion (where dentures are present they are also waxed to the jaws to hold them securely in place) and the condyles positioned in the glenoid fossa. A problem arises in edentulous jaws where no dentures are found or where there are insufficient natural teeth to allow easy articulation. In such cases average measurements are used. Occlusal wax rims, as used in *construction of dentures, of average dimensions (15 and 11 mm from crest of alveolar ridge of maxilla and mandible respectively) can be used as in figure 2. Obviously using such measurements are less accurate and detract from the overall accuracy of the final reconstruction as changes in the lower facial height can markedly alter facial appearance.*

Prior to duplicating the skull, modelling clay is used to block out all unnecessary undercuts, eg foramen magnum, external acoustic meatus, anterior and posterior nasal openings and zygomatic arches. Modelling clay is useful as it is pliable, non toxic, inert and easily washed away, but other materials may be used. Eyes are usually fitted directly to the skull as this conveniently blocks out the orbit undercuts at the same time. Prosthetic eyes may be used but plaster eyes are probably easier to alter and certainly much cheaper. The eyes are centred in a line between the midpoints of the superior and inferior orbital rims. The pupil should lie in the centre of this line and is marked in pencil on plaster eyes. From above the eyes should be just visible, over the supraorbital ridges. A small amount of clay is placed around the eye to simulate the orbital muscles, lachrymal gland and pad of fat.

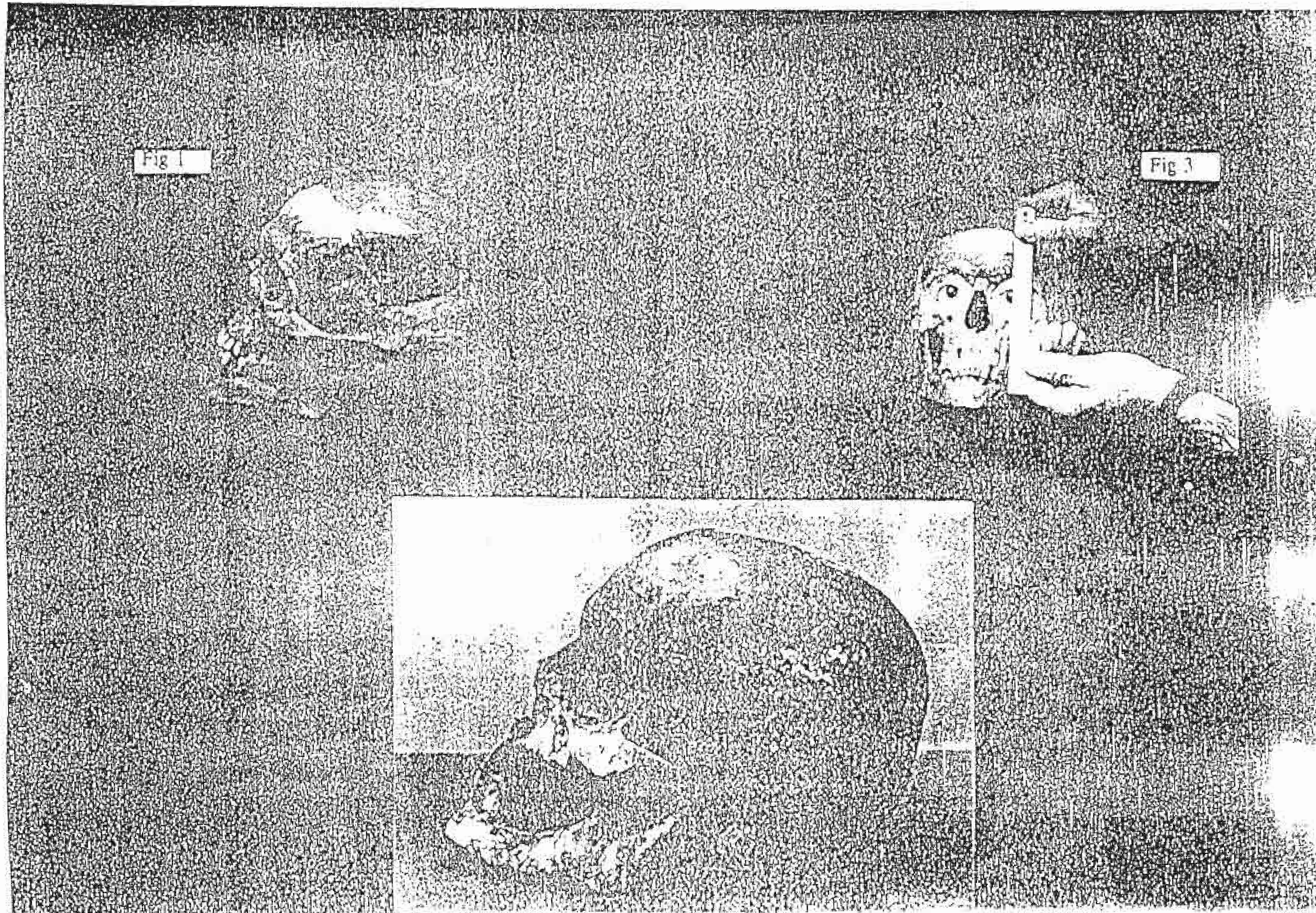


Fig 1
Fig 3

DUPLICATION OF SKULL

A split cast technique is used to duplicate the skull. Several methods of producing a split cast are possible but all use a flexible impression material which is supported by an outer rigid layer. The cast is divided in an oblique plane passing through the mental sulcus, across the body of the mandible, zygomatic arch, ear and parietal bones. The skull is placed with this plane horizontal and supported by clay. A horizontal table of clay 5cm wide around the entire skull is added (figure 4) to support the first half of the mould whilst it is setting. This table of clay is notched at regular intervals (this will later facilitate accurate positioning of both halves).

A large quantity of alginate impression material is mixed (450g powder). A slow setting material is ideal and use of iced water further retards the setting reaction. The alginate is rubbed across the skull surface of the skull to decrease the incidence of surface air bubbles and improve general adaptation of the alginate. An even thickness of alginate is ideal but impossible to obtain.

When the alginate is set glad wrap or similar material is adapted to it and a plaster support structure poured (figure 6). The glad wrap prevents dehydration of the alginate and serves as a separator. Before the plaster is set a shallow groove is scribed in it from the ear area to the contralateral ear (this groove is later continued on the second half of the mould and facilitates tying of both halves of the mould together when the model is being prepared).

Once the plaster has set, the clay supporting the skull is removed, a separating medium painted onto the first the half of the mould and the second half of the mould then constructed in a similar manner to the first half. When the entire mould is hard it is then dismantled carefully starting with the half covering the posterior aspect of the skull (figure 7). The plaster support is first removed and then the alginate from the skull, being careful not to tear the alginate. The alginate is then reseated in both halves.

A suitable quantity of plaster is then mixed, manually rubbed over the alginate internal surface of both halves (to decrease surface imperfections), and the rest poured to fill each half of the mould. Both halves are repositioned accurately together (using the location notches), tied together (using string in scribed groove) and the mould is shaken until initial setting has occurred. The mould is then left until the plaster model has set hard. The mould is then removed carefully - again the plaster outer support is removed first then the alginate. Further models can be poured if desired. Accuracy of the duplicate can be checked by use of callipers and comparing landmarks on the plaster model with the same landmarks on the skull. For convenience, and to minimise the risk of damage, the plaster model on a revolving work stand via a vertical metal bracket. A hole is drilled in the foramen magnum region to a distance of about 4cm, the metal bracket inserted and fixed in place by a new mix of plaster poured into the hole. The metal bracket should be long enough so that when the model is seated sufficient space to reconstruct the neck remains. The plaster model should have its centreline vertical and the Frankfurt plane should be horizontal.

Fig 4

Fig 5

Fig 6

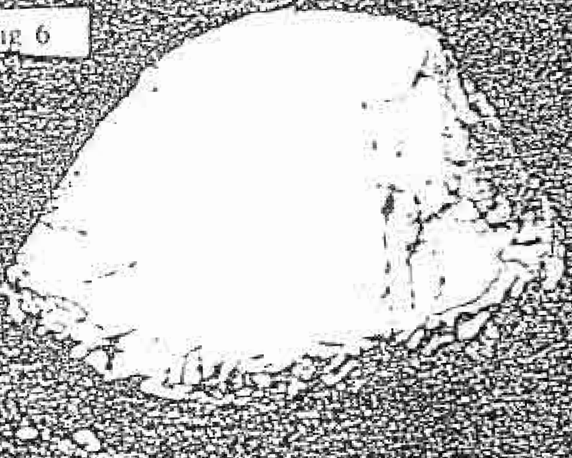
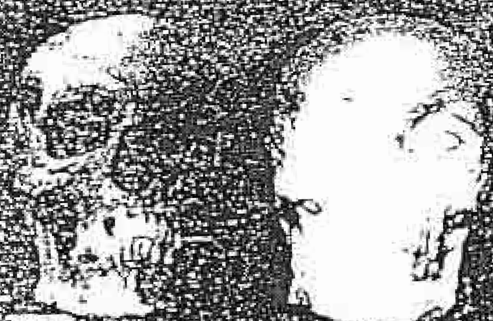


Fig 7

Fig 8



FACIAL RECONSTRUCTION

The basis of the soft tissue reconstruction is the use of average soft tissue thicknesses for given anatomical landmarks (see table). These landmarks are marked on the skull and cut matches of the appropriate length glued onto the model at these points. The colored end of the match is useful as it is clearly visible even through a thin layer of clay. In this technique muscles are built up first in an anatomical manner trying to keep the shape, origin and insertion as is found in nature. Details of these can be found in anatomy textbooks eg Gray's anatomy.

The temporalis, masseter, buccinator and occipito-frontals are first built up, followed by orbicularis oculi and orbicularis oris (figure 10). At this stage it is often useful to reconstruct the nose and lips before forming the other muscles.

The lips are approximately as wide as the interpupillary distance, but the form of the lips varies with age, sex, race, occlusion and loss of vertical dimension. In young adults the upper lip does not cover all the upper incisors but with age these may be completely covered. Obviously if the teeth are significantly worn, or if inadequate dentures are present,m the position of the lips will vary. Similarly certain occlusions are associated with lip features such as a short upper lip in Class II Division II occlusions. The philtrum of the lip will be affected by the length of the lip, the lip support by the teeth and the shape of the base of the nose.

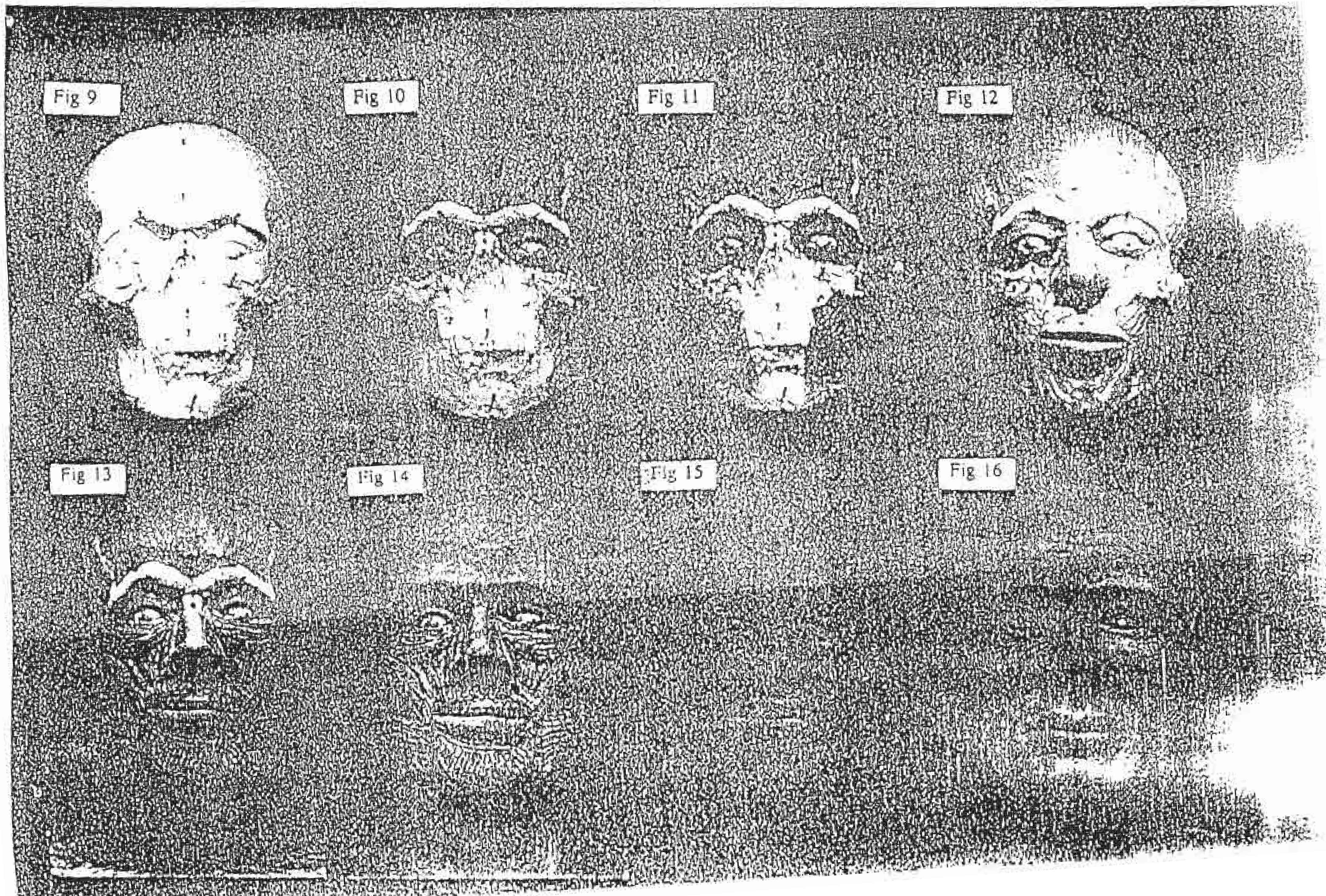


Fig 9
Fig 10
Fig 11
Fig 12
Fig 13
Fig 14
Fig 15
Fig 16

The nose is difficult to reconstruct because of limited underlying bone and the wide variability found in nature. The profile of the nose is arbitrarily determined by projecting two lines from the skull midline - the first is a continuation of the inclination of the nasal bones and the second is a horizontal line from the anterior nasal spine. On average Gatliff (1984) found the width of the nose is 1.67 times that of the anterior nasal aperture.

The muscles of facial expression are then reconstructed (figure 12) and after this the eyes completed. The medial palpebral ligament extends 3mm over the medial rim of the orbit and the lateral palpebral ligament extends 5mm from the lateral rim of the orbit. The lids extend from these and normally cover part of the iris. At this stage "fleshing out" of the brows and scalp to within 1mm of the depth marker is done, the neck built up (size helped greatly if clothing is found with body) and ears added. The latter are positioned so that the top of the tragus is positioned at the external acoustic meatus and set obliquely with a 15° posterior inclination. Again great variation in the appearance of the ears is possible.

Lastly the final "fleshing" of the face is carried out to the tips of the depth markers and characterisation may be done if indicated eg addition of wrinkles, accentuation of skin folds, and bags under the eyes to create an aged effect. Similarly if the vertical dimension is thought to be deficient due to excessive wear of teeth, creases from the angles of the mouth may be accentuated and the chin made more prominent. Racial characterisation may be carried out if indicated eg to give Asian appearance to eyes and surrounding tissues.

TABLE[*]: SOFT TISSUE THICKNESSES

DEPTH SITES	WELCKER (1883) GERMANS	HIS (1895) GERMANS		KOLLMAN & BÜCHLY (1898) SWISS		SUZUKI (1948) JAPANESE		RHINE & CAMPBELL (1980) AMERICAN BLACKS		O'GRADY AND TAYLOR (1990)					
										MALE		FEMALE			
												THIN		WELL NOURISHED	
		M	F	M	F	M	F	M	F	AV	SD	AV	SD	AV	SD
OCCIPITAL	6.6														
MIDDLE OF PARIETAL	5.3														
UPPER FOREHEAD HAIRLINE		4.50	4.18	[illegible]	[illegible]										
MIDDLE FOREHEAD	4.3					3.0	3.0	4.75	4.5	4.8	1.4	2.5	1.1	3.0	1.1
GLABELLA		5.10	4.75	4.29	3.90	3.8	3.2	6.25	6.25	6.6	2.0	4.8	1.2	6.0	1.5
NASION/NASAL ROOT	6.9	6.65	5.0	4.31	[illegible]	4.1	3.4	6.00	5.75	6.8	1.2	4.8	1.0	6.6	2.2
MID NASAL BONE	3.3	3.37	3.0	3.13	2.67					3.3	1.3	2.7	1.1	2.8	0.8
TIP OF NASAL BONE	2.2			2.12	2.07	2.2	1.6	3.76	3.75	3.9	1.6	2.5	0.8	3.8	1.8
MID PHILTRUM AKANTHION		11.49	9.75	11.65	10.1			12.26	11.25	12.9	4.1	8.8	2.1	12.3	2.8
UPPER LIP MARGIN PROSTHION	11.0	9.51	8.25	9.46	8.1			14.0	13.0	11.0	3.0	7.3	2.7	8.3	2.5
MENTAL SULCUS	10.8	10.26	9.75	9.84	10.95	10.5	8.5	12.0	12.0	11.9	2.8	10.4	1.3	13.2	2.6
MENTAL EMINENCE	8.5	11.43	10.75	9.02	9.37	8.2	6.3	12.26	12.25	9.1	2.3	5.4	1.0	8.9	2.0
BENEATH CHIN		6.18	6.6	5.96	5.86	4.8	2.6	8.0	7.75	9.4	3.3	6.3	1.3	7.5	2.1
MILD SUPRA-ORBITAL		6.89	5.5	5.41	5.15	4.5	3.5	4.75	4.60	8.0	1.6	5.4	1.3	7.4	1.3
MID SUB-ORBITAL		5.06	5.25	3.51	3.65	3.7	3.0	7.5	8.5	11.6	4.4	5.6	1.9	9.6	3.1
LATERAL ORBIT						5.4	4.7	13.0	14.25	13.0	6.0	7.7	1.9	11.7	3.4
MID ZYGOMATIC ARCH				4.33	5.32	4.4	2.8	8.75	9.25	10.3	3.7	6.3	2.3	10.0	2.3
SUPA GLENOID/ BASE OF ZYGOMATIC ARCH		6.07	5.75	7.42	7.1			11.75	12.0	13.3	4.4	7.6	3.8	11.4	3.9
IN FRONT OF MASSETER		8.86	8.1	7.75	6.16					13.6	4.8	9.0	3.2	12.7	4.0
MID RAMUS		18.05	17.06	17.01	14.65					24.3	6.2	14.3	2.7	22.9	4.2
GONION		12.21	11.6	8.72	7.58	5.8	4.0	14.25	14.25	15.5	7.1	8.3	2.2	14.8	4.9

[*] Modified and compiled from Caldwell 1981, Krogman & Işcan 1986 and O'Grady & Taylor 1990

DUPLICATION OF RECONSTRUCTION

Although the clay reconstruction will keep indefinitely with a damp towel wrapped around it when placed inside a polythene bag, it is preferable to make a more durable plaster duplicate. This is made in a similar manner as the skull was duplicated. The clay reconstruction is supported by towels and sheets of dental wax are placed horizontally in a plane just behind the ears (figure 16). Alginate is poured and then plaster over this to construct half the mould (figure 17). When this has set the wax sheets are removed and the second half constructed. Finally the mould can be removed from the clay reconstruction and a plaster model then poured.

SUMMARY

1. Reconstruction is carried out on a duplicate of the skull using average soft tissue thicknesses are the basis of the soft tissue reconstruction. In reality great variation is found in human soft tissue thicknesses and structures such as the nose and ears are extremely variable. Muscles are reconstructed in an anatomical manner and then final fleshing out carried out.

2. Final characterisation may be carried out depending on whether likely characteristics are known. Structures such as lips, ears, nose, eye colour, hair colour/length/style are very variable in appearance. These structures are generally more efficiently altered by using computer software.

3. The reconstruction will at best produce an image with features similar to the ante-mortem appearance. Identification is only possible if wide circulation of the reconstruction image is possible ie by use of the mass media.


Fig 18
Fig 17
Fig 20
Fig 19

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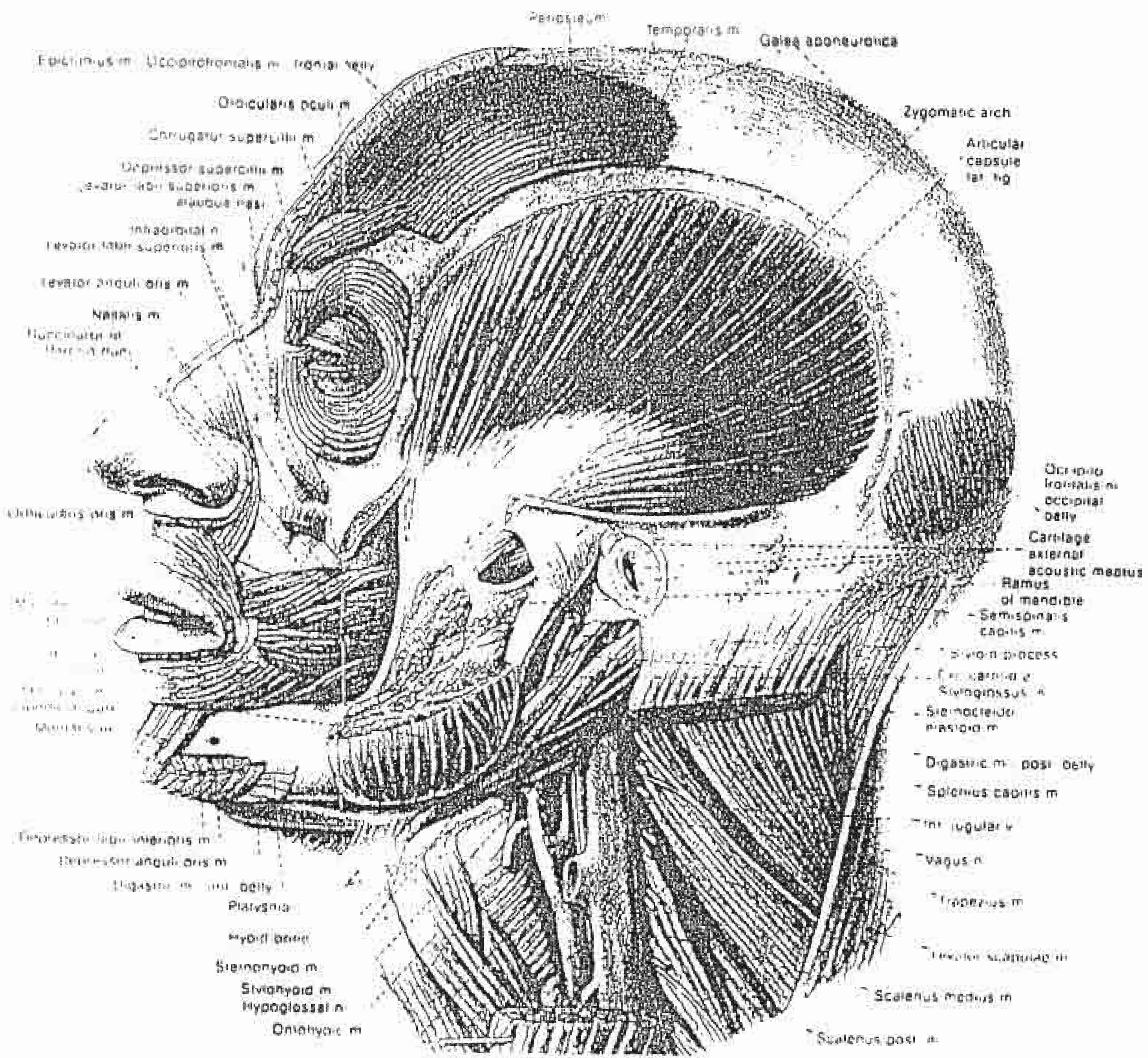
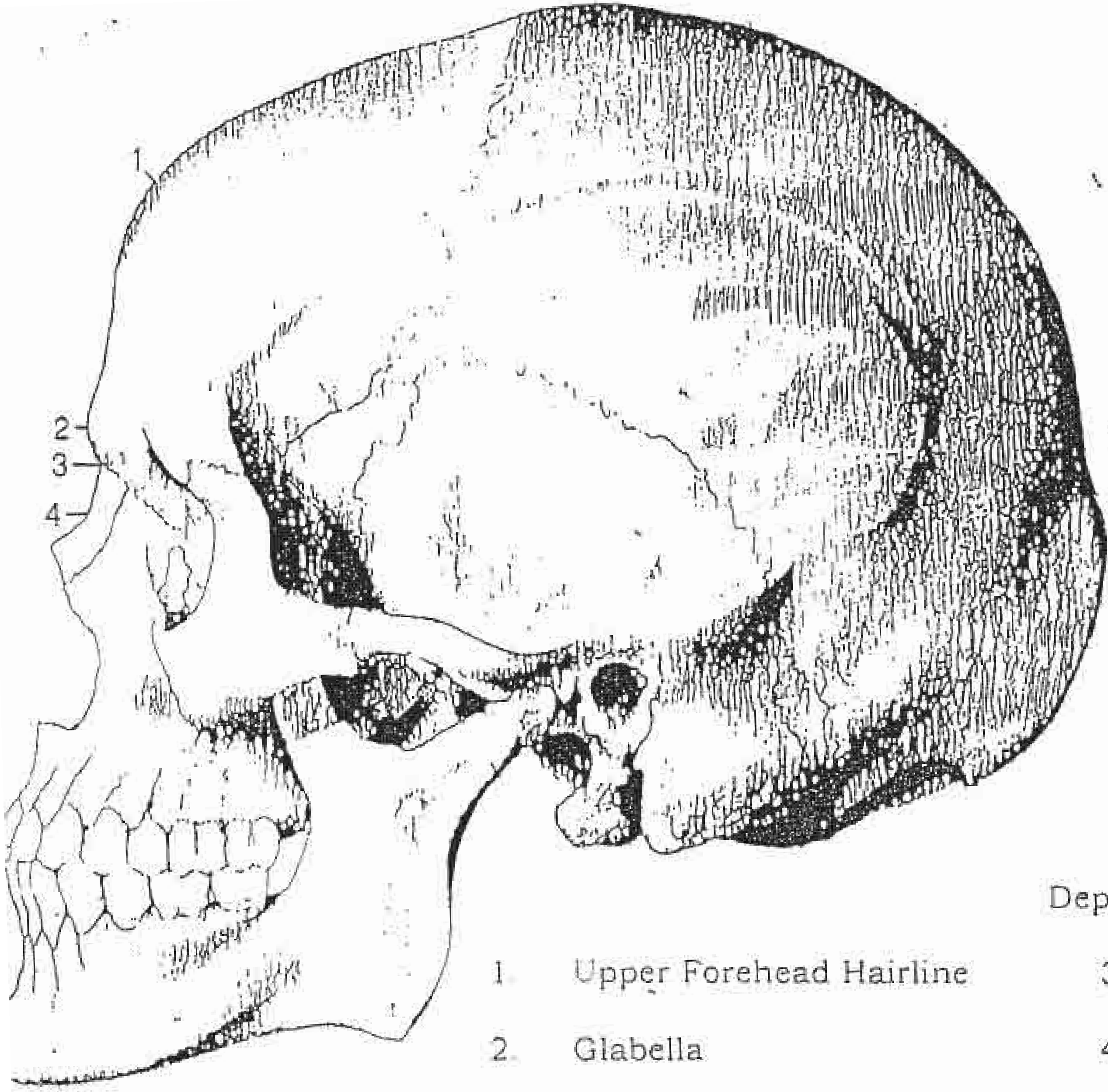
THE FACE FROM THE FRONT AND THE RIGHT

1 Auriculotemporal nerve and superficial temporal vessels
2 Anterior branch of superficial temporal artery
3 Orbicularis oculi
4 Frontalis part of occipitofrontalis
5 Supra-orbital nerve
6 Supratrochlear nerve
7 Procerus
8 Nasalis
9 Levator labii superioris alaeque nasi
10 Levator labii superioris
11 Zygomaticus minor
12 Levator anguli oris
13 Orbicularis oris
14 Depressor labii inferioris
15 Depressor anguli oris
16 Body of mandible
17 Marginal mandibular branch of facial nerve
18 Facial artery
19 Facial vein
20 Buccinator and buccal branches of facial nerve
21 Zygomaticus major
22 Accessory parotid gland overlying parotid duct
23 Masseter
24 Zygomatic) branches of
25 Temporal) facial nerve
26 Parotid gland
27 Great auricular nerve
28 Sternocleidomastoid

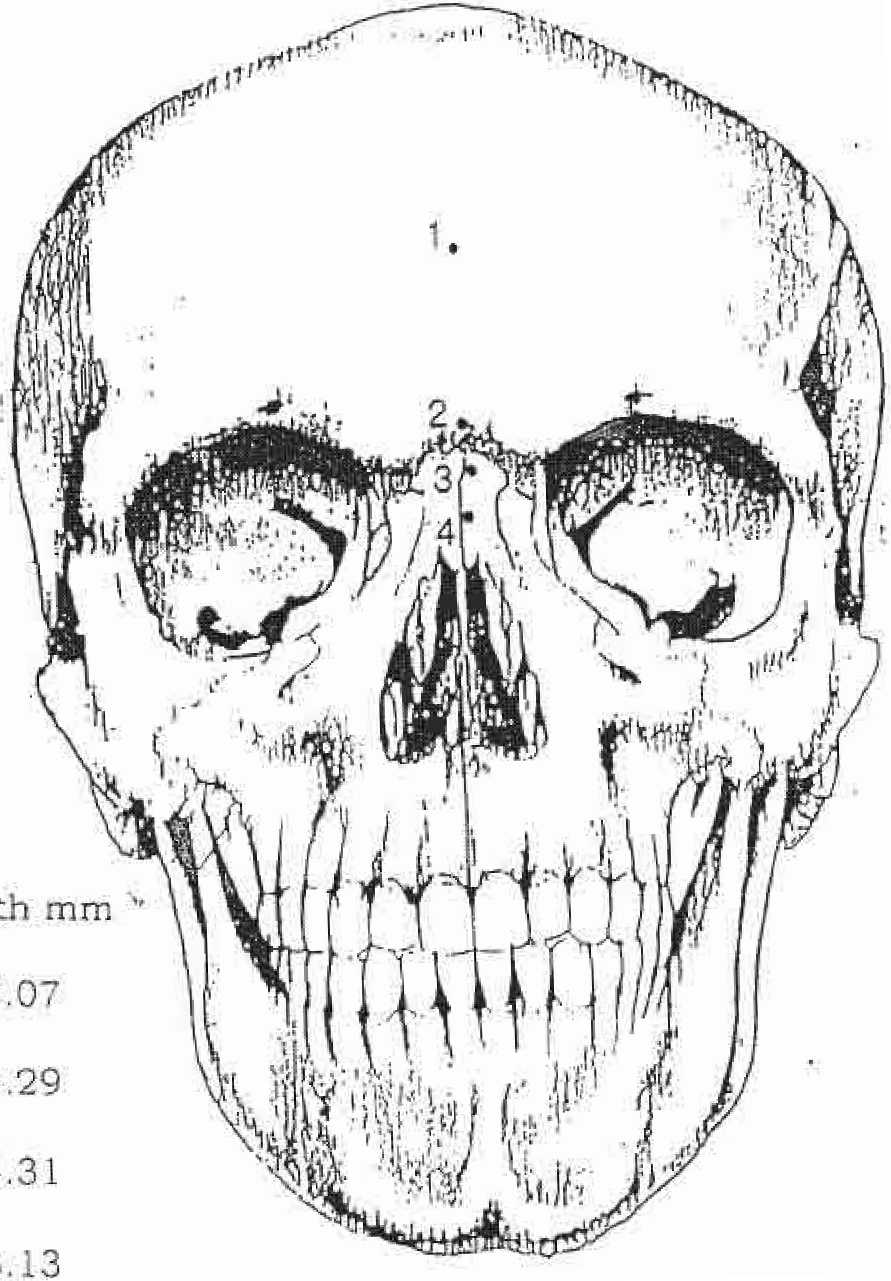
- The facial artery is tortuous and lies anterior to the facial vein which is straight. Both vessels pass deep to the zygomaticus muscles.
- The facial expression group of muscles (which includes the buccinator) is supplied by the facial nerve. (The muscles of mastication – temporalis, masseter, medial and lateral pterygoids – are supplied by the mandibular nerve.)

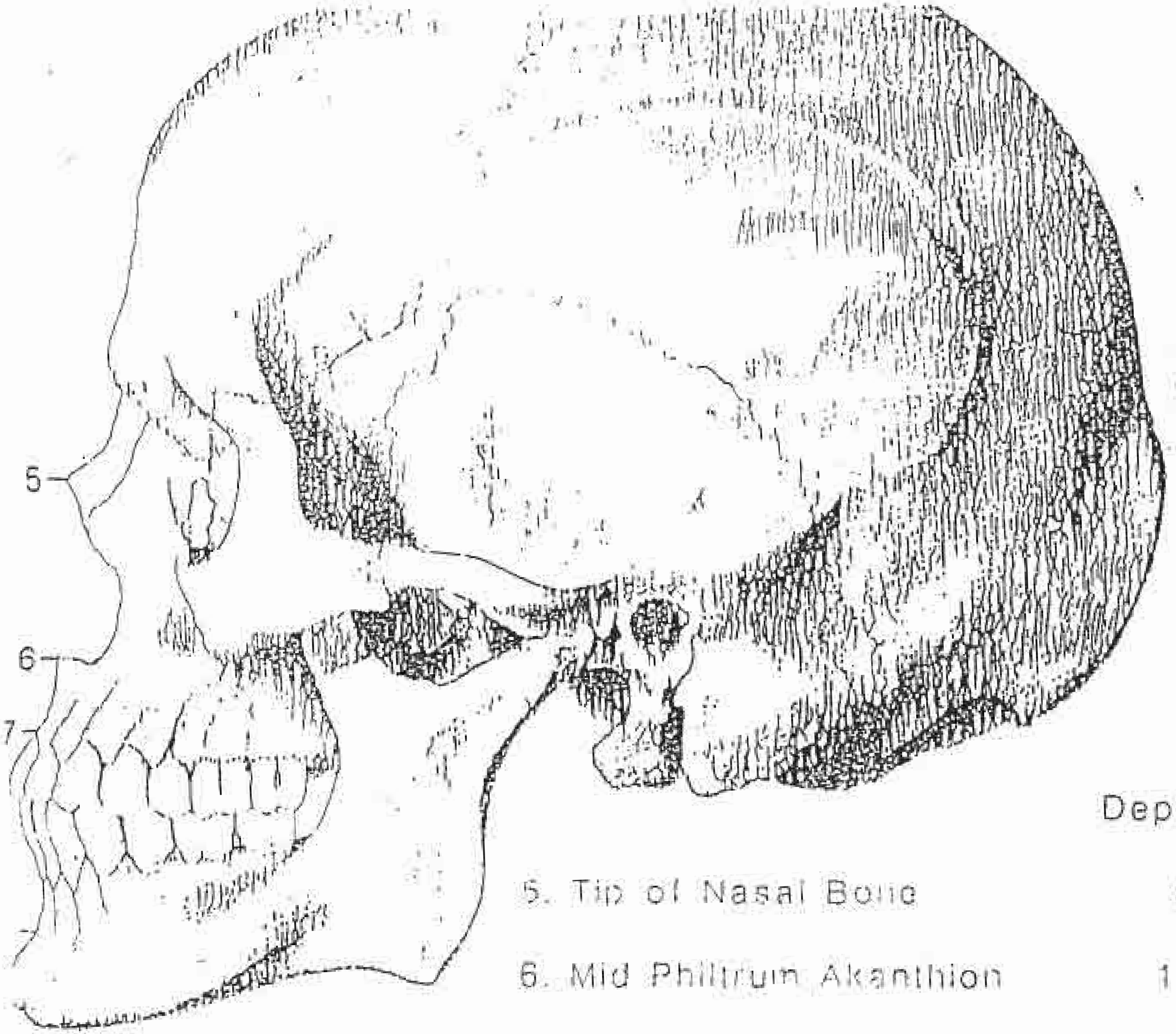
Masticatory Muscles – Lateral View

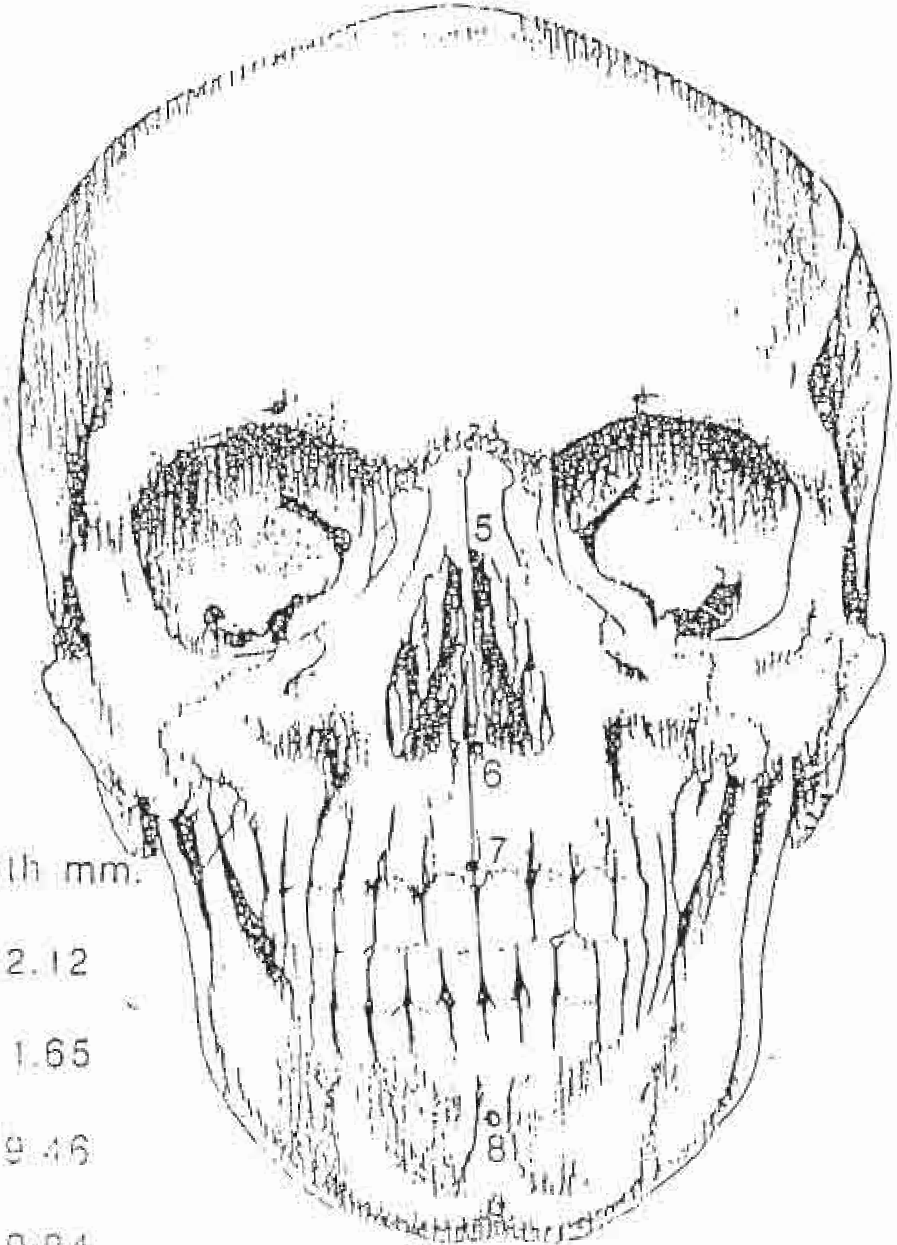




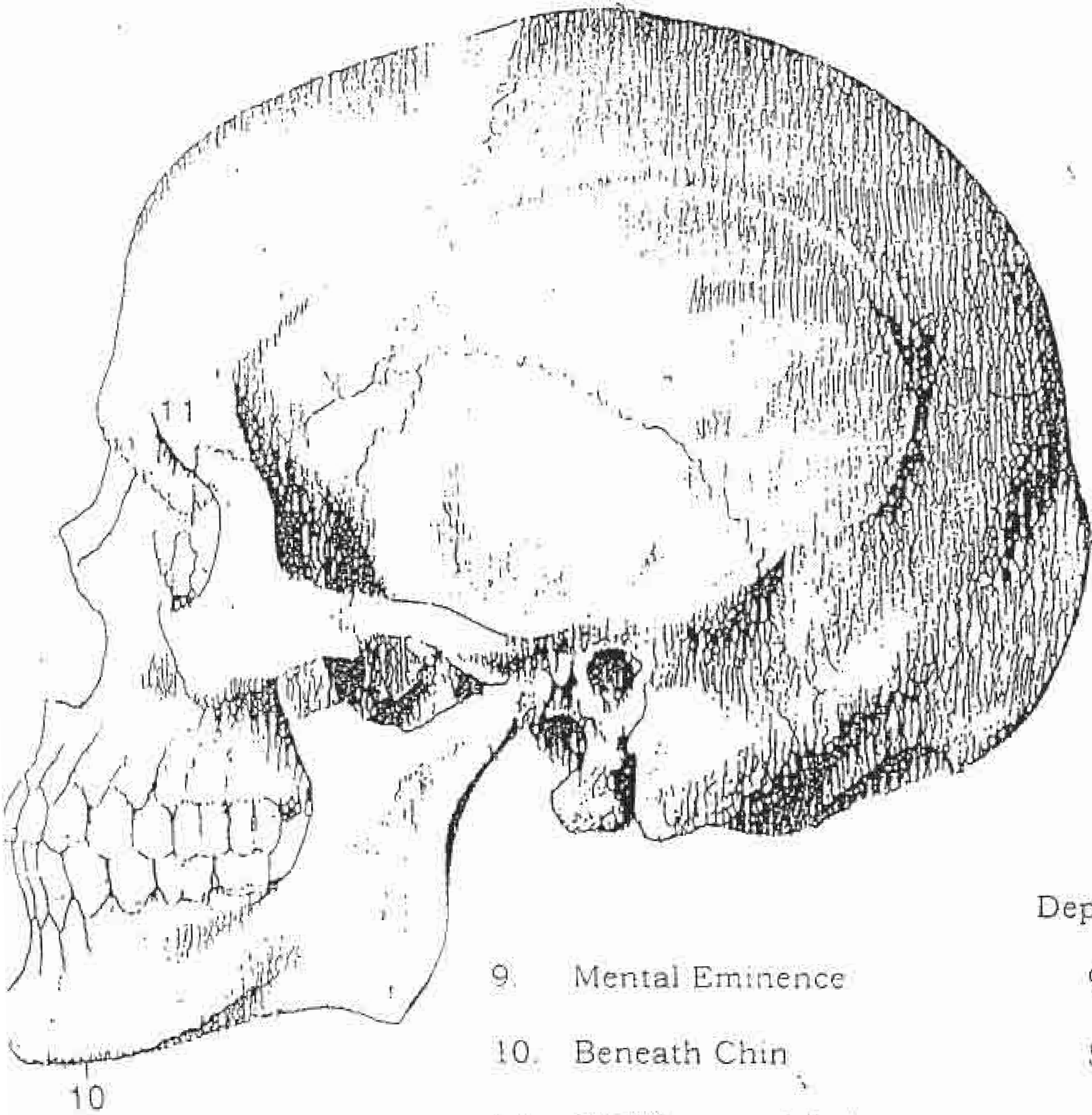
		Depth mm
1.	Upper Forehead Hairline	3.07
2.	Glabella	4.29
3.	Nasion/Nasal Root	4.31
4.	Mid Nasal Bone	3.13

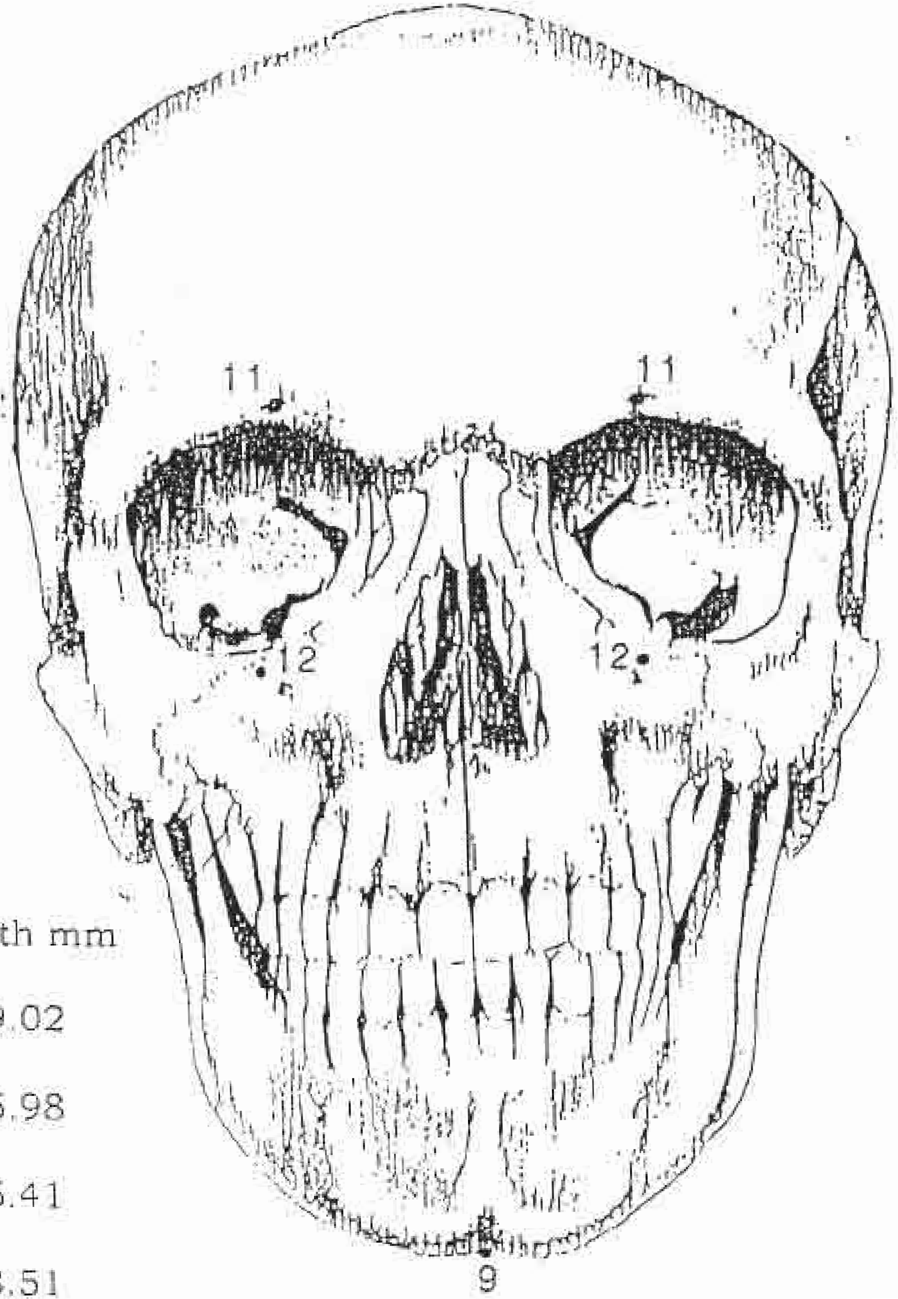




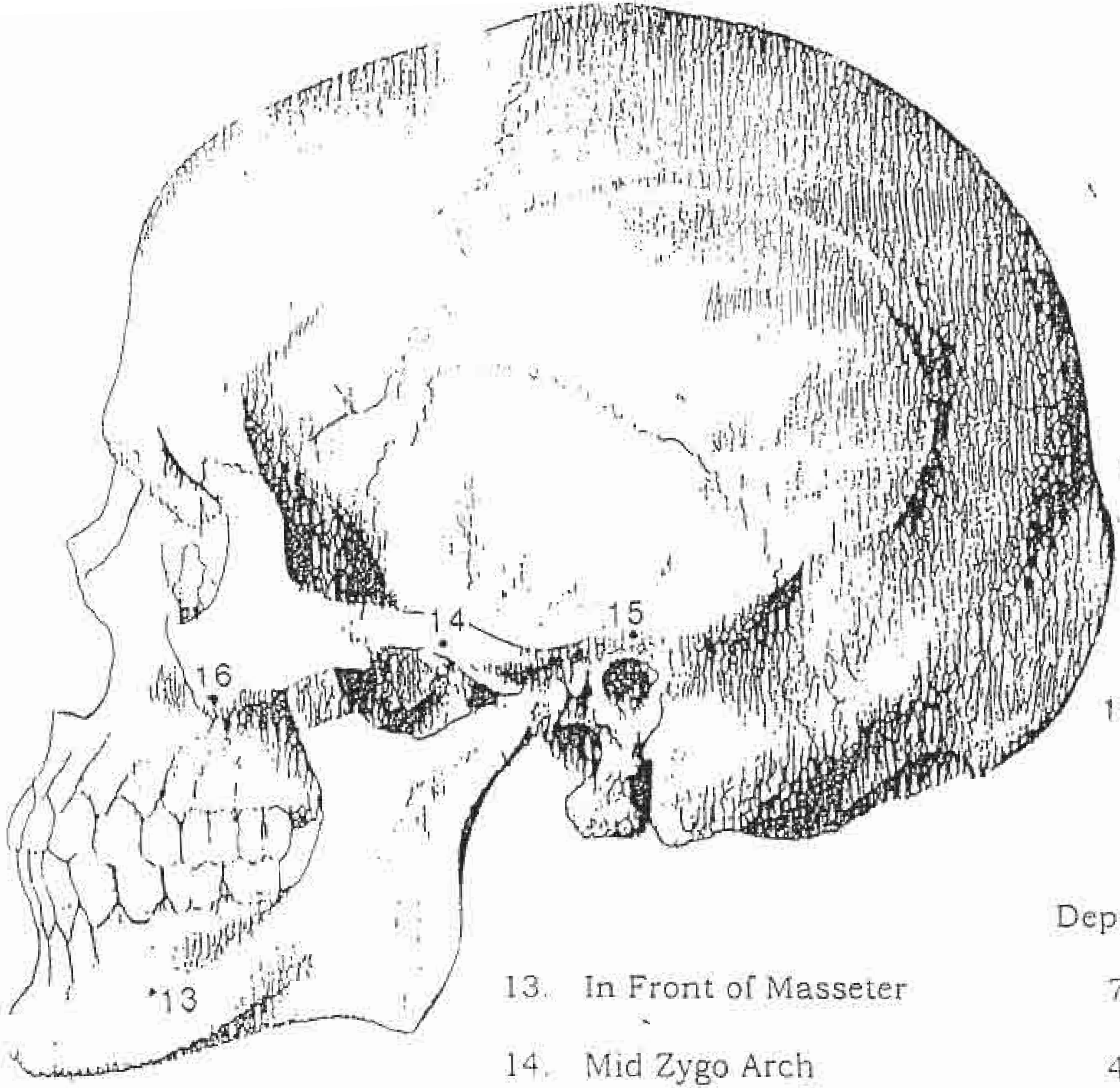


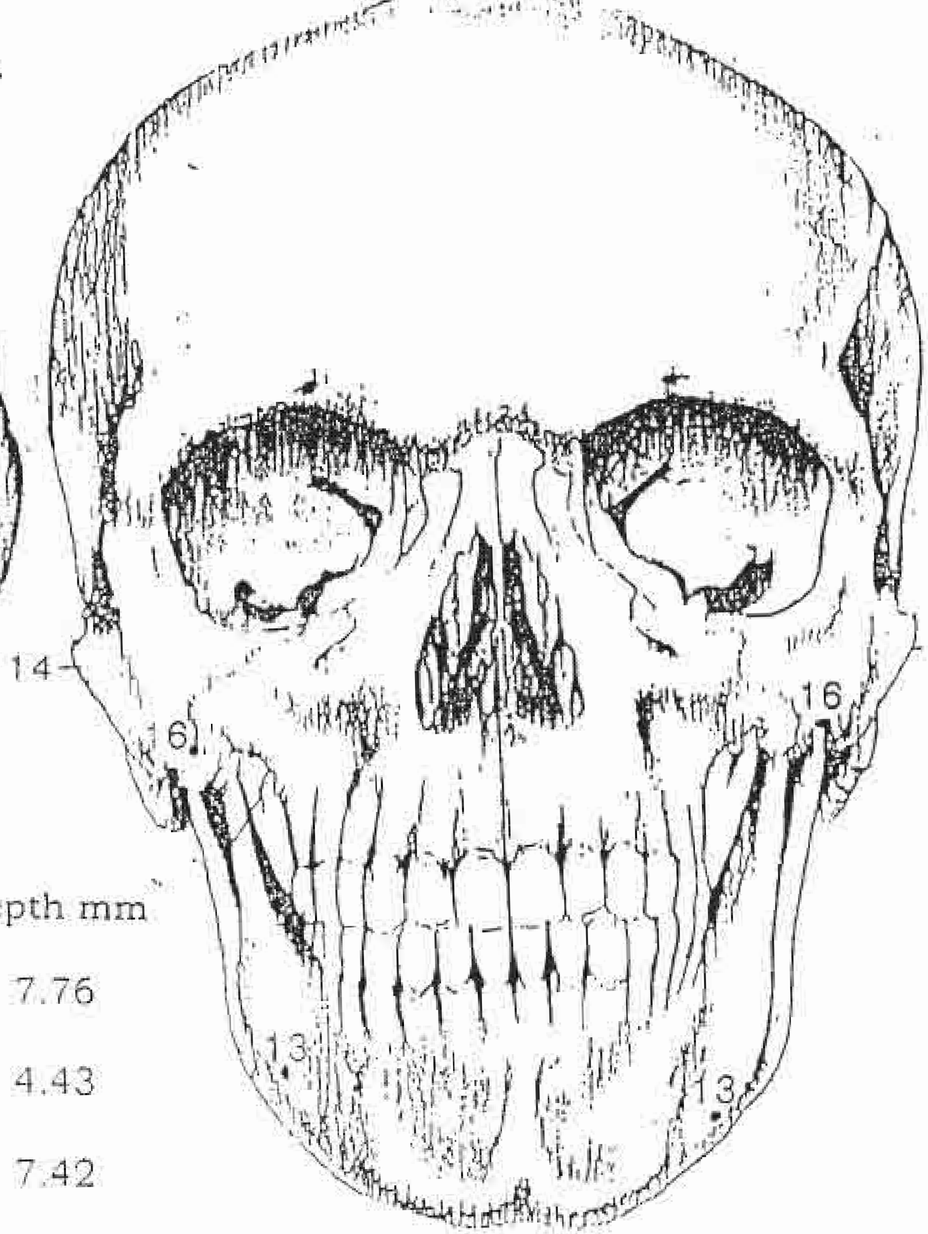
	Depth mm.
5. Tip of Nasal Bonc	2.12
6. Mid Philtrum Akanthion	11.65
7 Upper Lip Margin Prosthion	9.46
8. Mental Sulcus	9.84



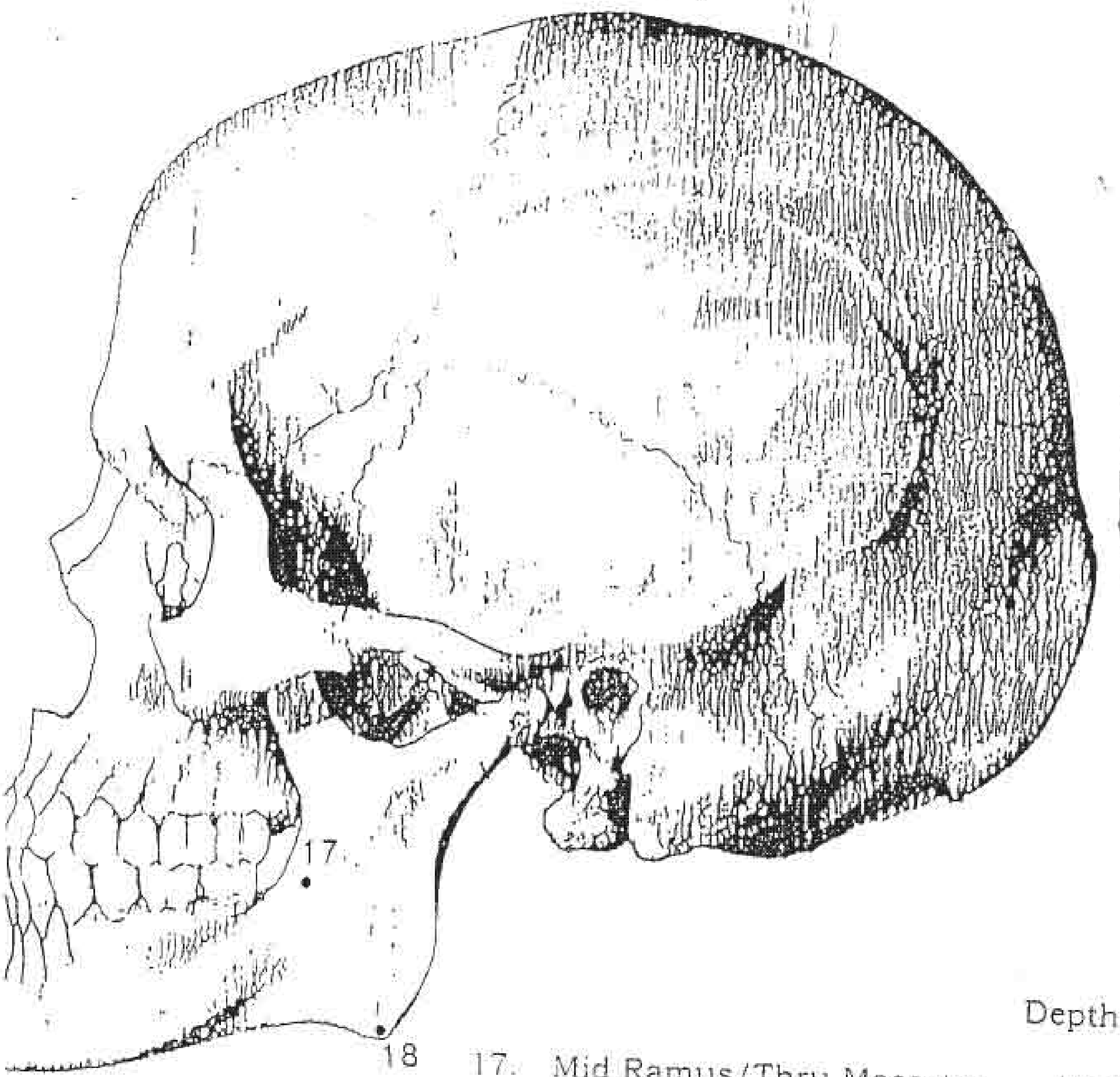


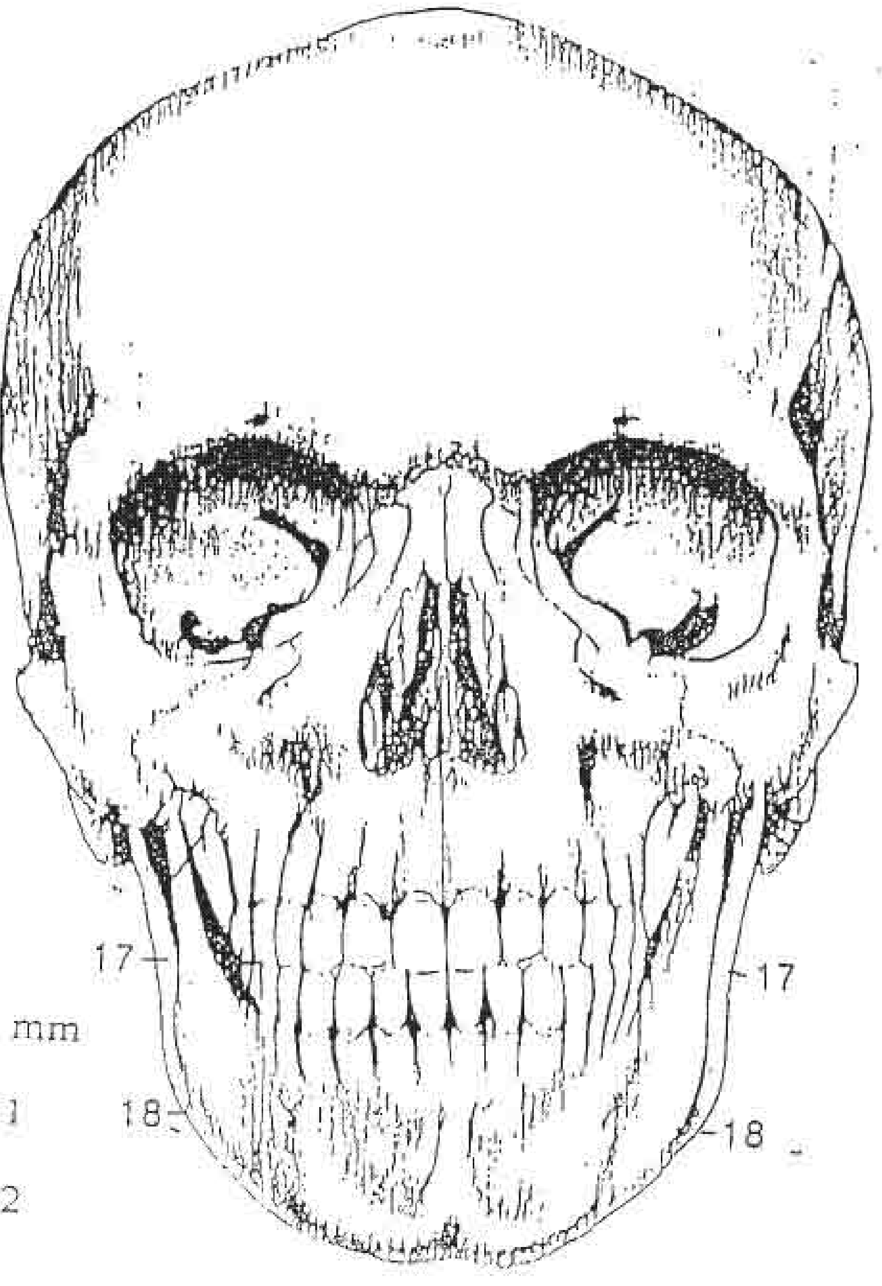
		Depth mm
9.	Mental Eminence	9.02
10.	Beneath Chin	5.98
11.	Mid Supra-orbital	5.41
12.	Mid Sub-orbital	3.51





		Depth mm
13.	In Front of Masseter	7.76
14.	Mid Zygo Arch	4.43
15.	Supraglenoid/Base of Zygo	7.42
16.	Lateral Orbit	6.62





		Depth mm
17.	Mid Ramus/Thru Masseter	17.01
18.	Gonion	8.72

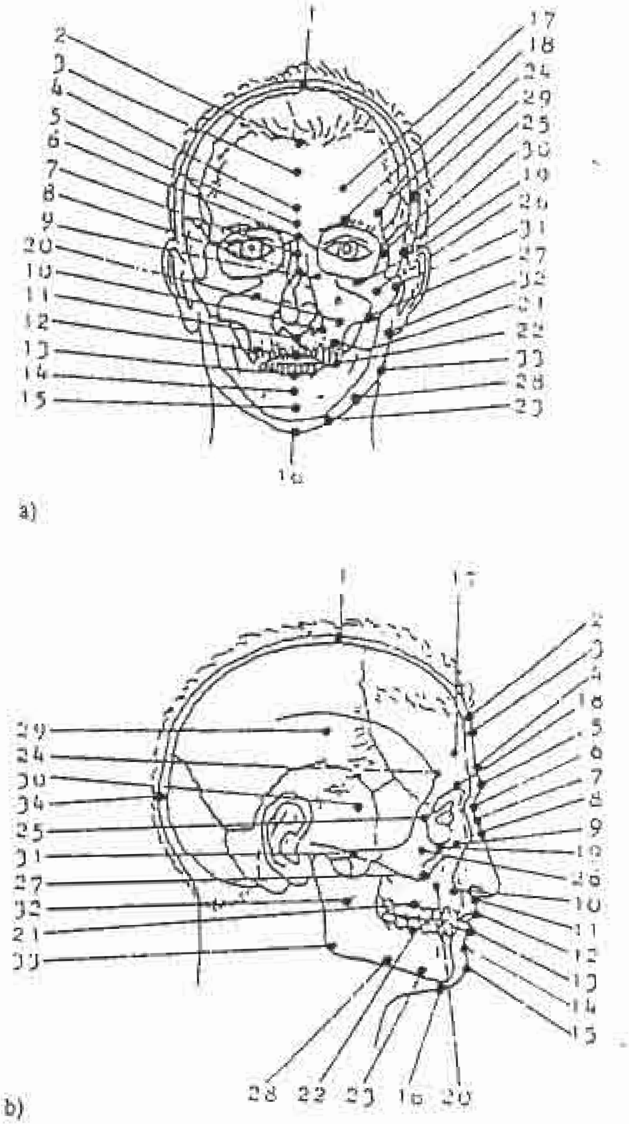


Abb. 17 a + b: Meßorte am Lebenden; ausgewählt für das Ultraschallimpulsechoverfahren.

Zusammenstellung und Beschreibung der Meßpunkte

1	v	Vertex
2	tr	Trichion
3	m	Metopion
4	on	Ophryon
5	g	Glabella
6	n	Nasion
7	nm	Nasenbeinmitte
8	rhi	Rhinion
9	na	seitlicher Nasenansatzpunkt in Höhe der Frankfurter Horizontale
10	al	Alare
11	sn	Subnasale
12	ls	Labrale superius
13	li	Labrale inferius
14	slm	Sulcus-labiomentalis
15	pg	Pogonion
16	gn	Gnathion
17	stm	Stirnmitte, Punkt über der Mitte des oberen Orbitarandes auf der Verbindungslinie von Frontotemporale zum Metopion
18	oa	Mitte oberer Augenhöhlenrand
19	or	Orbitale
20	fc	Fossa canina, tiefste Stelle der facies anterior maxillae, dicht neben dem Alare
21	ms	oberer erster Molar
22	mi	unterer erster Molar
23	ur	Unterkieferrand unterhalb des oberen Eckzahnes
24	ft	Frontotemporale
25	ek	Ektokonchion
26.	wh	Wangenbeinhöcker etwa in Höhe der Frankfurter Horizontale
27	zm	Zygomaxillare
28	m1	Unterkieferrand vor dem Masseteransatz
29.	eu	Euryon
30.	mt	M. temporalis oberhalb des Zygion in Höhe des Ektokonchion
31.	zy	Zygion
32.	m2	Massetermitte zwischen Gonion und Zygion
33.	go	Gonion
34.	op	Opisthokranion

Tabelle 9: Medianwerte, Vertrauensbereiche und Extremwerte der Weichteildicke an 34 Meßpunkten (in mm) — Alter: 20 – 29 Jahre

Männer (n = 13)					Frauen (n = 12)			
Meß-pkt.	x̃	VB (95%) – ≤ u ≤ –	Min.	Max.	x̃	VB (95%) – ≤ u ≤ –	Min.	Max.
01	5,0	5,0 – 5,5	4,0	6,5	4,5	4,5 – 5,0	4,0	5,5
02	4,3	4,0 – 4,5	3,5	5,5	4,1	3,8 – 4,3	3,5	5,0
03	5,0	4,5 – 5,3	4,0	5,5	4,5	4,0 – 5,0	3,5	5,2
04	5,5	5,2 – 6,0	5,0	6,7	5,0	4,5 – 5,5	4,2	5,8
05	5,7	5,5 – 6,5	5,2	6,7	5,5	5,0 – 5,5	4,5	6,3
06	8,2	7,0 – 8,9	6,3	10,2	6,9	6,0 – 7,0	4,7	7,3
07	3,0	2,3 – 4,2	1,5	4,5	2,9	2,5 – 3,0	1,7	4,0
08	2,3	1,0 – 2,8	1,0	3,7	2,3	1,5 – 2,7	1,5	4,2
09	7,5	6,5 – 8,0	5,8	9,0	7,0	6,0 – 7,5	4,5	[illegible]
10	13,3	11,8 – 13,7	11,2	14,5	11,6	10,8 – 12,0	9,3	13,0
11	15,5	13,7 – 16,3	12,3	17,2	13,8	12,8 – 14,3	11,3	15,0
12	14,0	13,3 – 14,7	11,8	17,0	11,8	11,0 – 13,3	10,2	14,2
13	14,2	13,7 – 14,5	10,5	16,0	12,0	12,0 – 13,0	10,5	15,7
14	12,0	10,2 – 12,2	10,0	14,0	10,4	10,2 – 10,8	9,3	12,5
15	9,7	8,2 – 10,2	7,3	13,7	9,6	7,2 – 10,1	6,7	[illegible]
16	7,5	6,7 – 8,5	6,5	10,0	7,1	6,0 – 7,3	5,6	[illegible]
17	5,5	5,0 – 6,0	4,5	6,7	5,2	5,0 – 5,5	4,5	5,7
18	7,3	6,5 – 8,0	6,3	9,2	6,0	6,0 – 6,7	5,7	8,0
19	5,2	4,7 – 5,3	4,2	5,7	5,5	4,5 – 6,2	2,7	6,7
20	18,8	17,2 – 20,0	16,0	23,7	18,8	18,0 – 19,5	15,7	21,0
21	20,2	17,7 – 22,8	15,7	25,3	19,2	16,8 – 21,1	15,8	22,7
22	19,0	16,0 – 19,8	14,5	24,2	16,6	15,5 – 19,3	13,8	20,8
23	9,2	7,7 – 10,0	6,2	11,8	9,2	7,5 – 9,8	6,0	11,3
24	5,0	4,5 – 5,3	4,3	6,0	5,0	4,5 – 5,0	4,3	5,5
25	5,3	4,8 – 5,5	4,5	5,7	5,2	4,7 – 5,3	4,2	6,0
26	7,5	6,5 – 8,0	6,2	9,0	8,9	7,5 – 9,7	7,3	9,8
27	9,5	9,0 – 10,2	8,3	10,7	10,3	9,3 – 11,2	8,8	12,3
28	12,0	11,3 – 12,5	10,7	14,3	10,7	9,0 – 12,2	8,0	13,0
29	6,0	5,5 – 6,8	5,0	9,5	5,0	4,5 – 5,3	4,5	7,0
30	15,3	14,0 – 16,0	13,2	18,0	14,2	13,0 – 14,7	12,0	17,0
31	5,3	4,0 – 5,5	3,5	6,3	4,8	4,5 – 5,0	4,3	5,8
32	19,2	17,2 – 20,8	15,0	23,3	17,2	16,3 – 18,5	13,8	21,0
33	11,0	8,0 – 13,7	6,3	15,8	11,6	9,5 – 12,5	9,2	16,0
34	5,5	4,5 – 6,0	4,5	6,5	4,5	4,5 – 5,0	4,0	6,0

Tabelle 10: Medianwerte, Vertrauensbereiche und Extremwerte der Weichteildicke an 34 Meßpunkten (in mm) — Alter: 30 – 39 Jahre

Männer (n = 14)					Frauen (n = 13)			
Meß-pkt.	x̃	VB (95%) – ≤ u ≤ –	Min.	Max.	x̃	VB (95%) – ≤ u ≤ –	Min.	Max.
01	5,0	4,0 – 5,5	4,0	6,0	5,0	4,5 – 5,5	4,5	5,7
02	4,7	4,0 – 5,0	3,3	6,0	4,0	3,8 – 4,5	3,5	5,0
03	5,0	4,5 – 5,5	3,7	6,5	4,5	4,3 – 5,0	4,0	5,7
04	5,8	5,0 – 6,3	4,5	7,5	5,2	4,8 – 5,5	4,5	5,8
05	6,2	5,3 – 6,5	5,0	7,7	5,7	5,2 – 6,0	5,0	6,5
06	7,3	7,0 – 7,5	6,0	11,3	6,5	6,0 – 6,8	6,0	7,7
07	3,5	3,0 – 4,0	2,0	4,2	3,0	2,8 – 3,5	1,5	4,5
08	2,5	2,0 – 2,7	1,5	4,0	2,5	2,2 – 2,7	1,0	3,8
09	7,4	6,7 – 8,5	5,2	9,5	6,3	5,2 – 7,5	4,7	8,0
10	11,7	11,2 – 12,2	10,0	16,2	11,0	9,8 – 12,7	9,2	13,7
11	14,6	13,5 – 16,0	12,5	18,7	12,8	12,2 – 13,5	11,5	14,5
12	12,3	10,5 – 12,7	9,5	17,3	10,7	9,8 – 11,0	9,0	12,8
13	14,9	13,7 – 15,3	12,3	17,2	12,0	11,3 – 12,5	10,0	13,7
14	12,1	11,5 – 12,8	10,7	14,3	10,8	10,0 – 12,0	8,8	12,7
15	10,1	9,2 – 12,0	7,8	13,0	10,0	8,8 – 10,5	7,3	12,2
16	8,3	7,0 – 9,0	6,0	9,7	7,2	6,2 – 8,2	5,3	8,8
17	6,3	5,5 – 6,5	5,0	7,0	5,0	5,0 – 5,5	4,5	5,7
18	7,3	6,5 – 7,5	6,0	8,5	6,5	6,0 – 6,7	5,8	7,5
19	5,0	4,5 – 5,5	4,2	8,2	5,5	4,8 – 6,0	3,7	8,5
20	19,7	17,8 – 20,2	16,3	24,7	20,2	17,7 – 22,5	16,0	27,7
21	22,0	19,0 – 24,0	16,0	29,0	21,5	19,5 – 23,5	16,0	29,3
22	18,5	16,7 – 21,7	15,3	23,0	19,0	17,0 – 22,8	14,8	29,0
23	10,1	6,5 – 12,2	5,2	15,0	9,0	7,7 – 11,0	5,3	13,0
24	5,3	4,8 – 5,8	4,0	6,7	5,0	4,8 – 5,3	4,3	8,7
25	5,2	5,0 – 5,5	4,3	6,2	5,0	4,5 – 5,5	4,3	5,7
26	7,6	6,3 – 8,3	6,0	9,5	9,0	8,0 – 10,2	7,2	10,7
27	9,9	8,5 – 10,5	5,5	12,0	10,3	9,8 – 11,7	8,3	12,8
28	11,9	10,0 – 14,0	6,5	16,7	11,5	10,0 – 12,2	9,7	15,7
29	6,7	6,2 – 7,5	5,0	9,0	5,5	4,8 – 5,5	4,0	6,7
30	16,3	14,5 – 17,7	13,7	19,3	14,2	13,5 – 16,2	8,7	19,8
31	5,3	4,5 – 6,3	4,0	9,7	5,2	4,5 – 5,3	4,0	8,5
32	21,3	18,7 – 22,2	15,5	23,0	18,3	15,8 – 19,2	14,8	22,3
33	13,2	11,5 – 14,3	8,5	16,3	11,7	10,2 – 12,5	9,7	16,2
34	5,5	5,0 – 6,0	4,5	6,5	5,0	4,0 – 5,0	3,5	5,5

Tabelle 11: Medianwerte, Vertrauensbereiche und Extremwerte der Weichteildicke an 34 Meßpunkten (in mm) — Alter: 40–49 Jahre

	Männer (n = 13)				Frauen (n = 11)			
Meß-pkt.	x̃	VB (95%) – ≤ u ≤ –	Min	Max	x̃	VB (95%) ≤ u ≤	Min	Max
01	5,0	4,5 – 5,5	3,5	7,5	5,0	4,0 – 5,0	4,0	5,5
02	4,5	4,0 – 5,0	3,5	5,7	3,9	3,5 – 4,5	3,3	5,2
03	5,0	4,2 – 5,5	3,2	6,5	4,6	3,5 – 5,0	3,5	5,2
04	5,5	5,0 – 6,5	3,8	7,0	5,3	4,3 – 5,5	3,8	6,0
05	6,0	5,5 – 6,8	4,3	7,5	5,9	4,5 – 6,2	4,5	6,7
06	6,8	6,2 – 7,8	5,3	8,3	6,2	5,5 – 7,0	5,3	7,3
07	3,9	3,0 – 4,2	2,5	4,5	3,0	2,2 – 3,5	1,5	4,5
08	2,7	2,5 – 3,2	1,8	4,5	2,4	1,7 – 2,8	1,0	3,2
09	7,3	7,0 – 8,2	6,0	9,5	6,7	5,2 – 7,2	4,5	9,8
10	12,2	10,0 – 12,8	9,3	14,7	11,0	9,5 – 11,8	9,2	12,3
11	15,6	12,5 – 16,5	9,5	19,0	12,6	11,8 – 13,8	11,5	14,5
12	12,6	11,2 – 14,0	9,0	18,2	10,5	9,2 – 11,0	8,7	11,7
13	14,2	12,2 – 14,8	11,5	19,2	12,5	10,3 – 13,7	9,5	14,0
14	13,3	12,2 – 14,7	10,0	15,8	12,3	10,5 – 13,3	9,5	14,2
15	11,7	10,5 – 15,0	8,3	18,2	9,6	7,3 – 10,8	5,5	11,8
16	9,5	8,0 – 11,0	6,5	13,7	6,9	5,3 – 9,2	5,0	11,0
17	5,5	5,2 – 6,5	4,2	7,3	5,3	4,0 – 6,0	4,0	6,3
18	7,2	6,3 – 8,2	5,3	11,7	7,4	5,8 – 7,7	5,3	8,3
19	5,8	4,2 – 6,2	3,3	7,5	5,4	4,2 – 6,7	3,8	7,3
20	21,5	19,0 – 23,0	18,2	25,7	19,1	18,0 – 21,3	15,0	23,3
21	21,7	18,7 – 24,2	17,8	28,7	20,5	17,3 – 21,5	16,8	24,0
22	18,3	17,2 – 20,8	16,0	24,3	18,0	15,7 – 19,7	15,0	22,8
23	10,2	8,7 – 11,5	6,3	14,8	9,1	7,7 – 10,3	7,5	12,5
24	5,5	4,5 – 6,0	3,8	7,0	4,8	3,7 – 5,8	3,5	6,5
25	5,8	5,5 – 6,0	5,0	7,0	5,1	4,5 – 5,5	3,5	7,5
26	6,8	6,0 – 8,2	4,8	9,1	9,1	7,5 – 10,2	6,5	11,1
27	10,1	8,5 – 11,5	7,5	12,2	10,6	8,3 – 11,3	7,8	14,3
28	12,8	11,0 – 14,2	8,0	19,0	11,8	9,3 – 12,2	6,8	[illegible]
29	6,5	5,7 – 7,5	4,5	8,0	5,0	4,5 – 5,0	4,5	6,5
30	16,1	14,2 – 18,7	13,0	19,3	14,3	12,7 – 16,0	11,0	16,2
31	5,5	4,7 – 5,7	4,3	8,0	5,4	4,5 – 6,7	4,3	7,8
32	20,4	19,2 – 22,7	13,7	29,8	17,8	15,3 – 19,2	15,3	22,2
33	13,3	12,0 – 15,0	3,5	15,8	11,2	10,0 – 13,8	9,5	14,5
34	5,5	5,5 – 6,0	4,5	7,5	5,0	4,0 – 5,5	3,5	6,5

Tabelle 12: Medianwerte, Vertrauensbereiche und Extremwerte der Weichteildicke an 34 Meßpunkten (in mm) — Alter: 50–59 Jahre

	Männer (n = 11)				Frauen (n = 15)			
Meß-pkt.	x̃	VB (95%) – ≤ u ≤ –	Min	Max	x̃	VB (95%) – ≤ u ≤ –	Min.	Max.
01	5,0	4,0 – 5,5	4,0	6,5	5,0	4,5 – 6,0	4,0	7,0
02	4,7	3,8 – 5,2	3,7	6,3	4,0	3,8 – 4,3	3,0	4,7
03	5,0	4,0 – 5,5	4,0	6,0	4,7	4,2 – 5,0	3,5	5,2
04	5,5	5,0 – 6,0	5,0	6,5	5,3	5,0 – 5,5	3,8	6,3
05	6,0	5,5 – 6,8	5,5	7,0	6,0	5,3 – 6,2	4,5	7,0
06	7,3	6,8 – 7,7	6,2	8,2	6,5	6,0 – 6,8	4,8	7,5
07	3,5	3,0 – 4,0	1,5	6,3	3,0	2,5 – 3,5	1,5	4,0
08	2,8	1,5 – 3,3	1,0	4,0	2,3	2,2 – 2,5	1,5	4,3
09	8,2	6,3 – 9,7	6,3	12,8	6,5	6,0 – 7,8	5,5	9,7
10	12,5	11,3 – 12,8	10,6	13,7	11,5	11,0 – 12,0	10,0	12,8
11	14,3	13,0 – 16,3	12,2	19,5	13,2	11,8 – 13,8	10,0	15,7
12	11,5	10,8 – 12,3	9,3	14,6	10,0	9,0 – 10,5	8,2	14,5
13	13,0	12,0 – 14,7	11,5	16,8	11,8	11,5 – 13,7	9,8	16,2
14	13,0	12,2 – 15,0	12,0	16,3	12,2	11,3 – 12,3	10,2	13,2
15	13,7	9,8 – 15,7	9,7	17,3	11,3	9,2 – 12,2	8,0	13,5
16	9,8	7,3 – 11,7	7,0	12,7	8,0	6,8 – 8,3	5,5	11,3
17	6,0	5,0 – 7,2	4,5	8,0	5,0	4,7 – 5,5	4,0	6,3
18	7,5	6,3 – 8,2	6,2	8,5	6,7	6,5 – 7,3	6,0	7,5
19	5,5	5,0 – 6,2	4,7	9,7	6,0	5,0 – 6,8	3,5	8,0
20	21,8	18,5 – 22,8	17,0	24,5	20,7	18,7 – 22,0	14,7	24,7
21	22,3	16,8 – 24,0	14,0	28,3	19,3	17,7 – 21,8	14,3	23,3
22	18,3	16,7 – 19,7	16,3	21,8	17,7	16,5 – 19,0	15,0	21,7
23	12,0	9,2 – 13,3	8,8	15,7	9,0	8,0 – 10,0	5,3	11,3
24	5,5	5,0 – 5,8	4,0	7,8	5,0	4,5 – 5,5	3,5	6,3
25	5,7	5,0 – 6,5	4,8	7,0	5,3	4,8 – 5,3	4,0	5,8
26	8,0	6,7 – 9,3	6,3	12,0	9,0	8,0 – 9,5	6,2	10,8
27	10,7	9,3 – 12,2	9,2	13,2	10,7	9,5 – 11,5	6,5	12,7
28	14,2	13,3 – 15,3	11,8	20,5	12,0	11,0 – 12,3	9,8	15,5
29	7,0	5,5 – 7,8	5,5	8,0	5,3	5,0 – 6,3	4,0	7,2
30	14,7	14,3 – 17,0	14,3	22,3	13,3	12,3 – 15,8	4,3	19,2
31	5,5	5,2 – 6,7	4,8	10,8	5,3	4,7 – 5,7	4,3	7,0
32	20,5	17,8 – 22,8	17,7	23,0	17,3	16,2 – 19,5	13,7	22,0
33	11,7	7,3 – 15,3	6,7	17,7	10,3	7,7 – 12,5	4,3	14,5
34	5,5	4,5 – 6,5	4,5	7,5	5,0	4,5 – 5,5	4,0	7,0

Tabelle 13: Medianwerte, Vertrauensbereiche und Extremwerte der Weichteildicke an 34 Meßpunkten (in mm) — Alter: 60 Jahre und älter

Männer (n = 10)					Frauen (n = 11)			
Meß-pkt.	x̃	VB (95%) – ≤u≤ –	Min.	Max.	x̃	VB (95%) – ≤u≤ –	Min.	Max.
01	4,8	4,0 – 5,5	3,5	6,7	5,0	3,7 – 5,5	3,5	6,3
02	4,9	4,0 – 5,0	3,8	5,8	4,0	3,7 – 4,5	3,7	5,5
03	4,8	4,3 – 5,7	4,0	6,0	5,2	4,5 – 5,3	4,2	5,5
04	5,8	4,5 – 6,2	4,5	7,3	5,8	5,2 – 6,3	5,0	7,2
05	6,3	5,3 – 6,5	5,0	7,7	6,5	5,5 – 7,2	5,3	7,3
06	7,1	6,8 – 8,0	6,0	9,2	6,5	6,0 – 7,0	5,5	7,7
07	3,7	3,3 – 4,2	2,8	5,0	3,0	2,5 – 3,7	2,2	3,8
08	2,6	2,3 – 3,5	1,3	4,3	2,5	2,0 – 2,5	1,8	3,5
09	6,7	5,8 – 9,3	5,7	10,0	7,3	5,3 – 8,7	5,0	10,2
10	11,9	9,8 – 13,0	9,7	14,3	11,5	10,0 – 12,2	9,5	12,8
11	12,9	11,0 – 14,3	8,5	15,3	12,2	9,8 – 13,7	9,7	14,2
12	9,9	9,2 – 10,3	7,7	11,7	9,8	9,0 – 10,2	8,7	10,3
13	12,7	11,7 – 13,0	11,5	16,0	11,5	9,8 – 13,7	9,7	15,3
14	12,8	11,8 – 14,3	11,2	15,3	12,7	10,3 – 14,2	10,3	15,3
15	12,3	10,7 – 13,2	10,3	14,7	12,0	9,8 – 12,8	8,8	13,8
16	8,9	8,0 – 9,7	8,0	11,7	8,7	7,5 – 9,3	6,0	12,2
17	6,2	5,5 – 6,5	4,8	7,5	5,3	5,0 – 5,8	4,5	6,5
18	6,7	6,2 – 7,8	5,8	8,2	6,8	6,3 – 7,3	6,3	8,0
19	5,8	4,8 – 7,7	3,7	11,7	6,3	5,5 – 7,5	5,2	10,7
20	21,5	18,7 – 22,0	15,7	24,0	22,3	18,7 – 23,0	18,2	28,0
21	18,8	16,5 – 20,8	13,8	23,2	20,5	12,7 – 22,3	11,8	26,3
22	17,2	15,2 – 18,2	14,7	19,8	19,0	13,7 – 20,7	11,3	24,0
23	10,3	9,8 – 11,5	9,5	12,5	10,3	8,5 – 12,3	8,0	13,7
24	5,5	5,0 – 6,2	4,0	6,7	5,0	4,2 – 5,2	4,0	5,3
25	5,6	4,5 – 6,3	4,2	6,7	5,5	4,5 – 5,8	4,5	7,2
26	7,5	5,5 – 8,5	5,3	9,5	10,3	8,3 – 10,8	6,7	13,0
27	9,0	8,3 – 10,3	6,5	11,2	12,0	8,0 – 13,3	7,5	15,0
28	13,4	11,8 – 15,2	11,2	16,3	13,7	12,0 – 15,8	11,3	19,3
29	6,4	5,5 – 6,7	5,3	7,8	5,2	4,5 – 5,5	4,5	6,0
30	14,9	12,3 – 16,2	8,7	17,2	13,3	11,8 – 15,5	11,3	18,5
31	5,0	4,5 – 5,7	3,8	8,2	5,2	4,5 – 5,7	4,5	10,0
32	20,6	17,0 – 21,0	16,3	25,8	19,2	16,2 – 20,8	15,8	23,7
33	14,4	8,3 – 16,0	7,5	17,3	14,3	12,2 – 16,3	11,2	17,3
34	5,5	4,5 – 6,5	4,5	7,7	5,0	4,5 – 5,5	3,5	6,3

Einflußgrößen für sich vorzunehmen. Wegen der geringen zahlenmäßigen Besetzung der einzelnen Felder des Typendiagramms, bedingt durch unsere relativ kleine Versuchspersonenzahl, war es erforderlich, mehrere benachbarte Typenfelder in Gruppen zusammenzufassen. Dies wurde durch eine gröbere Rastereinteilung des *Conradschen* Typendiagramms erreicht, wie die Abb. 20a, b, c zeigt:

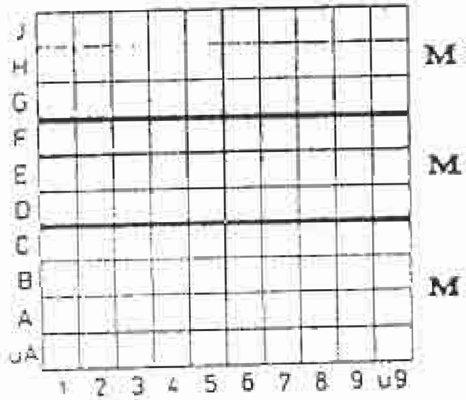


Abb. 20 a

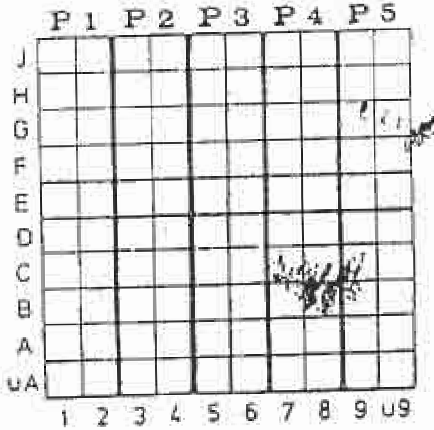


Abb. 20 b

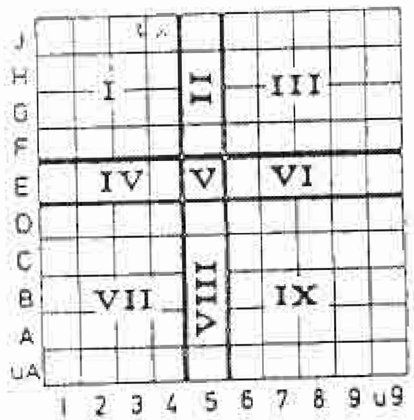


Abb. 20 c

Abb. 20 a, b + c: Conradsches Konstitutionstypendiagramm mit Einteilung von Typ-Gruppen zur Untersuchung von Korrelationen mit der Weichteildicke des Kopfes

NO.	MEASUREMENT Midline	EMACIATED Male (3)	 Female (3)	NORMAL Male (67)	 Female (19)	OBESE Male (8)	 Female (3)
1	Supraglabella	2.50	2.50	4.25	3.50	5.50	9.25
2	Glabella	3.00	4.00	5.25	4.75	7.50	7.50
3	Nasion	4.25	5.25	6.50	5.50	7.50	7.00
4	End of Nasals	3.00	2.25	3.00	2.75	3.50	4.25
5	Mid Philtrum	7.75	5.00	10.00	8.50	11.00	9.00
6	Upper Lip Margin	7.25	6.25	9.75	8.50	11.00	11.00
7	Lower Lip Margin	8.25	8.50	11.00	10.00	12.75	12.25
8	Chin-Lip Fold	10.00	9.25	10.75	9.50	12.25	13.75
9	Mental Eminence	8.25	8.50	11.25	10.00	14.00	14.25
10	Beneath Chin	5.0	3.75	7.25	5.75	10.75	9.00
	Bilateral						
11	Frontal Eminence	3.25	2.75	4.25	3.50	5.50	5.00
12	Supraorbital	6.50	5.25	8.25	6.75	10.25	10.00
13	Suborbital	4.50	4.00	5.75	5.75	8.25	8.50
14	Inferior Malar	8.50	7.00	13.50	12.50	15.25	14.00
15	Lateral Orbit	6.75	6.00	9.75	10.50	13.75	13.25
16	Zygomatic Arch, midway	3.50	3.50	7.00	7.00	11.75	9.50
17	Supraglenoid	5.00	4.25	8.25	7.75	11.25	8.25
18	Gonion	6.50	5.00	11.00	9.75	17.50	17.50
19	Supra M²	8.50	12.00	18.50	17.75	25.00	23.75
20	Occlusal Line	9.25	11.00	17.75	17.00	23.50	20.25
21	Sub M_2	7.00	8.50	15.25	15.25	19.75	18.75