

ANDRÉ HOFFMANN

**NOVEL METHOD FOR MEASURING THE TIME OF DEATH ON TEETH –
BASED ON LIQUID CONTENTS, REFLECTION SPECTRA AND COLOUR
PRESENTATION OF THE FIRST ANALYSIS AND MEASUREMENT METHOD
THAT IS ALSO REFERENCE-INDEPENDENT**

ANDRÉ HOFFMANN

**NOVEL METHOD FOR MEASURING THE TIME OF DEATH
ON TEETH –
BASED ON LIQUID CONTENTS,
REFLECTION SPECTRA AND COLOUR**

PRESENTATION OF THE FIRST ANALYSIS AND MEASUREMENT METHOD
THAT IS ALSO REFERENCE-INDEPENDENT

© 2000 André Hoffmann, Dammweg 16, 46535 Dinslaken
© 2003 André Hoffmann, Dammweg 16, 46535 Dinslaken
© 2004 André Hoffmann, Dammweg 16, 46535 Dinslaken
German edition peer reviewed
English abridged version

All rights reserved.

This work, including all its parts, is protected by copyright. All rights, including those of reprinting, storing, reproduction, transmitting in any form and by any means and translations, are reserved by author and publisher. Any exploitation – even in parts – and any form of reproduction outside the narrow limits of the Copyright is prohibited and punishable without the consent and written permission from the publisher or the author. This applies in particular to translations, reproduction, processing, transcription, abstraction, systematic evaluation, distribution, presentation, radio, television, broadcasting, telephone transmission, photomechanical (photocopy, microcopy), magnetic sound method, microfilming, storage and processing in or with electronic or mechanical systems. This concerns the work as well as parts thereof, illustrations and tables.

Registered names, trademarks, product descriptions, etc. used in this work, even without specific statement, do not entitle you to the assumption that such names may be used by anyone. Rather, they can often be legally protected trademarks.

The findings in medicine and dentistry are subject to ongoing progress through research and experience. The author and publisher of this work have taken great care to ensure that the information provided in this work (particularly with regard to indication, dosage and undesirable effects) corresponds to the current state of knowledge. However, this does not relieve the reader or user of this book from the obligation to independently check the correctness on the basis of the patient information or package leaflets or other literature and make his own regulation. The decision for or against a particular therapy and using information lies solely in the responsibility of the practitioner. Neither publisher nor author can give any guarantee for the information contained in this book. In every case the respective user must check correctness and accuracy by consulting other literature.

Contents

Preface	IX
1. Introduction	1
2. Literature Review	2
2.1 Time of Death	2
2.2 Applications of Spectrophotometry and Colorimetrics in Forensic Medicine; Drying and Colour	5
3. Materials and Method	6
3.1 Systems and Equipment	6
3.1.1 Spectrophotometer CM-503c	6
3.1.2 Spectrophotometer CM-503i	7
3.1.3 Microscopic Chroma Meter CR-241	8
3.1.4 Shade Guides	9
3.1.5 Sartorius Moisture Analyzer MA100	10
3.1.6 Microbalance MC21S (Sartorius)	11
3.1.7 Light-Systems	12
3.1.8 Experimental Measuring Setup and Positioning System	13
3.2 Variables, Standard Light, White Balance, Use of Shade Guides	15
3.3 Measurement Procedures	16
3.4 Environmental Conditions	17
3.5 Statistics and Diagrams	18
4. Results	19
5. Discussion and Conclusions	49
Basic Feasibility and Advantages	49
Reference-Dependent Procedures	50
Reversibility, Reproducibility and Reference-Independent Process	52
Measurement of the Time of Death Using Neural Networks, Reference-Dependent and Reference-Independent Procedure in Combination	52
Time of Tooth Loss Due to External Force at the Occurrence of Death	54
Initial Drying (First 3 Hours)	55
Peculiarities and Duration of the Drying Process	55
Measuring Areas – Where Are Processes Measurable?	56
Spectral Behaviour of the Reflected Light	56
Possible Benefits of this Method	56
Assessment of the Possibilities and Superimposition	57
Liquid Content-Dependent and Time-Specific Tooth Colour Spaces	57
Dental Clock, Dental Data Storage and Dental Memory – High Information Content	58
Prerequisites (Technological) and Technological Remarks	59
Processes Must Not Yet Be Completed	60
Environmental Conditions Must Be Taken Into Account	60
Transferability of Scientific Results	60
Pathophysiological and Physiological Requirements	61
Conceivable Factors Influencing Scientific Research and Application in Practice	61
Influence of Subjectivity	61
Influence of System Positioning	61
Influence of System Components and the System	62
Influence of Mouth Opening	62
Influence by the Position of the Tooth, Head and Body as well as Through Liquid (Saliva and Putrefaction Liquid)	63
Influence by Saliva Quality and Quantity, Diseases, Syndromes, Medicines	65
Influence by Temperature and Air Humidity	66

Influence of Procedure and Time	66
Identification of Individuals – Influence by Interindividuality	67
Influence by Pink Teeth, Special Tooth Condition, Fractured Teeth	67
Influence of Changes in Hard Tissue	68
Influence of Changes in Pulp Tissue	68
Influence from Tooth Root, Periodontium and Afterflow of Dental Fluid	69
Influence by Mucosa and Dental “Dawn Chorus”	69
Influence by Vacuum Packaging of the Tooth	69
Influence of the Storage of the Corpse (Water, Soil)	70
Influence of Age and Sex of the Dead Person	70
Procedure – for Research and Practice	71
General Corpse-Specific Information and Influencing Factors	71
Special Corpse-Specific Information and Situation	73
Influencing Factors	76
Known Anamnesis/Findings during Life Time	77
Sampling and Dispatch – Step by Step	77
Step 1: Individual Suitability Decision	77
Step 2: Capture of Corpse and Situation	77
Step 3: Preparing for Removal	77
Step 4: Choosing the Tooth	77
Step 5: Removal	78
Step 6: Extensive Measurement or Vacuum Foil Welding Packaging	78
Step 7: Photograph of the Removal Area after Tooth Extraction (See Findings Sheet)	78
Step 8: Shipping	78
Step 9: Subsequent Submission of Data	78
Step 10: Measurement	80
Relativity of Values	80
Forecast – a Look into the Future: Is This the Breakthrough in Forensic Medicine?	80
Cosmos of Countless Changes and Processes – Plea for Interdisciplinarity	81
8. Bibliography	83



André Hoffmann systematically researched the tooth colour at human teeth and dental shade guides with high-precision measuring systems and high-precision positioning system in vitro with highest precision. Due to this basic scientific research, he was able to quantify and isolate manifold factors influencing the colour of teeth. These include, for example, the light or measuring light and the type of light (illuminant) and illumination and colour temperature, the optical beam path of the light or the measuring geometry, the observation angle (2° , 10°), the size of the measuring surface, and measuring opening, the gloss effect, the liquid content (with scientific evidence of the relationship between liquid content and tooth colour), effect of drying, moisture and rehydration, the correlation between the liquid content and the gloss effect, the subjectivity of visual subjective shade matching, crown curvature, type of system (spectrophotometer, tristimulus colorimeter), measuring mode (contact or non-contact), system-object-relation, positioning, repeatability or reproducibility, lens shift, displacement between sample and measuring surface and further intra- and interindividual factors. In addition, subjective-visual determinations and objec-

tified measurements were examined in subjective-objective comparisons using colour coordinates comparisons. All these influencing factors are investigated on moist, drying, drier (various specific dehydration and rehydration states) and dry teeth based on the brightness (L^*), on colour measurement values, such as a^* , b^* (CIELAB), C^* , h , (CIELCH), ΔE , the metamerism index, spectral values and curves, tabs of dental shade guides and tooth colour spaces ...

As part of this exploration, phenomena (e.g. changes and breaks in behaviour as well as highly individual developments in colour values, paradoxes between the values of subjective determination using tooth shade patterns and the values of objective measurements) were identified; and insights into the very complex colour dynamics through dehydration and rehydration were shown (up to more than >8 days). The development of the individual colour measurement values was based on the liquid flow through the tooth and its tissues, in particular during drying and rehydration, and gave information about dynamics and the temporal extent of these processes.

On the basis of this data, Hoffmann had developed several methods for research and practice, suggestions for feasible innovations, such as monitoring of dental treatment to protect against pulp damage based on drying, and reconstructing the colour of naturally moist teeth on those that have already dried, the identification of the living and the dead, human and animals via the “dental fingerprint” and a novel method of measuring the time of death for forensic medicine.

He also described a time limit of drying up to which relatively natural, suitable colour values and shade matching results can be obtained and after which no colour determination should be carried out; and he established the rehydration time after the end of the drying or dental treatment, which must be waited in order to regain a natural tooth colour and to get correct values and results again.

His findings also show that teeth are able to store information, for example, on the condition (liquid content, colour values) and about the time within the drying and fluid reabsorption chronology. The author articulates a “dental chronometer” (“tooth clock”), “dental data storage” (“tooth data storage”) and a “dental memory” (“tooth memory”) and believes that significant progress in this area may include and could be achieved via a neural network for colour measurement apparatus.

Preface

As part of my scientific research on dental tissues and electromagnetic radiation and my work as an innovator, process and system developer, I have considered what dental processes can still be used for. I quickly came across the field of estimation of the time of death.

In addition, as a studied dentist, who is accustomed to high precision, I have found that in this field only a relatively imprecise estimate is conceivable due to intra- and inter-individual influences.

Previously known forensic-medical possibilities for estimating the time of death must inevitably be inaccurate. I wondered whether the limitations are insurmountable, or whether there could be a specific process and a technology, which could have a high level of accuracy and a statement after longer times in this forensic field.

The problem that has been inherent in the methods so far lies – in my opinion – in the dispersion of data, which is inherent in methods or tissues: the general scientific prerequisite for the use of a method for estimation the time of death is the existence of a process that is triggered by death and must be descriptive and differentiated in stages (e.g. rigor and livor mortis, putrefaction) or values (see body cooling method). In order to classify these stages or values, the results of previous studies were always needed. The assessment and estimation in the specific application is carried out in the light of previous studies. Without exception, all processes described in the literature in connection with the time of death estimations are highly individual, contain an intra- and inter-individual dispersion of reference values/stages/phenomena, are irreversible, so cannot be reversed, and without exception all methods use reference values (e.g. temperature) or reference descriptions. An assessment of a current time of death against the background of scattered references can be imprecise at best.

Quite different, as you will read in the book, the novel approaches and developed methods. Because not only one process, but above all the measurable processes that a tooth goes through during drying are very special and unique in their character. Read about the advantages and the special character of the usable processes and perhaps even the first reference-independent method of analysis or measurement in the natural sciences.

You will find out what this ultimately means and how you can measure processes with which systems and avoid errors in colorimetrics and spectrophotometry at teeth. Join me on a path that will introduce you to the colour theory, to the high-precision spectral analysis, colorimetry and liquid content measurement, to the topic of estimation of the time of death or, as we might call it in the future, death time measurement, and other novel and innovative technology-based methods.

I would be very pleased if you were as fascinated by the path, just as the way fascinated me when I first walked this path; and I would be pleased if you are grabbed by the subject just as it grabbed me and still captivates me.

May 2004

André Hoffmann

