# Dental Cementum in Anthropology

Benoît Bertrand

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Benoit Bertrand [1,2]*

1 Univ. Lille, CHU Lille, ULR 7367 – UTML&A - Unité de Taphonomie Médico-Légale et d'Anatomie, Lille, France
2 Muséum national d'Histoire naturelle, Département Homme et Environnement, UMR 7194 – HNHP, Institut de Paléontologie Humaine, Paris, France

* benoit.bertrand@univ-lille.fr

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Dental cementum attracts considerable attention and interest from biological anthropologists because it offers direct access to a chronological record, like a biological *black box*. A *black box* is defined as a system that systematically archives events, but the term also refers to a complex organization whose internal workings are not readily understood. Both definitions are well suited to this fascinating dental tissue. *Dental Cementum in Anthropology*, edited by Naji, Rendu and Gourichon, compiles the work of 67 scholars from multiple disciplines and attempts to unlock this *black box* through a broad, albeit non-exhaustive, coverage of dental cementum investigations.

The foreword written by Antoine, who has conducted advanced research on the development of periodic dental structures, reviews the fruitful discussions held during the symposium on cementochronology organized by Naji, Colard and Bertrand at the 82nd meeting of the *American Association of Physical Anthropologists*. Between the introduction by Naji and the final recapping Chapter by Naji and Rendu, the 23 Chapters based on published articles and original contributions are divided into three sections: cementum biology, protocols and applications.

The introductory Chapter usefully summarizes the relevant literature in chronobiology and provides solid arguments for cementochronology users who are regularly faced with the question of why periodic patterns occur in dental tissues. A discussion on the nomenclature sets out the history of the terms used to describe the layered appearance of cementum and seeks to standardize the terminology used in the Chapters that follow: a laudable but challenging aim that is difficult to achieve, since the experts that the editors were able to bring together from diverse origins and disciplines variously refer to growth layers, incremental layers, cementum layers, cementum annulations, tooth cementum annulations, TCA, annuli, deposits, or combinations such as TCA layers or cementum growth layers.

The first section on cementum biology provides an overview from the earliest investigations to the use of the latest technologies. This section opens with a Chapter written by Buisktra offering a detailed history of the discovery of cementum that takes the reader back to the 17th century, with the use of first microscopes (Chapter 1). The next five Chapters delve deeply into research on cementum microstructure, composition and development using optical or electron microscopy and synchrotron radiation (Chapters 2-6). This section also covers exciting investigations into inferences that might be drawn about life histories (Chapter 7), and ends with a review of the literature on ways of identifying how the cementum records physiological events across a lifetime (Chapter 8). This editorial intention reflects the growing interest in this captivating topic, but it is worth noting that although these fascinating contributions show that there are correlations between some physiological stresses or pathological conditions and modifications in cementum deposits, it is currently impossible to identify the cause of these perturbations. Furthermore, dating life events have to be assessed in conjunction with the precision and accuracy of age estimations. It would be unrealistic to achieve greater accuracy than those performed for adult age estimation. This first section is perhaps a victim of its own richness: the book switches to and fro between general and specific topics, basic and advanced techniques, acellular and cellular cementum, human and nonhuman samples, extinct and extant taxa, but also between acknowledged and experimental findings. This can be disorientating, but the book nevertheless remains on track in its confident presentation of the potential of dental cementum.

The second section (Chapters 9-16) addresses the lack of standardized protocols in the use of cementochronology by proposing different optimized procedures to produce high-quality micrographs for human and nonhuman mammals, to improve reproducibility and comparative studies

and to minimize the error range. Although the intention, again, is laudable, this concern, which was highly justifiable a few years ago, has lost its acuteness since robust protocols have already been published and experimentally tested, as mentioned or applied by the editors and the contributors to most chapters. One example is the excellent and exhaustive Chapter 1 by Buisktra, who had previously approached the need for standardization and described in detail the existence of an ISO-9001 certified protocol (Bertrand, 2013 *in* Colard et al., 2018) that specifies procedures as well as the required equipment and supplies. It is worth reminding readers that only audited laboratories receive ISO accreditation and that not just any user implementing a certified protocol is entitled to claim ISO certification, even though several authors refer to this protocol. Commitment to a process of certification to meet international standards therefore needs to be encouraged. The excessive detail in Section II (around one hundred pages) could be disheartening for potential future users and thus counterproductive. Regrettably, in the Chapters devoted to protocol optimization (Chapters 9-10), the micrographs that are the first indicators of the quality and efficiency of implementation of this protocol for future users are completely absent.

This book could have provided the quality and efficiency standards of the protocol implemented, as argued throughout this section. Instead, it is unfortunate that the quality of the optical micrographs is discrepant throughout the book, because this suggests a heterogeneity in procedures even though the authors themselves are advocating standardization. Some protocols leading to unproductive investigations (Chapters 12-13) or preliminary procedures developed from only two teeth (Chapter 14) can scarcely be included within a framework of standardization. It is also surprising that some authors discuss the use of methyl methacrylate resin (Chapter 10), while two papers published by the first author of this Chapter (Cerrito et al., 2020, 2021) suggest that the choice of this embedding medium was the reason why yearly incremental structure was not observable. Even more worrisome, some authors who endorse specific preparations, such as transversal sections (Chapter 11), do not follow their own recommendations and analyze longitudinal sections (Chapter 17). Surely one of the main pitfalls of cementochronology is a lack of consistency among researchers and their procedures, and not the lack of standardized protocols as argued in Section II. Unfortunately, this section still does not offer any clear 'take home' rules that would be useful to biological anthropologists who want to engage in dental preparations.

The third section offers several examples of the various applications of cementochronology, including estimations of age-at-death and season-of-death, reconstructions of mobility patterns and subsistence strategies, and palaeodemography (Chapters 17-23). The detection of life history events (Chapters 7 and 14, section II) and season-of-death in humans (Chapter 13, section II) might have been better placed in Section III. Age-at-death estimation is the predominant application of dental cementum analyses. This section places a particular emphasis on population-based studies examining archaeological assemblages (Chapters 20-23), but again does not offer recommendations to construct age ranges, or any information on mean error for biological anthropologists seeking to perform an accurate age-at-death estimation. The editors state that the "error rate is by far the smallest of any other skeletal or dental age indicators for any adult decade of life" (Chapter 24). While this may well be true, the error rate associated with age estimations remains unclear after reading this section. The reader has no option other than to glean information from the different Chapters (particularly Chapter 13) or to refer to published validation studies (Bertrand et al., 2019; Wittwer-Backofen and Buba, 2002) or systematic reviews of the literature (Perrone et al., 2022; Pinto et al., 2022). The last Chapter summarizes the key concepts and findings from all fronts discussed in Sections I, II and III, but might have deserved to be a separate section rather than being part of Section III.

Unfortunately, the book misses some important topics: for example, taphonomic alteration and its impact on histological preparations and on estimations are only briefly mentioned in some chapters. Other crucial and regrettably missing topics are studies of cremated remains that are of interest to archaeologists and forensic anthropologists (Gocha and Schutkowski, 2012; Großkopf, 1989; Oliveira-Santos et al., 2017), and studies of software-assisted applications (Bertrand et al., 2022), since several contributing authors apply untested tools for processing and analysing micrographs. Overall, the main strength of this book is to have succeeded in bringing together a large number of talented international researchers around a disregarded but promising biological tissue. However, the contributions are of variable quality and the book lacks a well-balanced discussion of various limitations and of the accuracy of estimations, which is somewhat disappointing since it purports to provide a broad approach to cementum investigations. The *black box* remains locked, but *Dental Cementum in Anthropology* is an honourable compilation suitable for anyone 'dipping their toes' into dental cementum deposits for the first time. There is no doubt that scholars and postgraduate students would benefit from such a book prior to completing their own systematic and critical review of the bibliography.

## References

Bertrand B (2013) Procedure ISO-9001 - Cementochronologie, référence : MOP-Dap-04, Indice a

Bertrand B, Cunha E, Bécart A et al (2019) Age at death estimation by cementochronology: Too precise to be true or too precise to be accurate? American Journal of Physical Anthropology 169 (3):464-481 [https://doi.org/10.1002/ajpa.23849]

Bertrand B, Vercauteren M, Cunha E et al (2022) Automated age at death estimation by cementochronology: Essential application or additional complication? American Journal of Biological Anthropology 179(2):314-326 [https://doi.org/10.1002/ajpa.24612]

Cerrito P, Bailey SE, Hu B et al (2020) Parturitions, menopause and other physiological stressors are recorded in dental cementum microstructure. Scientific Reports 10(1):5381 [https://doi.org/10.1038/s41598-020-62177-7]

Cerrito P, Cerrito L, Hu B et al (2021) Weaning, parturitions and illnesses are recorded in rhesus macaque (*Macaca mulatta*) dental cementum microstructure. American Journal of Primatology 83(3):e23235 [https://doi.org/10.1002/ajp.23235]

Colard T, Bertrand B, Naji S et al (2018) Toward the adoption of cementochronology in forensic context. International Journal of Legal Medicine 132(4):1117-1124 [https://doi.org/10.1007/s00414-015-1172-8]

Gocha TP, Schutkowski H (2012) Tooth cementum annulation for estimation of age-at-death in thermally altered remains. Journal of Forensic Sciences 58(Suppl. 1):S151-155 [https://doi.org/10.1111/1556-4029.12023]

Großkopf B (1989) Incremental lines in prehistoric cremated teeth. A technical note. Zeitschrift Für Morphologie Und Anthropologie 77(3):309-311 [http://www.ncbi.nlm.nih.gov/pubmed/2665341]

Oliveira-Santos I, Gouveia MM, Cunha E et al (2017) The circles of life: age at death estimation in burnt teeth through tooth cementum annulations. International Journal of Legal Medicine 131 (2):527-536 [https://doi.org/10.1007/s00414-016-1432-2]

Perrone V, Gocha TP, Randolph-Quinney P et al (2022) Tooth cementum annulation: A literature review. Forensic Sciences 2 (3):516-550 [https://doi.org/10.3390/forensicsci2030038]

Pinto PHV, Fares LC, Silva RHAD (2022) Dental age estimation by cementum incremental lines counting: A systematic review and meta-analysis. Forensic Science International 341:111492 [https://doi.org/10.1016/j.forsciint.2022.111492]

Wittwer-Backofen U, Buba H (2002) Age estimation by tooth cementum annulation: perspectives of a new validation study. In: Hoppa RD, Vaupel JW (eds) Paleodemography: Age distributions from skeletal samples. Cambridge University Press, Cambridge, pp 107-128 [https://doi.org/10.1016/S0047-2484(03)00046-0]

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