American Dental Association
Technical Report No. 1059

Guidelines for the Application of the DICOM Standard to Radiographic Cephalometric Data

A Technical Report prepared by the American Dental Association and registered with ANSI.

ADA American Dental Association®

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RADIOGRAPHIC CEPHALOMETRIC DATA

The Council on Dental Practice of the American Dental Association has approved American Dental Association Technical Report No. 1059 for Guidelines for the Application of the DICOM Standard to Radiographic Cephalometric Data. Working Groups of the ADA Standards Committee on Dental Informatics (SCDI) formulate this and other specifications and technical reports for the application of information technology and other electronic technologies to dentistry's clinical and administrative operations. The ADA SCDI has representation from appropriate interests in the United States in the standardization of information technology and other electronic technologies used in dental practice. The ADA Standards Committee on Dental Informatics confirmed approval of ADA Technical Report No. 1059 on January 19, 2010.

Publication of this technical report that has been registered with ANSI has been approved by the American Dental Association, 211 E. Chicago Ave., Chicago, IL 60611. This document is registered as a technical report according to the *Procedures for the Registration of Technical Reports with ANSI.* This document is not an American National Standard and the material contained herein is not normative in nature. Comments on this document should be sent to the American Dental Association, 211 E. Chicago Ave., Chicago, IL 60611.

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RADIOGRAPHIC CEPHALOMETRIC DATA

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RADIOGRAPHIC CEPHALOMETRIC DATA

FOREWORD

(This foreword does not form a part of American Dental Association Technical Report No. 1059 for Guidelines for the Application of the DICOM Standard to Radiographic Cephalometric Data).

In 1992, there was interest in the standardization of clinical information systems related to electronic technology in the dental environment. After evaluating current informatics activities, a Task Group of the ANSI Accredited Standards Committee MD156 (ASC MD156) was created by the ADA to initiate the development of technical reports, guidelines, and standards on electronic technologies used in dental practice. In 1999, the ADA established the ADA Standards Committee on Dental Informatics (SCDI). The ADA SCDI is currently the group that reviews and approves proposed American National Standards (ANSI approved) and technical reports developed by the standards committee's working groups. The ADA became an ANSI accredited standards organization in 2000.

The scope of the ADA SCDI is:

"To promote patient care and oral health through the application of information technology to dentistry's clinical and administrative operations; to develop standards, specifications, technical reports, and guidelines for: components of a computerized dental clinical workstation; electronic technologies used in dental practice; and interoperability standards for different software and hardware products which provide a seamless information exchange throughout all facets of healthcare."

This technical report is a collaborative effort between SCDI Working Groups 11.6 and 12.1. It was edited by Antonio Magni and Carla Evans, co-chairmen of Working Group 11.6. and was prepared at the request of SCDI Subcommittee for Clinical Informatics (Mark Diehl, Chairman).

STANDARD TO RADIOGRAPHIC CEPHALOMETRIC DATA

INTRODUCTION

It was only in 1991, during the annual meeting of the American Association of Orthodontists (AAO), that the belief of the new information age reaching into the orthodontic world was accepted. Unfortunately, the introduction of computer technology into the orthodontic office occurred before the analytic requirements of a computerized orthodontic record keeping system could be determined. To continue to communicate effectively in the information age, a standard way of storing and retrieving computerized orthodontic records needs to be established.

Currently, the profession is being challenged to provide more information on the efficacy of various treatment methods. In addition, valuable cephalogram film series belonging to studies performed during the first half of the 20th Century, are now starting to decay. Various growth studies have been done in the past century, where patients were voluntarily x-rayed periodically (sometimes even with implanted artificial landmarks) in order to research cranial growth and development.

Today, such studies would be impossible to perform, which makes the preservation of these films a high priority project for many institutions. These challenges have increased the need for a standardized cephalogram database of treated and untreated orthodontic cases. The personal computer may provide a solution to this problem, because it is easy to make and access copies of computerized information and because digital copies don't suffer from deterioration. However, for the copies to be useful, they need to be compatible among various computers and computer software programs.

To date, no standards have been generally adopted by the orthodontic profession for storage and exchange of computerized cephalograms and other patient information. During a 1991 meeting of Orthodontic Educators, three issues were identified that need to be addressed before standards can be established:

A   Lexicon issues: what terms to use to describe orthodontic conditions.

B   Resolution issues: what is the resolution (spatial and gray scale) necessary for orthodontists to use digital representations of x-ray and models instead of the originals.

C   Registration issues: how should digitized records be registered and scaled.

Two years after the 1991 educators meeting, Hans organized a workshop sponsored by the American Association of Orthodontics Foundation (AAOF) which was held at the Bolton-Brush Growth Study Center (Case Western Reserve University, Cleveland, OH, USA) in March 1993. It was entitled Standards for Digital Storage, Retrieval and Analysis of Orthodontic Records [1] and was the first attempt to discuss the technical details of creating a standard for digital orthodontic data. The workshop only focused on digital x-rays and delivered a rather broad set of minimum requirements necessary for digital cephalograms to be of orthodontic use. After the workshop, interest in the project faded. It was only ten years later that Hans et al. proved the conclusions held at the workshop to be true [2]. Two years later, Magni recovered the effort and produced a master's thesis [3], an article [4] and a poster-board [5]. The work provided a method for the development of a standard for the electronic orthodontic patient record, as well as a draft for a digital cephalogram standard, and a small implementation of it in JAVA[1].

Cephalograms are more than a simple radiograph of the skull. They are used for craniofacial growth studies as well as for orthodontic treatment planning. It is therefore important to store, along with the radiograph itself, further information, which can guarantee the accuracy of the image itself. For this purpose, the DICOM (Digital Imaging and Communications in Medicine) standard is highly developed and contains enough definitions to unambiguously store the digital cephalograms along with their metadata. DICOM is a well established standard maintained by the National Electric Manufacturing Association (NEMA). It defines how to store and transfer images related to the medical field. Currently, most medical

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[1] Further information can be found at URL: http://panio.antoniomagni.org. The end date for this website is unknown.

images, the description could include data such as picture size, resolution, color depth and date and time of creation.

The intention of this document is to apply the image resolution issues presented in [2] and the registration issues discussed in [1] into a DICOM extension for cephalograms. Lexicon issues are not addressed, as they are believed not to be necessary for the storage and retrieval of digital cephalograms.

RADIOGRAPHIC CEPHALOMETRIC DATA

1   RATIONALE
A need exists to provide software vendors with guidelines on how to use DICOM for cephalograms in an ADA approved fashion.

To date, no standards have been generally adopted by the orthodontic profession for storage and exchange of computerized cephalograms and other patient information.

2   SCOPE
In the current DICOM documentation, cephalograms are not addressed directly. This technical report (TR) was developed to fill the gap in such a way as to provide imaging equipment vendors an approved way of storing cephalograms along with their clinically relevant data, in an interoperable way.

In addition, this TR shall serve as a part of the foundation for the definition of ADA SCDI approved guidelines for the storage and transfer of orthodontic electronic patient records through the utilization of existing popular informatics standards. This TR shall be included in the definition of an ADA SCDI document to specify the integration of DICOM and HL7 standards for orthodontic data.

This document was initially designed for scanned film-based cephalograms, but is intended to be used for digitally created cephalograms as well.

3   NORMATIVE REFERENCES.

3.1   DICOM version 3 2008

(DICOM is available from the National Electrical Manufacturers Association, Rosslyn, VA, or http://medical.nema.org).

3.2   HL7 version 3.0
(HL7 standards are available from Health Level Seven, Inc., 3300 Washtenaw Avenue, Suite 227, Ann Arbor, MI 48104, or www.hl7.org).

4   DEFINITIONS

4.1   Auriculo-orbital plane – In this context, equivalent to Frankfurt Plane.

4.2   CAU – Caudal

4.3   CRA – Cranial

4.4   DICOM (Digital Imaging and Communications in Medicine) – DICOM is a global information technology standard that is used in virtually all hospitals worldwide.

4.5   Frankfurt plane – The Frankfurt plane (also called the auriculo-orbital plane) was established at the World Congress on Anthropology in Frankfurt, Germany in 1884[9], and decreed as the anatomical position of the human skull. It was decided that a plane passing through the inferior margin of the left orbit (the point called the left orbitale) and the upper margin of each ear canal (the point called the porion) was most nearly parallel to the surface of the earth, and also close to the position the head is normally carried in the living subject. Note that in the normal subject, both