

Role of Orthodontics in Forensic Odontology- A Social Responsibility

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ABSTRACT

Orthodontics like any other specialty has much to offer law enforcement in the detection and solution of crime or in civil proceedings. Forensic odontology often requires an interdisciplinary approach towards dentistry for the purpose of proper diagnosis of cases. In cases where the forensic odontologist has to establish a person's identity, an orthodontist can be of great help at times. Teeth, with their anatomic/physiologic variations and therapy such as orthodontic treatment, restorations and prosthesis may record information that remains throughout life and beyond. The teeth may also be used as weapons for defense or offense and as such may leave information about the identity of the biter at the time of crime. Forensic odontology also plays an important role in the recognition of crime and abuse among people of all ages. Orthodontists like all other dental professionals can play a major role by maintaining proper dental records and thus providing important or vital information or clues to the legal authorities in order to help them in their search.

Keywords: Bite marks, Cephalometric software, Forensic science, Orthodontic scars

INTRODUCTION

Forensic science is the application of a broad spectrum of sciences used in order to answer questions of interest to a legal system related to crime or civil action [1,2]. Forensic dentistry or forensic odontology deals with proper handling, examination, and evaluation of dental records, which are then presented in the interest of law for Justice. Interest in forensic dentistry was sparked in 1930's by the first formal instructional program [3] on the same was given in the United States at the Armed Forces Institute of Pathology. The American Academy of Forensic Sciences established the American Board of Forensic Odontology in the year 1976. Since then the number of cases reported expanded to such an extent that the term "Forensic Odontology" is familiar, not only to the dental profession, but also to law enforcement agencies and other forensic groups [4,5]. The new millennium has brought many good things to our lives along with new challenges of terrorism, natural disasters and high rate of crime. Forensic dentistry has become an integral part of forensic medicine over the past 100 years. This has been due to the relentless contributions made by people like Amoedo [6], Gustafson [7], Sognaes [8], Whittaker [9], Clement [10], to name a few. They established the essential role which forensic dentistry plays, mainly in the identification of human remains. The teeth are extremely resistant to fire and hence are usually of great importance [11] in medico legal cases wherein the face is completely disfigured.

The specialty of forensic odontology generally covers three basic areas, which include-

1. Identification of the deceased where the body is unidentifiable. E.g.: Multiple fatality incidents such as accidents, plane crash etc.
2. Legal help related to malpractice.
3. Criminal proceedings, primarily in the areas of bite-mark evaluation and abuse cases especially child abuse.

The evidence that may be derived from such records [12] help in determining the age and/or identification of the person to whom the teeth belong. This is done using dental records such as Radiographs, Photographs- ante mortem (prior to death) and postmortem-and DNA. Dental identification of humans is required in different situations for different reasons [13] such as in violent crime, fire [14], drowning, road accidents [15] etc., wherein the body could be fully disfigured to the extent of being unrecognizable. "Tooth for truth" has a multidisciplinary role to play in such cases [16]. Although forensic dentistry does not offer an objective method of identification comparable to either the fingerprint or more recently, the use of DNA technology, it is still employed as it is relatively inexpensive, is capable of rapid results, and in some

cases, virtually a certain identification tool. Even when data are sparse, it may result in recognized identification that can later be confirmed by more scientific techniques such as the DNA sampling [17]. Identifying individuals by rugae area [18,19], intercanine width [20,21] cementum [22-24], lower canines [25-27] etc. have been used as aids in the identification process [26,28]. The first article on the importance of orthodontic diagnostic aids in forensic odontology was mentioned by Salzmann in 1974 [29]. Orthodontic reconstruction in a victim of murder was one of the finest articles of the late nineties [9]. The importance of orthodontic records in playing a major role in identifying disfigured victims was further emphasized by Wahl [30]. Meticulous maintenance of diagnostic and treatment records by orthodontists may help in identification of victims or suspects after death [31]. At times a single feature may be so extraordinary or unique that, it alone maybe sufficient to make a positive identification. Imperative of which ever the employed method that is being used in order to identify a disfigured face (person), the results of the comparison of antemortem and postmortem data would lead to any one of these four situations [4,32]:

1. Positive identification: The items that are compared are sufficiently distinct in both antemortem and postmortem databases, hence, observations show no major difference between the two.

2. Possible identification: A few common findings exist among the comparable items in the antemortem and postmortem databases, but not sufficient enough to prevent the establishment of a positive identification. For example, one restoration among many postmortem radiographs.

3. Insufficient evidence for identification: Insufficient evidence to support the comparison (antemortem and postmortem findings) for definitive identification, but the identity of the deceased cannot be fully ruled out and is deemed inconclusive.

4. Exclusion: Unexplainable discrepancies exist among comparable items in the antemortem and postmortem databases.

The role of an orthodontist may be discussed under the following headings-

1. Pre treatment records
2. Mid treatment
3. Post treatment records

PRE-TREATMENT RECORDS

A. Photographs: One of the best and easiest diagnostic aids used in identifying the deceased are the facial and intraoral photographs. While the extra oral photographs can be used to directly identify

the face in recognizable faces, the intraoral photographs are of more value in completely disfigured faces, as there may be certain classical hard tissue findings such as fluorosis, enamel decalcification, enamel cracks [33] and fractures, tooth attrition [34], abrasion, lower canines anatomy, to name a few.

B. Models: A 3-dimensional view of the maxillary and mandibular arches through models, help us assess certain features of the malocclusions, morphology and anatomy of teeth such as enamel abrasions, attrition and fractures. In particular, the rugae area [18,19] intercanine width [20,21], lower canine size and shape can be better assessed on a model which are of great help in age and sex determination of the victim [22-24].

C. Radiographs: Radiographs [35] such as the OPG [36], lateral cephalogram [37], IOPA [4], occlusal radiographs [38] etc., are routinely used as essential and supplemental diagnostic aid in orthodontic patients. Comparison of such antemortem radiographs with the postmortem radiographs is the most accurate and reliable method of identifying remains. Classical radiographic findings such as tooth restorations, Root Canal Treatment, bases under restorations, tooth and root morphology, the shape of various sinuses and jawbone patterns, TMJ etc., may be all that is required for a positive identification. Hence, original antemortem dental radiographs of all kinds are of immense value for comparison. Therefore it is essential that all routine radiographs exposed during the course of a dental practice be adequately fixed, washed and stored so that they remain viewable for a long time. However, the best postmortem radiographs for comparison are obtained by maintaining the same angulation of the film to the x-ray tube as that of the original films [4]. Lateral cephalogram in particular, can aid in reconstruction of facial soft tissues as it compiles and gives an accurate picture of the soft and hard tissue analysis of lateral view of the face. With the use of these measurements at specific points on the face it is possible to digitize and reconstruct a face on a computer screen. However, use of photographs and superimposition of the lateral cephalometric findings on it help in maximizing the accuracy levels. The anatomical landmarks that can be taken into consideration during reconstruction include Sellaturcica, Nasion, Porion, Orbitale, Subspinale, Infradentale, Pogonion, Gonion, ANS, PNS etc. The use of computer software's permits the addition and deletion of components to mix and match. They have been extremely useful for facial superimposition [4,39]. The underlying structures can thus be viewed below the soft tissue, providing a means to check the accuracy and try out various permutations and combinations. The superimposition technique by Mc Namara [40] commonly followed and practiced. The various other cephalometric analysis methods include Steiner's, Down's and Tweed's analysis. Some of the cephalometric softwares pertaining commonly used include NEMO CEPH [41] and DOLPHIN [42].

D. Clinical examination: Though the findings of the clinical examination may not be as important and conclusive as the radiographic findings, nevertheless, it may be useful as an adjunct at times. For example, the shape of the head [43] (Dolichocephaly, Mesocephaly or Brachycephaly), Facial form [44] (Dolichofacial, Mesofacial or Brachyfacial type) or a very deep scar on the face, etc. may be of help at times.

MID-TREATMENT

Patients undergoing treatment at that point in time can be certainly identified, as the appliance is a hard-core proof in itself. It is especially useful in cases of mass destruction identification where a lot of time is required due to the number of victims involved.

POST-TREATMENT

Apart from the available data discussed under pretreatment diagnostic records, several other post treatment data may be equally useful. It should be kept in mind that depending on when the

disaster occurred, pre and/or post treatment records may be used accordingly. Also, it is important to know that certain findings of pre and post-treatment records may remain the same as in the case of teeth that have undergone restorative fillings, RCT's, missing teeth, to name a few.

A. Photographs: In patients who died after the treatment, the post treatment records become more relevant as they supersede the previous findings of pre treatment records. Hence, it should be kept in mind that certain relevant intraoral findings such as enamel decalcification, enamel cracks, tooth attrition, abrasion may have still been present at the end of the treatment. On the other hand, certain findings such as enamel fractures and malocclusion (e.g.: crowding, spacing between teeth etc.) may have been treated and hence may give a completely different picture following treatment. Photographs may show enamel decalcification/white spot lesions following orthodontic treatment [45,46].

B. Models: Post-treatment models may show differences in the alignment, symmetry and number of teeth present. Also, the linear measurements related to intercanine width, rugae area, depth of the sulcus may change depending on the type of malocclusion treated.

C. Radiographs: One of the most conspicuous finding that may be observed on a post treatment radiograph Orthopantomograph is the generalized root resorption due to orthodontic treatment [47]. At times, since orthodontic treatment warrants extraction of a few teeth for correction, the post treatment radiograph can form a very important tool in identifying the victim. Assessment and recording the post treatment findings is very important.

D. Orthodontic treatment: Has the potential risk of causing significant damage to hard and soft tissues [48,49] and are called Orthodontic scars which can be of great help in identification process. A few of them of relevance to forensic odontology include:

1. Lesions of Enamel

- a) Enamel decalcification/White spot lesions [45,46].
- b) Physical damages on enamel [50-52] (Enamel Wear / Enamel Fractures).

2. Periodontal tissues.

- a) Gingival recession [53].
- b) Dark Triangles [54]
- 3. Soft tissue damage.
- a) Direct damage by appliances and their component parts:
 - i. Impingements
(E.g.: Lingual arch, TPA (Trans Palatal Arch), Loops, Archwires, brackets, bands etc.)
 - ii. Lacerations
(E.g.: brackets, molar tubes, ligature ties etc.)
 - iii. Ulcerations
(E.g.: brackets, molar tubes, ligature ties etc.)
 - iv. Injury to eyes [55,56]
(E.g.: Headgears, Face-bow injury)

While soft tissue damage by impingements of bands, brackets and archwires heal quickly and may not be of great help, injuries caused to enamel and periodontal tissues may result in permanent damage if untreated following orthodontic treatment.

CONCLUSION

The orthodontist can play a major role in identification of victims or suspects by maintaining proper diagnostic records. The tragic incidences of past and present have given an insight into the increased importance of forensic dentistry in identification of the deceased or victims of disaster in general. Also, with the expected future increase in disasters due to terrorism and natural disasters

such as earthquakes and other causes, the orthodontists with the help of the available software's can use superimposition techniques on lateral cephalograms to rebuild the victims face to a great extent. It is the duty of all orthodontists to store dental documents as they may help in such unexpected/critical circumstances. All practitioners of various fields must understand the forensic implication associated with his/her profession. Thus, the importance of the forensic field should give the dental clinician yet another reason to maintain proper records in accordance to law and assist legal authorities in the identification of victims and suspects.

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