ORIGINAL ARTICLE

Occurrence of diversity in dental pattern and their role in identification in Indian population: An orthopantomogram based pilot study

Abhishek Kumar,
Sujoy Ghosh[1],
Ajay Logani
Department of Conservative Dentistry and Endodontics, Centre for Dental Education and Research, All India Institute of Medical Sciences, Ansari Nagar, [1]Department of Oral Medicine and Radiology, Maulana Azad Institute of Dental Sciences, Bahadur Shah Zafar Marg, New Delhi, India

Address for correspondence:
Dr. Ajay Logani, Department of Conservative Dentistry and Endodontics, Centre for Dental Education and Research, All India Institute of Medical Sciences, New Delhi - 110029, India.
E-mail: apexlogani@yahoo.co.in

Abstract

Objective: The objective of the study was to identify the diversity of dental pattern in the Indian population based on specific patterns of missing, filled, unrestored and impacted teeth using dental radiographs. **Materials and Methodology:** Three hundred dental orthopantomograph were randomly selected and observed for the occurrence of dental patterns. The frequency of occurrence of dental patterns and the diversity in dental patterns were calculated for full dentition, maxilla and mandible. **Results:** The incidence of the most common dental pattern formed by 32 virgin teeth was 9.3%. The diversity of dental pattern for full dentition was 99.7%. Diversity in the maxilla was 59.0% and that in the mandible was 82.0%. **Conclusion:** The study reveals the importance of diversity in dental patterns and their role in identification for forensic purposes.

Key words: Dental diversity, dental patterns, forensic odontology, orthopantomogram

Introduction

The use of unique features of the human dentition to aid in personal identification is well accepted and documented in the forensic fraternity.[1] Being the hardest (270-350 Knop Hardness Number for enamel and dentine) structures of the human body, teeth represent an ideal means of identification in situations of advanced decomposition, fire, massive trauma or mass disaster.[2-4] Regardless of the condition of the body; it is highly likely that the teeth will be preserved, and it is this line of evidence that oftentimes proves to be the most reliable comparative tool.[3]

Identification by abnormal dental characteristic dates back to 66 A.D. when the decapitated head of Lollia Paulina, mistress of the Roman Emperor Claudius, was identified by his wife, Agrippina, based on severe malocclusion and discolored anterior teeth.[5] With recent advances in dental investigations and a more streamlined approach to practicing dentistry, dental records such as periapical radiographs, panoramic radiographs, treatment notes, dental charts, dental casts and intraoral photographs are commonly applied methods of personal investigations and post-mortem and ante-mortem comparisons.[3] Gustafson was the first to use orthopantomography in forensic practice for identification.[6] The availability of orthopantomograms (OPGs) has established this dental record as a valuable aid in comparing ante-mortem and post-mortem dental characteristics. Human identification using panoramic radiography proved to be useful not only when the whole complement of teeth

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is present but also when only a few (molars) are present. OPGs provide a complete view of both jaws and teeth in one image and offer advantages in terms of dental record keeping. Therefore, it can be applied more economically and practically in identifying a large number of victims from mass disasters and other calamities.

Dental comparison is based on unique characteristics of the teeth (shape and outline of teeth and restorations, supernumerary teeth, impacted teeth, fractured teeth etc.,), jaws (structure of the trabecular bone), as well as on the characteristics of any restorations or dental work (fixed or removable dentures, crowns, etc.,). By empirically observing the frequencies of dental patterns from large representative datasets, it is possible to estimate accurately the diversity of the population as a whole.[7] If only three possible characteristics for each tooth (such as its structural intactness, presence of restoration or absence of tooth) are utilized, the possible combinations of characteristics can give rise, in theory, to trillions of possible dental patterns, which could allow the identification process to be quantified.[3,7] Thus, dental patterns provide a valuable instrument of comparison in human identification. It has been correctly reported that, there is sufficient dental diversity between people to enable a scientifically-based human identification method to be developed for forensic purposes.[7] The present study is a pilot study for further research in the field of post-mortem identification of especially in mass disaster and tragedies.

Materials and Methodology

The present study was designed with a view to study the larger databases as an easy and feasible way of keeping records for identification. Three hundred OPGs were randomly selected from those stored at the Centre for Dental Education and Research, All India Institute of Medical Sciences, a tertiary health care unit in New Delhi, India. Each tooth observed on the dental radiographs and was then categorized into virgin, restored, missing or impacted [Table 1]. The collective dentition on the radiograph formed the dental pattern of that particular individual. Such a dental pattern can be distinct to a particular individual.

In the present study, OPG's of only dentulous and partially edentulous subjects were used for analysis. The authors excluded all OPG's with cyst, tumors or any maxillofacial abnormality from the study as they would itself be a distinct characteristic of that particular individual. Each dental arch (maxillary and mandibular) was divided into three segments (right posterior, anterior and left posterior) [Table 2]. The combine occurrence of missing, restored decayed and impacted formed the dental pattern of the individual [Table 3]. The OPG's were thus analyzed for the occurrence of diversity in dental pattern.

Statistical analysis

The data was analyzed using Statistical Package for Social Sciences (SPSS) 11.5 version software. The test applied was descriptive statistics.

Results

The most commonly observed dental pattern was formed by the combination of 32 sound (virgin) teeth, which was found in 9.3% of the sample [Table 3]. Two hundred and forty six different dental patterns were observed in the full dentition set with 228 distinct individual dental patterns, that is dental pattern observed only once in the sample [Table 4]. However, in the maxilla and the mandible, 155 and 161 dental patterns were observed respectively. The diversity of dental pattern for full dentition was 99.7%. Diversity in the maxilla was 59.0% and that in the mandible was 82.0%. The diversity was calculated as per the method by Bradley JA 2003.[8]

Table 1: The occurrence of dental codes on the orthopantomogram

Code	Tooth designated	Description
V	Virgin tooth	No evidences of dental treatment, decayed teeth, root stumps etc.,
R	Restored tooth	Amalgam, composite, or any other restoration, single unit crowns etc.,
M	Missing tooth	Radiographically missing teeth
I	Impacted tooth	Unerupted or impacted teeth

Table 2: Division of dental arches into segments

Maxillary right posterior teeth	18-14
Maxillary anterior teeth	13-23
Maxillary left posterior teeth	24-28
Mandibular right posterior teeth	38-34
Mandibular anterior teeth	33-43
Mandibular left posterior teeth	44-48

Table 3: Distribution and occurrence of the five most commonly observed dental patterns

Dental pattern	Frequency	Percentage
VVVV VVVVV VVVV VVVV VVVVV VVVV	28	9.3
VVVV VVVVV VVVV IVVV VVVVV VVVV	5	1.7
IVVV VVVVV VVVV IVVV VVVVVV VVVV	5	1.7
IVVV VVVVVV VVVV VVVV VVVVV VVVV	3	1.0
IVVV VVVVV VVVV MVVV VVVVV VVVM VVVV VVVVV VVMM	3	1.0

Table 4: Occurrence of dental pattern in maxilla, mandible and full dentition

Dentition	No. of dental patterns	No. of individual dental patterns
Maxilla	155	132
Mandible	161	138
Full dentition	246	228

Discussion

Forensic odontology is the branch of forensic medicine which in the interest of justice deals with the proper handling and examination of dental evidence and with the proper evaluation and presentation of the dental findings.[8] The use of dental records for forensic identification has increased in the last two decades and is well accepted worldwide.[9] More than 70% of the victims of Asian Tsunami and victims of September 11 (9/11) terrorist attack on World Trade Centre, New York, were identified through dental records.[10-13] Forensic dental identification of human remains largely depends upon the comparison of post-mortem dental characteristics to ante-mortem dental information such as written records, dental casts and radiographs. OPGs are more desirable materials of antemortem evidence because of their highly objective nature when compared to other dental records.[10] OPGs are also relatively economical while also having the ability to determine normal as well as abnormal structures on a single 'snapshot'. Furthermore, OPG's are commonly used in routine dental practice and are easily available. Traditionally, forensic odontologists relied on the morphology of dental restorations (fillings, crowns, etc.,) to identify victims.

In the present study, the diversity of dental pattern for full dentition was in consonance with the study conducted by Sang-Seob Lee 2004.[14] However, the results varied greatly when the maxilla and the mandible were considered alone. The high value of diversity for full dentition implies sufficient power for personal identification. For example, the probability of finding a subject with missing third molars in the upper right and left teeth region and missing third and second molars in the lower quadrant with the entire rest teeth being sound (virgin) can be as less as 1% in a given sample.

The low rate of diversity individually in the maxilla or mandible may be attributed to the fact that the authors designed the study on the basis of only four parameters (i.e., virgin, missing, restored and impacted). The four parameters which were used in the present study were primarily for specific implementation in the Indian scenario. It was decided to exclude caries as a parameter for dental diversity as caries is a slow progressing disease and the extent of caries was not identified. Furthermore, initial radiolucency of the carious lesion can be misinterpreted with the artifact of the radiograph. And since the study was a pilot study the authors decided on studying only the four most commonly observed parameters.

The dental patterns provide an excellent tool for comparison in human identification similar to that in mtDNA. Literature suggests that there is sufficient dental diversity between people to enable a scientifically-based human identification method to be developed for forensic purposes.[6] The distinct nature of dental anatomy and the placement of custom restorations can ensure accuracy when the techniques are correctly employed. Diversity of dental patterns formed by combinations of missing, filled, and unrestored teeth can be comparable to the diversity of mtDNA sequences formed by combinations of variants at multiple polymorphic sites within the mtDNA sequence. However, the lower stability of dental pattern in the population unlike DNA which is only affected by mutation and heteroplasmy can be a disadvantage at times.[6]

Conclusion

The authors suggest that the dental records can play a primary source of identification in spite of the advances in DNA identification technology. However, the authors also advocate that the results of the present study are to be used with 'caution' and more researches with a larger sample size from randomly distributed samples are necessary. The authors also emphasize the importance of dental record keeping and strict guidelines to be framed on examination and documentation of dental records in day to day clinical practice. However, despite the mentioned drawbacks of the identification method, dental information may be in several cases the only available means of identification, where most of the other popular methods of identification are completely destroyed.

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