Original Research Paper

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The Diversity in Dental Pattern in Indian Population: An Orthopantomogram Based Retrospective Study.

Abstract:

Aim and Objectives: To evaluate and identify the diversity of dental patterns in the Indian population based on specific patterns and measure the incidence of dental diversity in the full dentition, as well as maxilla and mandible individually in Indian population.

Materials and Methodology: 600 digital Orthopantomogram were randomly selected from the department of oralradiology satisfying the established criteria. The code was given to each tooth and collective dentition on the radiograph formed the dental pattern of that particular individual. The diversity in the dental pattern was measured and assessed for their distinctiveness. Moreover, the 3rd molar angulations were taken as a criterion and their prevalence was measured.

Results: The diversity of dental patterns observed for full dentition, maxilla and mandible were found to be 99.8, 99.6, and 99.7%, respectively. The comparison of dental patterns between maxilla and mandible showed highly significant results. On comparing patterns among males and females, statistically insignificant results were obtained. Moreover, the impacted 3rd molars were noted to be more commonly present in the mandible and were of the vertically impacted type.

Conclusion: Identification by dental characteristics can have a variety of conclusions like identification without discrepancy, consideration of a possibility of identification, insufficient to reach a conclusion and definite exclusion.In addition, this study strongly promotes the need for maintaining and periodic updating of patient records in every dental setting

Key-words: Dental pattern, dental diversity, forensic odontology, human identification, panoramic radiography

Introduction:

Every human has an identity in life; therefore, society has the duty to preserve this identity beyond life.[1] [2] The use of unique features of the human dentition with radiographs to aid in personal identification is well accepted and documented in the forensic fraternity.[2] [3]Dental radiographs are often used in the identification process. In present study, the application of diversity of dental patterns in orthopantomograms was assessed in the implementation of human identification. Moreover, study takes angulations of impacted 3rd molars while calculating the dental diversity, to check its efficacy as a criterion for personal identification.[4] [5] [6]

Materials and Methods:

The present study is an in-vitro retrospective study and did not involve any intentional radiation exposure to any patient.

Study Population:

A total of 600 digital orthopantomogram (males=300, females=300) were selected from the records in the Department of Oral Medicine, and Radiology. These radiographs were selected by simple random sampling after satisfying the established criteria of selection.

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Criteria for selection:

1. **Inclusion Criteria:**
   - Good quality radiographs were selected.
   - Radiographs with only permanent dentition were selected.
   - OPGs of only dentulous and partially edentulous subjects were used for analysis.
2. **Exclusion Criteria:**
   - Radiographs of completely edentulous patients were excluded.
   - The rthopantomogramwith cyst, tumors or any maxillofacial abnormality were avoided from the study as they would themselves be a distinct characteristic of that particular individual.
   - The adiographs with incomplete tooth development were excluded other than the 3rd molar.
   - The radiographs of patients undergoing orthodontic treatment were excluded.

Method of Data Collection:

All 600 orthopantomograms were examined and evaluated by both the athors to avoid inter-observer discrepancy. The dental patterns were established by considering 12 parameters in total. Each tooth was assigned a code. These parameters and their codes and definitions are shown in Table 1.

Code	Parameter	Description
V	Normal Tooth	No evidence of dental disease, treatment or anomalies.
M	Missing Tooth	Missing tooth
D	Defect	Defect by dental caries, tooth fracture, dislodged fillings, attrition (a low degree of attrition is not considered a defect) and prepared tooth for a crown or bridge abutment.
F	Filling	Amalgam, composite or any other restoration (F+D=F).
R	Residual Root	Remained root due to severe dental caries.
T	Root canal treatment	1. Endodontically treated tooth with coronal filling/crown (T+F=T or T+C=T). 2. Tooth with an endodontic post. 3. Residual root with endodontic treatment (T+R=T).
B	Pontic	Bridge Pontic
C	Tooth with prosthesis	Tooth with a crown or a bridge abutment (C+D=C)
I	Impacted Tooth	Impacted tooth that is partially or completely in bone or an unerupted tooth to the occlusal level except 3rd molars (I+D=I)
P	Implant	Dental Implant (P+C=P)
S	Supernumerary Tooth	Presence of a supernumerary tooth.
A	Dental Anomaly	1) Persistent deciduous tooth without its permanent tooth is coded as a dental anomaly. The permanent un -erupted successor isn't coded. 2) If both the deciduous and its permanent successor are present, the deciduous is not coded.

Table 1- Classified dental patterns on the Orthopantomogram and their corresponding codes.

Other details: When a canine, one of the premolars, and the first molar are in contact, second premolar is coded as missing.

The impacted 3rd molars were coded separately according to their angulations. Their codes and definitions are described in Table 2

Code	Tooth Designated
G	Mesio-angular impaction of tooth partially or completely in bone.
O	Disto-Angular impaction of tooth, partially or completely in bone.
X	Vertical Impaction of tooth, partially or completely in bone.
H	Horizontal Impaction of tooth, partially or completely in bone.
N	Inverted tooth completely in the bone.
Z	Transverse Impaction (Buccal/Lingual) of tooth, partially or completely in bone.
E	Erupting 3rd molar with an open apex, an un-erupted tooth to the occlusion level or an incompletely formed tooth.

Table 2- Codes for an impacted 3rd molar.

All data collected was anonymized, compiled, tabulated and analyzed statistically.Dental diversity was calculated for full dentition, maxilla, and mandible. It was further compared between males and females.The prevalence of different types of impacted 3rd molars was calculated.

Statistical Analysis:

The statistical analysis was performed using Statistical Package for Social Sciences (SPSS Inc., 233 South Wacker Drive, 11th Floor, Chicago, USA) software version 23. The test applied to the study was the chi-squared test.The diversity was calculated as per the method by Hümeyra et al (2017).[8]

Results:

The diversity of dental patterns observed for full dentition, maxilla, and mandible were found to be 99.8%, 99.6%, and 99.7%, respectively (shown in Table 3).

Individual Dental Pattern	Diversity
Full Dentition	99.82%
Maxilla	99.63%
Mandible	99.71%
Males	99.71%
Females	99.73%

Table 3- Dental pattern diversity among Indian population 492 individual dental patterns (that occur only once) were observed in the sample. However, in the maxilla and mandible, 297 and 378 individual dental patterns were observed. Males and females had 550 and 563 individual dental patterns respectively (shown in Table 4).

	Number of Individual Dental Patterns	Number of Repeated Dental Patterns
Males	550	50
Females	563	37
Full Dentition	492	108
Maxilla	297	303
Mandible	378	222

Table 4– Occurrence of dental patterns in full dentition, maxilla and mandible and each gender.

The most commonly observed dental patterns have been tabulated in Table 5. On comparing patterns among males and females, statistically insignificant results were obtained (p value=0.517).The comparison of dental patterns between maxilla and mandible showed highly significant results (p value=0.000).

	Dental Pattern	Number	Percentage
Males	EVVVVVVVVVVVVVE EVVVVVVVVVVVVVE	12	4%
	VVVVVVVVVVVVVVV VVVVVVVVVVVVVVX	7	2.33%
Females	EVVVVVVVVVVVVVE EVVVVVVVVVVVVVE	10	3.33%
	VVVVVVVVVVVVVVV VVVVVVVVVVVVVVX	7	2.33%
Full Dentition	VVVVVVVVVVVVVVV XVVVVVVVVVVVVVX	14	2.33%
	VVVVVVVVVVVVVVV VVVVVVVVVVVVVVV	11	1.83%
Maxilla	VVVVVVVVVVVVVVV	114	19%
	MVVVVVVVVVVVVVM	37	6.17%
Mandible	EVVVVVVVVVVVVVE	40	6.67%
	VVVVVVVVVVVVVVV	35	5.83%

Table 5 - Most frequently observed dental patternsin full dentition, maxilla and mandible and males and females

The prevalence of the different types of 3rd molar impactions was found in relation to their gender and jaw distribution. The impacted 3rd molars were more common in the mandible and were of the vertically impacted type (shown in Table 6).

Dental Pattern	3rd Molars	Percentage	Maxilla	Mandible	Males	Females
Mesio-angular	123	5.1%	10	113	76	47
Horizontal	78	3.3%	-	74	40	34
Disto-angular	19	0.8%	16	3	7	12
Vertical	278	11.6%	88	190	137	141
Transverse	8	0.3%	5	3	4	4
Inverted	-	0%	-	-	-	-

Table 6 – Prevalence ofdifferent types of impacted 3rd molars andprevalence of impacted 3rd molars between maxilla and mandibleand males and females

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.[9] Dental evidence is legally and scientifically accepted around the world for the forensic identification of victims of crimes and disasters and living people.[7] [10] [11] More than 70% of the victims of the Asian Tsunami and victims of the September 11 (9/11) terrorist attack on the World Trade Centre, New York, were identified through dental records.[12] [13] [14] [15]

In the literature, several studies have been conducted on the diversity of dental patterns and their potential use as a tool for identification. Lee et al.[16] defined eight common dental parameters and suggested 99.92% diversity for dental patterns in panoramic radiographs of full dentition, and 98.28% and 99.22% for the mandible and maxilla, respectively. Singh et al.[17], who proposed a dental coding system in panoramic radiographs for forensic identification, included root angulations, in addition to Lee et al.'s[16] parameters. They reported 100% diversity in dental patterns from 30 radiographs. Kumar et al.[1] used four dental parameters: virgin, missing, restored, and impacted teeth. They reported 99.7%, 82.05%, and 59.0% diversity with dental patterns of the full dentition, the mandible, and the maxilla, respectively.

In addition to Lee et al.'s parameters, Bhateja et al.[18] included the presence of supernumerary teeth. They found 99.9%, 98.4%, and 98.2% diversity in dental patterns for full dentition, mandible, and maxilla, respectively. Perez[19] examined 900 panoramic radiographs according to Lee et al.'s[16] parameters and found 99.89%, 99.85%, and 99.81% diversity of dental patterns for the full dentition, the mandible, and the maxilla, respectively. Metgud et al[20] used virgin, restored, missing and impacted teeth as their criteria for studying 300 orthopantomograms, and obtained a diversity of 99.7%, 99.5%, and 99.49% respectively. With 11, 6, and 4 parameters, respectively, Hümeyra et al obtained 99.95%, 99.95%, and 99.31% diversity for full dentition, 99.43%, 99.41%, and 97.64% for the mandible, and 99.52%, 99.50%, and 97.71% diversity for the maxilla.[8]

In present study, a sample size of 600 was selected. The diversity of dental patterns observed for full dentition, maxilla, and mandible were found to be 99.8, 99.6, and 99.7%, respectively. These values were observed to be identical to the previously conducted studies. The addition of the 3rdmolar as a criterion and using 12 different codes, did not significantly affect dental diversity, as evident in the study conducted by Hümeyra et al.[8]

The most prevalent dental pattern noted in the study sample for full dentition was composed of completely normal teeth in the maxilla and mandible with bilateral vertically impacted 3rd molars in the mandible. These findings did not coincide with the other studies probably because of the potential difference in the size of the teeth or the jaws of different populations. The difference in dental diversity was found to be statistically insignificant, thus suggesting the potential incapability to differentiate based on gender characteristics.

In the course of the study, it was found that the maximum 3rd molar impactions were vertical in nature, followed by mesio-angular. These impactions were more prevalent in the mandible than the maxilla. It was also found that mandibular left 1st molar was the most variable tooth with a diverse range of codes. The mandibular right central incisor was identified as the least variable tooth with the least range of codes.

Although it is the moral obligation of the dentist to maintain patient records, a significant amount of dentists tend to neglect their duty. Record keeping may be a challenge in India because of lack of space, infrastructure, skilled manpower, and financial support, ignorance and lack of cooperation of patients, lack of a centralized health care monitoring system or lack of a statutory body to monitor records maintenance. Also, no official training for record maintenance is provided in the dental school curriculum.[21]

If dental records are maintained by every dental professional, it can provide continuity of care for the patient and can be a written communication between the previous treating dentist and any other dentist or doctor who treats the patient in the future. Furthermore, it is a part of good clinical practice protocols. Apart from these, dental records also help to protect against any commercial, legal and medico-legal litigation, and they are critical in events of a malpractice insurance claim. They can play an additional and very crucial role in forensic investigations.[22] [23]

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.[24] This study envisions and encourages the development of a dental record maintaining software for recording dental patterns, which can be used unanimously by every dentist. The software should have a simple design, which allows easy updating of records after every dental visit. The presence of such a technology will result in an effortless hunt for all the information about a patient with just a few mouse clicks. Perhaps, electronic record-keeping is efficient, safe and minimizes the effort to maintain and store paperwork, which would otherwise require infrastructure and space in a dental office.

In context with this article, dental pattern diversity is proposed as a useful technique in the identification process. The presence of repetitions indicates that dental patterns cannot be unique but their diversity could allow further refinement to identify those individuals who could possibly be evaluated by other methodologies. It must be noted that, in some cases, the eventual outcome of an identification process may be inconclusive. Nonetheless, there is a threshold, or series of thresholds, that makes the likelihood of identity proportionately higher or lower.[25]

This study promotes the use of dental patterns as a very effective method for the identification of an individual. For further differentiation, other criteria can be combined with this method. For instance, Singh et al [17] used root angulations as a criterion in cases of a possible match between two individuals, to significantly increase the efficacy in the identification of an individual.

Conclusion:

One of the greatest challenges of dental identification is having the largest number of similarities, and the smallest number of discrepancies, in order to obtain a positive identification in ante - mortem and postmortem records.

The success of forensic identification through dental means largely depends on the availability of ante-mortem dental records. The government and statutory bodies should enforce certain guidelines in this regard. Every dentist should realize their social responsibility of maintaining dental records of their patients so that they can be used for the identification in the event of any disaster.

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