

ORIGINAL ARTICLE

FORENSIC IDENTIFICATION THROUGH TOOTH DISCOLORATION AND ALIGNMENT

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Background: Due to poor oral hygiene and use of tobacco, dental discolorations are present in some people and may indicate presence of toxic substances in food or body, while some have anatomical faulty alignment of teeth. The objective of the study was to know the frequency of these discolorations and faulty dental alignment in the target population so that a forensic tool could be developed. **Methods:** A cross-sectional descriptive study was done in the Dentistry Department of Ayub Teaching Hospital Abbottabad during the month of October 2019, on routine patients visiting the department, using non-probability convenience sampling. A Performa was made to be filled by dentists examining their patients using the standard dentition chart to locate teeth; notation chart was used for recording observations. The preliminaries along with sub-variables were recorded in the Performa for each of 101 patients observed; data were analyzed by SPSS 20 for descriptive statistics. **Results:** Of 101 subjects examined, 54.5% were males and 45.5% females; the percentage of good, satisfactory, and bad hygiene among patients was 12.9%, 11.9%, and 75.2% respectively, with a significant difference of poor oral hygiene among males ($p=0.034$). Dental discoloration was present in 87.1% of patients, with a significant male dominated gender difference ($p=0.038$). Faulty alignment was present in 37.6%, as an independent variable. **Conclusion:** Dental discolorations and faulty alignment of teeth can be utilized as useful tools in exclusionary method of identification which can be used in living and dead for investigation of identification. It was also observed that there is need to emphasize on community dental hygiene in our hospitals.

Keywords: Tooth discoloration; Malocclusion; Tooth crowding; Open bite; Cross bite; Over bite

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INTRODUCTION

Crimes and disasters are common in human societies since the dawn of history; in disasters, identity can be obscured or obliterated due to several reasons and there is always compulsion to individualize human being, or body for so many reasons. In the history of crimes and justice it is the rule to identify criminals, to apprehend them and establish justice by punishing the perpetrator and compensate the victim, thereby protecting the society and citizens.¹ One has to know the criminals or individualize victims or their dead bodies for the purpose of identity and other legal matters, so that justice is not misled.

Human beings after birth till death adopt many habits and these habits leave their marks one or another way, which remain on the human body and mostly they remain even after death, even if the body is incinerated or putrefied;² dental characteristics remains protected for longer, because teeth are protected in mouth cavity and are indestructible³. For examination and record keeping purposes, situation of individual tooth or all teeth can be located in the standard dentition chart and

any character can be recorded of any tooth by symbols by the Notation chart; the other useful tool to record the anatomical situation and characters is (OPG) X-ray, nearly every big hospital has this facility to know the situation of teeth.¹

For purposes of personal identification, teeth, their specific arrangement, development, their loss, and manipulations marks are among the best tools to use; age estimation by their eruption and root calcification is the common method in use. Sex and profession of some can also be determined by them; DNA finger printing is done by material obtained from dental pulp which can absolutely individualize a person. There are several ways in which parameters of identity are known by teeth, e.g. Boyd and Gustafson's methods of age estimation.¹

Human beings absorb different substances by natural routes knowingly or unknowingly due to natural habits or acquired habits during life and they remain temporarily or permanently in the body or detected for short or longer duration; among acquired and natural habits in which teeth or oral cavity is involved are chewing, eating, inhaling and drinking,

through these habits, substances such as nicotine, fluorides, copper, lead, and mercury are ingested. Nicotine is found in Tobacco, which when chewed like betel leaf, can leave yellow or brown discolorations on teeth, while dark black stains behind the incisors teeth are found in smokers; so in living or dead persons, evidence of this can be corroborated with history or autopsy findings of the person under investigation and this can help in exclusion of individual or suspect.⁴ If a living or dead body is having green stained line at the junction of gum and teeth, it means intoxication with copper and blue back line at the same position is indication of mercury or lead poisoning. These linear discolorations show cause of intoxication and can be corroborated with previous evidence in suspect.⁵

The anatomical characters and ossification of bones in an individual play a major role in identification in life and after death, and so do the anatomical characters of teeth; the teeth have peculiar characters on each surface e.g. on buccal, labial, occlusal surfaces, and roots.⁶ The developmental defects and dental alignment are also of great importance; normal alignment of teeth in a jaw will leave normal bite mark, whereas a jaw with faulty alignment of teeth will leave faulty imprint of bite mark. The arrangement of teeth, recorded in ante-mortem X-ray can be corroborated with the post-mortem X-ray of an individual and identity can be sorted. Faulty alignment of teeth is of four types, 1) spacing of teeth in the arch of jaw 2) over riding or crowding of teeth 3) protrusion of upper incisors to overlap lower called over bite, and 4) protrusion of lower incisors to overlap upper called cross bite.⁷⁻¹⁰

Alignment of teeth in each individual is peculiar and so are the bite marks and this can permit precise identification; often at the scene of crime, the perpetrator leaves a bite mark on food or on the individual in sexual crimes e.g. on buttock, breast, and skin of any part. The transparency of suspect bite mark is prepared by cast of suspect mouth and compared with the unknown bite mark and in such a way a suspect can be excluded if they do not match, so the role of bite mark is not conclusive rather exclusionary.

The alignment of teeth in the arch of a jaw and their position e.g. spacing and pattern of arrangement can provide valuable points of similarity and dissimilarity in the court of law and can exclude the perpetrator.¹¹⁻¹³ The bite mark mostly contains saliva, in which there are enzymes and blood group substances, if a person is a secretor and the blood group of the perpetrator can be identified from it and also compared with the accused.¹⁴

MATERIAL AND METHODS

A cross sectional study was carried out from 1st October to 31st October 2019 in the Department of Dentistry at Ayub Teaching Hospital Abbottabad; sample size was calculated as 96 with WHO formula, the population targeted was the adult patients coming to the hospital with all permanent teeth; non-probability convenience sampling technique was adopted, and patients with dental injuries, infections, oral and dental carcinoma were excluded. Ethical approval was taken from the Ethical Committee of Ayub Teaching Hospital and College. After taking informed and written consent from the patient reporting to the OPD of the Dentistry Department, data were collected on a structured Performa which was having the preliminary information, dental charting and dental notation chart. Each patient was examined with no intervention done by the researcher; oral examination was carried out with the help of mirror and visual examination. Patients were asked to produce mouth cast, dental alignment and discolorations were assessed by studying the physical status of teeth. Statistical analysis was performed by SPSS-20; frequency and percentages were calculated for the variables. The Chi Square test was used to know the significance of differences of frequencies between groups; a $p \leq 0.05$ denoted significance.

RESULTS

Demographic and dental profile data of patients are given in table-1. Of the 101 patients examined, 55 were male and 45 female (male: female ratio of 1:1.19); the ages were from 16 to 64 years (mean age 37.15 ± 13.5 years) with most cases (52, 51.5%) being of ages 26–35 years; the majority (65, 64.4%) belonged to Abbottabad. Only 13 (12.9%) had no discolorations while the rest (88, 87.1%) had discolorations of various types. The majority of discolorations (40, 39.6%) were brown, followed by black (31, 30.7%) and yellow (17, 16.8%). Normal alignment was found in 63 (62.4%) of subjects; of the 38 subjects with faulty alignment, spacing was the most common (15, 14.9%), followed by Crowding (10, 9.9%), Crowding with cross bite (07, 6.9%), and Crowding with over bite (06, 5.9%). The most striking finding was the poor state of oral hygiene of patients, in that 76 (75.2%) had Bad Oral Hygiene; Satisfactory Oral Hygiene was found in 12 (11.9%), and Good Oral Hygiene was found in 13 (12.9%) patients.

Table-2 shows the relationship of dental discoloration with demographic and dental variables. Various types of dental stains were identified in 51

(50.4%) males compared to 37 (36.6%) females, while 04 males and 09 females had no stains ($p=0.034$). The age distribution of dental discoloration was not significant, although the age having the most dental stains was the 26–35 years group (43, 42.6%); similarly, the address and dental alignment did not show any significant difference in terms of dental staining. However, there was a strong significant difference of dental stains in relation to oral hygiene, where all 76 (75.2%) patients with Bad Oral Hygiene had dental stains compared to none in the Good Oral Hygiene group and 12 (11.9%) in the Satisfactory Oral Hygiene group ($p<0.001$). and among them 27 (36%) had black stains and 31 (41.3%) brown stains.

Table-3 shows the relationship of faulty dental alignment with demographic and dental variables. Most patients (63, 62.4%) had normally aligned teeth; faulty alignment was found in 38 (37.6%) patients. No significant relationship was found between dental alignment and gender, age, address, or oral hygiene. Thus, dental alignment appears to be an independent variable. Table-4 shows the relationship of Oral Hygiene status with demographic variables. The only significant variable is that of Gender, where males have poor oral hygiene compared to females ($p=0.034$).

Table 1: Demographic and dental profile of subjects (n=101).

Variables	Number of cases	Percentage
Gender		
Male	55	54.5
Female	46	45.5
Age Groups (years)		
15–25	16	15.8
26–35	52	51.5
36–45	17	16.8
46–55	12	11.9
56–65	04	04.0
Address		
Abbottabad	65	64.4
Rest of Hazara	27	26.7
Rest of KP	07	06.9
Rest of Pakistan	02	02.0
Dental discoloration		
No stains	13	12.9
Yellow stains	17	16.8
Brown stains	40	39.6
Black stains	31	30.7
Dental Alignment		
Normal alignment	63	62.4
Spacing	15	14.9
Crowding	10	09.9
Crowding with cross bite	07	06.9
Crowding with over bite	06	05.9
Oral Hygiene		
Good	13	12.9
Satisfactory	12	11.9
Bad	76	75.2

Table-2: Relation of dental discoloration with demographic and dental features (n=101).

Variables	Dental Discoloration				p value
	No stains	Yellow stains	Brown stains	Black stains	
Gender					
Male	04	14	21	16	0.038
Female	09	03	19	15	
Age Groups (years)					0.650
15 – 25	02	02	07	05	
26 – 35	09	09	17	17	
36 – 45	01	03	07	06	
46 – 55	01	01	08	02	
56 – 65	-	02	01	01	
Address					0.324
Abbottabad	09	13	21	22	
Rest of Hazara	02	03	13	09	
Rest of KP	02	01	04	0	
Rest of Pakistan	0	0	02	0	
Dental Alignment					0.235
Normal alignment	08	11	31	13	
Spacing	01	03	04	07	
Crowding	02	01	03	04	
Crowding with cross bite	01	0	01	05	
Crowding with over bite	01	02	01	02	
Oral Hygiene					<0.001
Good	13	0	0	0	
Satisfactory	0	0	08	04	
Bad	0	17	32	27	

Table-3: Relation of dental alignment with demographic and dental features (n=101).

Variables	Tooth Alignment					p value
	Normal	Spacing	Crowding	Crowding with Cross Bite	Crowding with Over Bite	
Gender						
Male	37	07	05	03	03	0.855
Female	26	08	05	04	03	
Age Groups (years)						
15 – 25	08	04	0	01	03	0.161
26 – 35	39	03	05	03	02	
36 – 45	09	04	02	01	01	
46 – 55	05	03	03	01	0	
56 - 65	02	01	0	01	0	
Address						
Abbottabad	38	12	05	04	06	0.301
Rest of Hazara	17	02	05	03	0	
Rest of KP	07	0	0	0	0	
Rest of Pakistan	01	01	0	0	0	
Oral Hygiene						
Good	08	01	02	01	01	0.674
Satisfactory	10	0	0	01	01	
Bad	45	14	08	05	04	

Table-4: Relation of oral hygiene with demographic features (n=101).

Variables	Oral Hygiene			p value
	Good	Satisfactory	Bad	
Gender				
Male	04	04	47	0.034
Female	09	08	29	
Age Groups (years)				
15 – 25	02	03	11	0.203
26 – 35	09	06	37	
36 – 45	01	01	15	
46 – 55	01	0	11	
56 - 65	0	02	02	
Address				
Abbottabad	09	07	49	0.597
Rest of Hazara	02	05	20	
Rest of KP	02	0	05	
Rest of Pakistan	0	0	02	

DISCUSSION

The routine uses of dental records by dental physicians, if practiced meticulously, would provide sufficient data that could be used for forensic purposes, whenever needed; sadly, such practices are not well maintained or documented in Pakistan. The present study was an attempt to probe into the possibility of developing such records and determine their utility as forensic tools for the local population. Hence, importance was given to identifying and recording some dental characters of potential forensic importance that could help in establishing identity, such as dental discolorations, pattern of alignment, status of oral hygiene, and the variability associated with gender and age.

The findings indicate that such data may be of help as forensic tools to identify or exonerate suspects or victims based on examination of their teeth or from teeth obtained at the scene of a crime. Over 75% of patients had poor oral hygiene reflecting their socio-economic and education level

and lack of importance given to oral hygiene. Further evidence of such habits was the finding of dental discoloration in over 87% of patients, reflective of their habits of using tobacco in various forms as well as lack of care of teeth; a significant ($p=0.038$) increased frequency of dental discoloration was found in males (50.6%), even though quite a few females (36.6%) had the same issue. This agrees with a previous study from a similar population, where dental discoloration was noted in 86.6% of subjects.¹⁵ A review article from Poland (2015) noted that black dental discolorations ranged from 2.4–18% in various studies, which were done mostly on children; the authors describe black stains as being composed of bacteria and calcium, reflecting poor dental brushing habits as well as a number of other weaker associated factors, and that they tended to increase with age.⁴ In the present study, most of the stains (42.6%) were found in patients of age group 26-35 years, with decreasing frequencies in younger and older age groups.

Faulty alignment was noted in 37.6% of subjects; a previous study¹⁵ on a similar population noted normal alignment in 61% compared to the present 62.4%. Spacing was the most common (almost 15%) faulty alignment, followed by Crowding (almost 10%) reflecting fair similarity with the previous study, where the figures were 13.5% and 11.5% respectively. In the present study, most cases of Spacing (almost 14%) were found in subjects with Bad Oral Hygiene and in those with Black Stains (almost 7%).

As per a Sudanese study,⁸ Cross bite occurred in 8.5% of Sudanese university students, with African incidence varying from 1.6–2.8%; the previous study from Pakistan¹⁵ showed cross bite was 7.3% compared to almost 7% in this study; Overbite was present in almost 6% of patients of the present study.

In the present study, Faulty Alignment was not significantly associated with gender, age, dental discoloration, or status of oral hygiene, indicating that faulty alignment is an individual character and cannot be generalized, so making it a unique characteristic for identification of that individual, provided that a baseline X-ray or assessment is available for comparison with post mortem X-ray.

Teeth are very important organs, being virtually indestructible, which allows them to preserve individual characters of teeth, and such characters can be related to the body of deceased; they also help in diagnosis of certain metallic poisons, a person having stain of blue line due to poisoning will have them in his dead body, and their nonexistence allows a person's identity to be excluded. Their role in identification and age estimation is established and recognized worldwide, but their role especially in identity of putrefied, incinerated bodies and mass disasters in which mostly identity is obliterated is of great importance due to indestructibility, resistance to putrefaction and their protected site in the oral cavity due to which one can include or exclude a suspected person; hence, the record of presence or absence of tooth and all its characteristics is a useful tool of forensic identity.^{15,16} A study was done in the kingdom of Saudi Arabia to compare the ante-mortem record with the post-mortem record for its use in positive identity.⁵ In a previous study of odontology positive identity was expected in 95%.¹⁵

Forensic dentistry in spite of its importance is not included in the undergraduate study by the Pakistan Medical & Dental Council (PMDC),¹⁷ while in the neighboring country of India, medical and dental professionals are educated and aware of its importance and need and are complying with dental record keeping.¹⁸ In the United Kingdom,

postgraduate qualifications in forensic dentistry are awarded, and its role in forensic identification is well established.¹⁹

Disasters are always a threat to humans everywhere; people not only lose their loved ones, they also cannot identify or locate their loved ones after impersonation or death, due to obliteration of identity by disastrous events, or for many other reasons. Different characters of tooth, acquired or by birth, anatomical or manipulative, and their record are useful for comparison in ante-mortem or post-mortem cases for identity, as were used in recent disasters e.g. tsunami of Far Eastern area.^{15, 20} However, it was not used in the 2005 earthquake of Pakistan, nor the more recent airplane crash in Havelian, Hazara. It is suggested to keep the record of discolorations and alignment along with other characteristics in the dental clinics and hospitals of Pakistan so that it can be used in disasters, which are unavoidable in human life.

CONCLUSION

Dental records are useful for establishing individual identity in forensic cases, where characteristics such as dental discolorations, faulty alignment and status of oral/dental hygiene can be used as specific aids to include or exclude various types of suspects.

AUTHORS' CONTRIBUTION

NS: Conceptualization of study, final approval and review of manuscript. IA: Study design, review. OJ, FS: Data collection, data interpretation. MZH: Review, Study protocol writing. RH, AK: Literature search

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