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FORENSIC DENTISTRY: A REVIEW

Review Article

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ABSTRACT: Forensic dentistry is implicated in civil, criminal and research. It is useful for determination of age, sex and race in disputed cases. Age can be determined by using the criteria like eruption and calcification of teeth, Stack's method, Miles formula, Boyde's method and Gustafson's method. For determination of sex Visual/ clinical, Microscopic and Advanced criteria are used. The peculiarities of the teeth will help in determination of race. Various methods like Universal system, Palmer's system, Haderup system, Federation Dentuire Internationale (FDI), Modified Federation Dentuire Internationale (Modified FDI) and Zigmondy's method are in use for charting of teeth worldwide. The knowledge of interpretation, preservation and correlation of bite marks will be helpful in administration of justice.

INTRODUCTION

Forensic dentistry is defined as application of dental knowledge in the investigation of crime and administration of justice. At present major medicolegal workload is shared by graduates in the periphery. Preliminary knowledge of forensic dentistry will help to upgrade the quality of medicolegal work, done by graduates. Also the overview of bite marks will help to avoid neglecting this vital clue to occurrence of sensitive crimes.

Importance- forensic dentistry is very useful in

Identification of unknown dead bodies. This is done by comparing antemortem and postmortem records or by DNA study of tooth pulp. No two sets of teeth are identical.

Identification of burnt, mutilated or decomposing remains, as the teeth are very resistant to decomposition or destruction, particularly in mass disasters.

Age estimation. Identification of race, occupation, sex, etc. by study of characteristic features. Identification of culprits through bite mark.

Diagnosis of poisoning in certain cases. E.g. lead poisoning, phossy jaw, betel nut chewing habits, smoking habit.

Profession can be inferred from localized attrition of teeth.

Fields of activity- the fields of activity of forensic dentistry are mainly

Civil areas

Criminal areas

Research areas

The civil areas include- Malpractice and other areas of fraud and neglect in which compensation is sought. Identification of individual, where death has occurred in unsuspicious circumstances including mass disasters or natural calamities.

Identification of living person also comes under this category. The criminal sector includes all the scopes of forensic dentistry where the identification from teeth as well as from bite, may be on the victim, assailant or on some inanimate objects like food items. The research field encompasses the academic courses for undergraduates and postgraduates training of dental students, teaching of forensic odontology to police and research work in the field of dentistry.

Need and importance of dentition in identification- The need for identification of an unknown person can be social, emotional or legal. Confirmation regarding identity of the deceased is needed for obtaining a death certificate and for claims of insurance as well as to carry out the will. Identification of an unknown dead body is indispensable to carry out the investigation of offences like murder, abuse etc. Emotion also plays an important role as the relatives of a dead person wish to have their beloved buried or cremated according to their rituals. Teeth are very important for the identification purpose. Teeth are relatively resistant to environmental factors and postmortem proteolysis than the other body parts. They exhibit many individual developmental and functional characteristics. Dentition is affected by diseases like caries, periodontosis etc. which are very common among human beings. The multiple combinations of intact decayed, restored and missing teeth lead to astronomic variations among thirty two teeth. A particular combination is almost unique to an individual and if recorded properly will help in identification. Age estimation- estimation of age in antemortem and postmortem cases and determination of sex of the victim or remains are important guides that help in process of identification.

Methods of age estimation in forensic dentistry-
Tooth eruption and calcification. During natal and neonatal period
In children (up to 14 years)
In young adults (14-20 years)
In adults
Tooth eruption and calcification-
Average time of eruption of temporary teeth-

Teeth	**time of eruption**
Central incisor (lower)	6-8 months
Central incisor (upper)	7-9 months
Lateral incisor (upper)	9-11 months
Lateral incisor (lower)	10-12 months
1st temporary molar	12-14 months
Canine	17-15 months
2nd temporary molar	20-30 months

Average time of eruption of permanent teeth-

Teeth	time of eruption
First molar	6-7 years
Central incisor	7-8 years
Lateral incisor	8-10 years
First premolar	9-11 years
Second premolar	10-13 years
Canine	11-13 years
Second molar	12-14 years
Third molar	17-25 years

Average time of calcification of teeth-

Teeth	Appearance of calcification	Root calcification
First molar	at birth	9-10 years
Central incisor	4 months	9-10 years
Lateral incisor	12 months	10-11 years
Canine	15 months	13-15 years
First premolar	18 months	12-13 years
Second premolar	24 months	14-15 years
Second molar	30-36 months	14-16 years
Third molar	9-10 years	18-25 years

1. Method of Stack-

Stack has provided a regression line of weight of growing dental tissues against age. By weighing the teeth specimen, age of unknown can be obtained from 5 months in utero to postnatal age of 7 months.

Prenatal age (weeks)	Sum of teeth weight (mg)
28	60
40	460
Postnatal age (weeks)	Sum of teeth weight (mg)
2	530
30	1840

Miles formula- Miles determined age at death by measuring the thickness of enamel and dentine from neonatal line and divided it by appropriate daily rate of formation.

Boyde's method- Cross striations in the enamel of teeth represent daily incremental lines. The age of an individual can be calculated by counting the number of lines from neonatal line onwards. This method is applicable mainly to infants. The age so calculated is accurate with an error of around 20 days.

Gustafson's method- After the eruption and calcification of 3rd molar (maximum 25 years of age) estimation of age in adults can be done based on physiological changes of teeth. Gustafson used the following criteria-

Attrition: wearing down of incisal or occlusal surface.
Paradentosis: loosening of teeth due to gum retraction.
Secondary dentine: deposition of dentine in pulp cavity.
Cementum apposition: deposition of cementum in roots.
Root resorption.
Transparency of root.
Total score = A+ P+ S+ C+ R+ T
Age (years) = 11.43 + 4.56 (total score)
Standard error = 3.63
Determination of sex using teeth-
Various features of teeth like morphology, crown size, root length etc.are characteristic for male and female. These will help a forensic expert to identify sex.

Classification of methods-

1. Visual/ clinical 2. Microscopic 3. Advanced

Visual/ clinical method- Amongst teeth mandibular canines shows the greatest dimensional differences with larger teeth in males than in females.
Root length and crown diameter – using optical scanner and radiogrammetic measurements on mandibular permanent teeth sex determination can be done with 80% accuracy by measuring root length and crown diameter.
Sex determination from pulp tissues- it can be done from necrotic pulp tissue stained by quinacrine mustard using fluorescent Y chromosome test for maleness. Barr bodies and F bodies of Y chromosome are preserved in dehydrated pulp tissues up to one year.
PCR amplification method – sex determination from blood and teeth by PCR amplification of alphoid satellite family using amplification of X (131 bp) and Y (172 bp) specific sequences showed to be an useful method.

Sex determination from enamel protein- Amelogenin or AMEL is a major protein found in human enamel. It has a different signature in male and female.

Determination of race using teeth-

Shovel shaped upper central incisor is seen in mongoloids. In white races lateral incisor in upper jaw are smaller than the central especially in females.
Long pointed canine root is seen in mongoloids.
Enamel pearls are frequent in mongoloids.
Carbelli's cusp common in white races.
Taurodontism (bull tooth) common in mongoloids.
Congenital lack of third upper molar is common in mongoloids.
Large teeth with more cusps in their molars even up to 8 with 2 lingual cusps on mandibular first premolars are common in negroid races.

Charting of teeth-

1. Universal system: each teeth is given a number 1 through 16 for upper jaw, beginning from right upper third molar and 17 through 32 for lower jaw, beginning from left lower third molar.

   For permanent teeth:

	Right							Left							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17

For deciduous teeth:

	Right					Left			
A	B	C	D	E	F	G	H	I	J
T	S	R	Q	P	O	N	M	L	K

Palmer's system: the teeth of each quadrant are numbered from 1 to 8, beginning with central incisor and moving away from midline.

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8

Haderup system: similar to Palmer's notation, except that it uses + sign for upper teeth and a – sign for lower teeth. The sign is placed before the number for left teeth and after the number for right teeth.

Permanent teeth:

8+	7+	6+	5+	4+	3+	2+	1+	+1	+2	+3	+4	+5	+6	+7	+8
8-	7-	6-	5-	4-	3-	2-	1-	-1	-2	-3	-4	-5	-6	-7	-8

Deciduous teeth:

05+	04+	03+	02+	01+	+01	+02	+03	+04	+05
05-	04-	03-	02-	01-	-01	-02	-03	-04	-05

Federation Dentuire Internationale (FDI): Two digit system. It is similar to Palmer, but substitute a number for quadrant sign. 1 for right upper, 2 for left upper, 3 for left lower and 4 for right lower quadrant.

Permanent teeth:

18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38

Deciduous teeth:

55	54	53	52	51	61	62	63	64	65
85	84	83	82	81	71	72	73	74	75

Modified Federation Dentuire Internationale (Modified FDI): it is similar to FDI except that quadrant numbers are changed. 1 for left upper, 2 for right upper, 3 for right lower and 4 for left lower quadrant.

Permanent teeth:

28	27	26	25	24	23	22	21	11	12	13	14	15	16	17	18
38	37	36	35	34	33	32	31	41	42	43	44	45	46	47	48

Deciduous teeth:

65	64	63	62	61	51	52	53	54	54
75	74	73	72	71	81	82	83	84	85

Zigmondy's method: this is similar to Palmer's method. The teeth of each quadrant are numbered from 1 to 8, beginning with central incisor and moving away from midline. In this method roman numbers are used for deciduous teeth.

Permanent teeth:

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8

Deciduous teeth:

V	IV	III	II	I	I	II	III	IV	V
V	IV	III	II	I	I	II	III	IV	V

BITE MARKS-

Dentistry also renders its assistance in interpretation of bite marks, i.e. interpretation of trauma to the body or inanimate surface. It is particularly useful in some obvious dental abnormality of a suspect could have caused the unusual bite mark.

Preservation of bite mark- (inanimate).

Where substance is plastic (butter, cheese, wax, chocolate etc.) should be stored in refrigerator to prevent melting. It should not be deep frozen.
Fruits – bottled in metabisulfite fluid (Campden solution) or solution of 5% acetic acid + 40% aqueous formaldehyde solution.

Objects should be photographed before preservation, with film plane at right angle to bite and scale placed in focal plane.

If possible swabbing for saliva traces should be carried out.
Bite mark on human body surface- may be- Animal bite or

Human bite

Human bite may be self inflicted or inflicted by others.

Animal bite- deep parabolic arch or U shaped can most probably be animal in origin.

Human bite- may present only a small part of dental arc, caused by front teeth, with an almost invariable gap at either side. Lips can transiently mark the skin if forcibly nipped, especially on children. Mars are short-lived, not persisting after death unless associated with petechiae. Suction can produce a crop of punctuate hemorrhages or larger ecchymoses.

Bites are common in cases of child abuse and in adult sexual assault cases. Size of bite mark is important in these cases. Love bites in cases of sexual assault with suction petechiae may be a part of acceptable sexual intercourse and always of human origin, but real damage especially to breasts and nipples suggests violent or sadistic element.

Self inflicted bite marks-
Fall onto face- bite to tongue or lips (may be accidental).
Deliberate- to fabricate injuries. Psychiatric disorder.

Multiple bite marks especially of suction type, on accessible areas of shoulder and arms, in older children and teenage girls should raise the suspicion of self infliction.

Teeth marks may be

1. Abrasion
2. Bruises
3. Laceration or
4. combination.

Investigation of bite mark-

- Photograph should be taken from several different angles.
-Photograph taken perpendicular to plane of bite mark.
-Scale adjacent and close to lesion.
-Both color and monochrome photographs should be taken.
-Use infrared insensitive films to reveal occult bruises.
-Bite mark shot with anatomical landmarks.
-Don't allow skin to heat by flash. -
After photography swab for saliva should be taken.

Impression of bite mark-

By laying plastic substance on bite mark which, after hardening produce permanent negative cast of lesion. (rubber or silicon based medium containing catalytic hardener, plaster of Paris).

After autopsy area of skin carrying bite mark may be preserved in formalin. It is useful in addition to dental evidence

If re-examination is desired, skin removal is delayed.

Matching the bite mark-

Unless there is striking dental feature in the bite mark or in teeth of suspect the best can be done is to try to exclude a limited number of potential assailants on the basis of lack of correspondence of their dentition with the bite mark. (consent of the person should be obtained beforehand).

Draw diagram.

Unlike fingerprints, fewer prints of definite correspondence are required to claim correspondence.

REFERENCES

1. Dayal PK, Srinivasan SV, ParavathyR. Textbook of Forensic Odontology. First Edition, 1998, Paras Medical Publishers, Hyderabad.
2. Pillay VV. Textbook of Forensic Medicine and Toxicology- 14th Edition, 2007, Paras Publishing, Hyderabad.
3. Narayan Reddy KS. The Essentials of Forensic Medicine and Toxicology- 27th Edition, 2008.
4. Mathiharan K, Patnaik AK. Modi's Medical Jurisprudenceand Toxicology and Toxicology- 23rd Edition, Lexis Nexis Butterworths: 2006.