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# Forensic Anthropology: A Consequential Facet of Forensic Odontology

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**ABSTRACT:**

All skeletal remains are very indispensable either found from the ground as exhumed or from the cadavers and a significantly imperative aspect in the realm of legal scenario. Forensic odontology, a part of forensic anthropology; forensic pathology and other dental medicines, they are cracking to throw the light on mostly supports on artefacts. Tooth is a part of exoskeleton which present and positioned in the maxillary and mandibular arch. In human dentition, dental morphology and anatomy, both are also played a crucial role for the forensic investigation and identification. Age assessment can be classified into various ways through various techniques of investigation like radiographic method, clinical or visual method, histological method, physical and chemical analysis, all these are providing most authentic process of identification in the sphere of forensic odontology. In the mandibular part, there are five primary teeth per quadrant then ten per arch, and in the maxillary part, again there are five per quadrant then ten per arch and the total is twenty in the primary dentition; eight permanent teeth quadrant then it will be sixteen per arch in the maxilla and mandible and the total is thirty two permanent dentition in adult human. Even the tooth can also facilitates to provide recognize the sex determination either through employing of various methods; human skull can be provided to identify the gender and the mandible, the best way is to examine and identify from the skeletal remains because in male, larger and thicker, more robust than female. Anterior and posterior of teeth, labial view, buccal view, occlusal view of teeth etc., these are the other process of identification to gain reliable information. Occlusal view helps to identify the dental carries or cavity which facilely recognizable and ridges are more present on the molars than the premolars. Teeth can be number in Arabic numerals for permanent teeth from the median line backwards at the lower dental arcade and also for the maxillary arch but for the deciduous teeth, employed Roman numerals in some implemented notation system, in Universal Numbering System ( UNS ), numbered the teeth in Arabic numerals from 1 to 32 but for deciduous teeth employed alphabetic letters from A to T. Bite marks are injured or tissues wounded which makes physiological change through damaging the cells and always associated with assaults, sex crimes and child abuse or sometimes wounded by the sexual arousal. Multifaceted tools and techniques like computed axial tomography scan ( CAT ) for orthodontic assessment, computed tomography ( CT ), X-ray etc., these are the another development and advancement of science and technology that brought the light for the world. Even the miniature artifacts are very imperative elements and in the present scenario, no one could not sweep under the carpet about the doubts and concealed of something can drastically change to unmask for the world to bear in the law enforcement.

**Keywords:** Dentition, Maxillary, Mandibular, Bite marks, Age estimation, Dental notation, Anterior teeth, Dental identification, Buccal, Occlusal, Posterior teeth, Indentation, Lingual, Labial, Quadrant
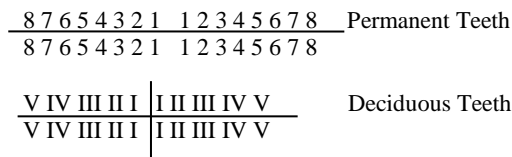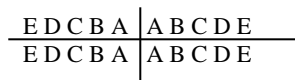
## Introduction

In biological anthropology branch, forensic odontology is a part of forensic anthropology and it is a very broad field of this aspect that exhibits the consequential in the legal scenario and also in the field sciences. Experience is an essential aspect which always nexus in any field of education, industries etc. The forensic odontologist, he or she should have a thorough knowledge of methods, principles, techniques and able to facilely detect, analyse, evaluate, and interpret through visual method. Through forensic odontology, helps to understand by using multifaceted tools and techniques which provides most reliable information. In dentition part, dental anatomy and morphology are the basic understanding of knowledge in the field of forensic anthropology and forensic odontology; and not only in these areas but also in the field of archaeological aspects. To identify the teeth, one should have a valuable knowledge and can be interpretable on about the dentition. Dental record interpretation can be done by utilising the systematic notation that was numbered from 1 to 32 in Arabic numerals and some illustrious dentists employed Roman numerals for deciduous teeth or given the alphabetical order; they implemented to easily interpret the teeth from the dentition and still utilizing in the various fields like in the field sciences. Dental charts and visual recognition can also facilitate to identify for the forensic odontologists who are involving in the discipline of forensic anthropology. Various methods and equipments  like odontometrics, orthometric etc., provides valuable source of information because these methods provide to differentiate the gender through utilizing of bones, especially from the mandibular arch which permanent teeth attached to it. In age estimation, multifaceted techniques of investigation like radiographic method, clinical or visual method, histological method, physical and chemical analysis, these methods also help to classify in the process of identification while forensic investigation; employing of advance tools and techniques is the another source of information in the field of sciences.
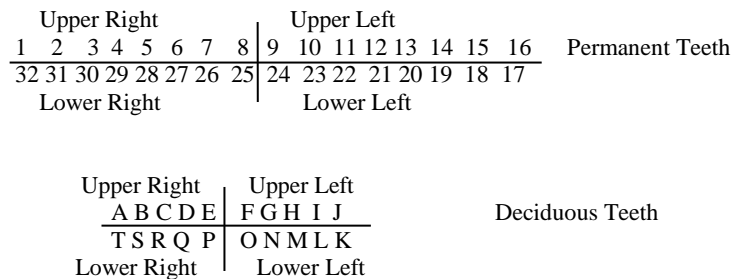
## Dental Interpretation

Dental record of interpretation is a very indispensable to preserve the dental records from the dentition for the documentation in the field of forensic odontology, forensic anthropology, forensic pathology and in the dentistry field too and is an essential component to imbibe knowledge through interpretation from the dentition ( Pendharkar, 2024 ).The recorded dental plays a major role for personal identification in the area of forensic odontology, forensic pathology, forensic anthropology; also helps the using of dental charts to gain information and visual recognition from the deceased person through various techniques ( Shanbhag, 2016 and Dineshkumar, 2017 ). This method had employed by the celebrated dentists through multifaceted method for tooth notation. Tooth notation was used by the Austrian dentist, Adolph Zsigmondy and he was the first to described through this method, and he introduced in 1861 for dental coding system; In Zsigmondy notation, numbered the teeth in Arabic numerals for permanent teeth from the median line backwards at the mandibular arch also known as lower dental arcade and also for the maxillary arch but for the deciduous teeth, employed Roman numerals, in Universal Numbering System, numbered the teeth in Arabic numerals from 1 to 32; the Cunningham's notation is similar to universal notation but the Palmer deciduous modification is not similar and it is used alphabet letters ( Scheid & Weiss, 2012; Ahuja, 2014 and Elmehadwi *et al.,* 2024 ).

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

 V IV III II I │ I II III IV V
 V IV III II I │ I II III IV V          Deciduous Teeth
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**Fig. 1 The Zsigmondy Notation**

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 E D C B A │ A B C D E
 E D C B A │ A B C D E
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**Fig. 2 Zsigmondy – Palmer System (The Palmer Deciduous Modification)**

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

   Upper Right  │  Upper Left
      A B C D E │ F G H I J                                Deciduous Teeth
      T S R Q P │ O N M L K
    Lower Right │   Lower Left
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**Fig. 3 Universal Numbering System**

## Human Dental Morphology and Anatomy

In Human dentition, study of external structure, size, shape etc., known as morphology and these distinct aspects of set of teeth are very indispensable in the sphere of biological anthropology because forensic odontology is a sub-field of forensic anthropology. It is a subsumed component in the field of forensic sciences as well as forensic anthropology, and in the broad-ranging field of medical aspects. In the mandibular part, there are five primary teeth per quadrant then ten per arch, and in the maxillary part, again there are five per quadrant then ten per arch and the total is twenty in the primary dentition; eight permanent teeth quadrant then it will be sixteen per arch in the maxilla and mandible and the total is thirty two permanent dentition in adult human ( Scheid and Weiss, 2012; Tooth Atlas, 2013 and Campista *et al.,* 2023 ). Anatomically, tooth can be divided into two, crown and root. Enamel and dentin are the part of tooth crown. Pulp, cementum, periodontal and nerve are the part of root. The neck of the tooth connects the root to the crown and it is also known as the dental cervix, and it is at the gum line of the mouth and covered by the gum tissue.

Teeth have different shapes and sizes which attached to the bone popularly known as mandible and maxilla and each tooth has a particular role to perform during mastication and helps to crash the food and also lastly for the digestion. They are positioned differently and help to speak clearly while we are communicating with someone. There are four different types of teeth in humans. Listed below are the form and functions of types of human teeth:

**Incisors:** Incisors are present at the anterior part of the mouth, they are well attached to the bones, lower jaw called mandible which attached to the temporal bones of the human skull and upper jaw called maxilla which attached to the nasal bones. Incisors teeth have sharp edges and are facilitating for cutting food into small pieces. Humans have eight incisors, four incisors in the maxilla part and four in the lower jaw.

**Canines:** These teeth are also called cuspids. Canines are present in between the incisors and cuspids and these are present at the anterior part of the mouth. They are sharp, elongated and pointy surface which is almost resembles to dog's tooth. Their primary function is to grip and tear food especially the tough food such as meat and other hard foods. There are four canines in humans, two in the upper jaw and two in the lower jaw.

**Premolars:** Premolars are present at the posterior part of the mouth and also called bicuspids and are located behind or next to the canines and in between the cuspids and molars. These teeth have a flat surface with ridges, which is adapted for crushing and grinding food into smaller portions. Humans have eight premolars, two on each side of the jaws in the upper and lower jaw.

**Molars:** These teeth are the largest among the others and strongest teeth. They have a large and flat biting surface with ridges which is well-adapted for masticating food and helps into smallest portions through these teeth for grinding and crushing before digestion in the stomach. Humans have 12 molars, six in each jaw. Four of those are wisdom teeth, which is also called the third molar.

**Table 1: Dental Morphology ( Primary Teeth )**

| Primary Teeth | | |
|---|---|---|
| **Mandibular Primary Dentition** | | **Maxillary Primary Dentition** |
| Two Incisors ( Central and Lateral Incisors ) | Anterior ( Right ) | Two Incisors ( Central and Lateral Incisors ) |
| One Cusp | | One Cusp |
| Two Molars ( 1st Molar and 2nd Molar ) | Posterior ( Right ) | Two Molars ( 1st Molar and 2nd Molar ) |
| Two Incisors ( Central and Lateral Incisors ) | Anterior ( Left ) | Two Incisors ( Central and Lateral Incisors ) |
| One Cusp | | One Cusp |
| Two Molars ( 1st Molar and 2nd Molar ) | Posterior ( Left ) | Two Molars ( 1st Molar and 2nd Molar ) |

**Table 2: Dental Morphology ( Permanent Teeth )**

| Permanent Teeth | | |
|---|---|---|
| **Mandibular Primary Dentition** | | **Maxillary Primary Dentition** |
| Two Incisors ( Central and Lateral Incisors ) | Anterior ( Right ) | Two Incisors ( Central and Lateral Incisors ) |
| One Cusp | | One Cusp |
| Two Premolars ( 1st and 2nd Premolars ) | Posterior ( Right ) | Two Premolars ( 1st and 2nd Premolars ) |
| Three Molars ( 1st , 2nd and 3rd Molars ) | | Three Molars ( 1st , 2nd and 3rd Molars ) |
| Two Incisors ( Central and Lateral Incisors ) | Anterior ( Left ) | Two Incisors ( Central and Lateral Incisors ) |
| One Cusp | | One Cusp |
| Two Premolars ( 1st and 2nd Premolars ) | Posterior ( Left ) | Two Premolars ( 1st and 2nd Premolars ) |
| Three Molars ( 1st , 2nd and 3rd Molars ) | | Three Molars ( 1st , 2nd and 3rd Molars ) |

## Human Tooth Identification

In dental aspect, the tooth identification is an imperative and engrossing facet in the sphere of forensic anthropology which facilitates to cognize in regards to the human dentition in forensic odontology. Without knowledge to this realm of forensic odontology is a very uphill task to identification of dental aspects and to be a savant or an expert person in the recognition and identification of dental facet ought to be a trained and acquired knowledge in this field; if a person whom he or she has trained proficiently and through manual dexterous to handle the human teeth and knows the detailed morphology of each tooth and anatomy, visual identification etc., then assuredly infallible would be done meticulously either in the legal scenario too ( Ahuja, 2014 and David & Lewis, 2018 ). A person must recognize the landmarks of the tooth while analyzing and to identify the various teeth from each individual from the mandibular and maxillary part. If a person with this proficient and it facilitates facilely to comprehend and also helps to interpretation while either in the field of forensic anthropology or in the realm other medical sciences which related to dental aspects ( Nelson and Ash, 2010 ).

The evidence of dental identification is not a new and it had been done employing of multifaceted techniques to gain tremendous knowledge in the field of forensic anthropology as well as in medical sciences ( Shood *et al.,* 2014 ). Teeth can be identified by employing various ways, as in the anterior teeth, there are three teeth, namely, two incisors and one canine which presents in the mandible and maxilla. It can be done from the median line towards the right side and likewise repeated the same as towards the left side. In labial surface of tooth, central incisor is the first incisor and lateral incisor is the second incisor and the canine also known as cuspid. In buccal view, there are five numbers of teeth, namely, first premolar or first bicuspid, second

premolar or second bicuspid, first molar, second molar and third molar. These teeth are present in the adult human and there are eight tooth names encompassed in each quadrant of the dental arches and making a total of thirty two teeth in all (Scheid and Weiss, 2012 ). In lingual surface of tooth, the teeth are typically concave but depending on variation of tooth type. Teeth like incisors and canines are more concave than any other teeth. Occlusal view helps to identify the dental carries or cavity which facilely recognizable for the dentists. Ridges are more present on the molars than the premolars, which these chewing surface of teeth facilitate to crush food into pieces ( Scheid and Weiss, 2012 and Riquieri, 2019 ).
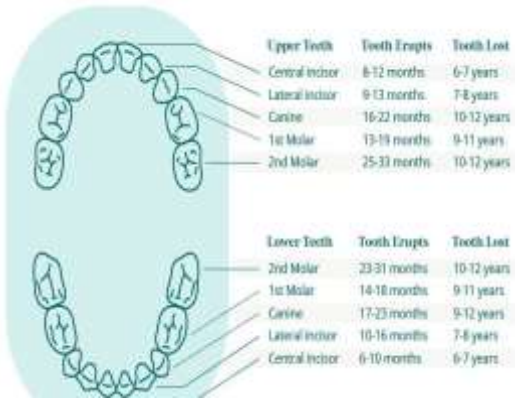


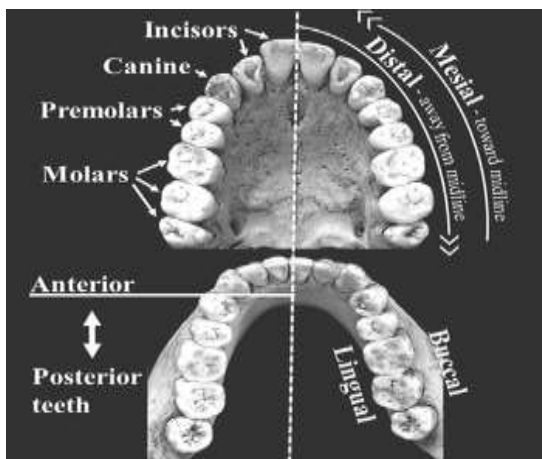**Fig. 4 Teeth Morphology**



**Fig. 5 Tooth Anatomy**



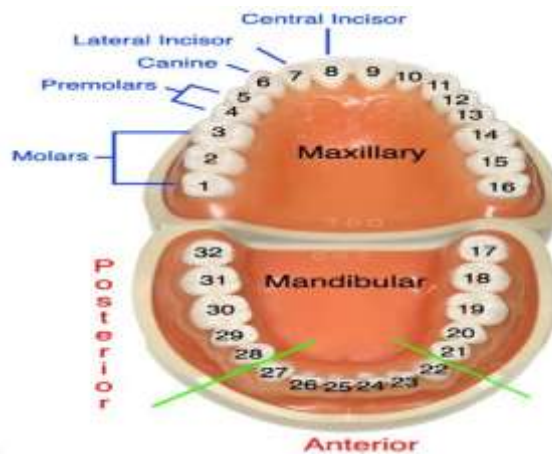**Fig. 6 Anterior and Posterior Teeth**



**Fig. 7 Maxillary and Mandibular Arch**

## Dental Age Estimation

Dental age estimation can be recognised by using multifarious tools, techniques and visualization method too. Tooth estimation has been utilised from the early postnatal children to aged adults. Age assessment can be classified into various ways through various techniques of investigation like radiographic method, clinical or visual method, histological method, physical and chemical analysis, all these are providing most authentic process of identification in the sphere of forensic odontology, forensic anthropology and other related field of dentistry ( Shamim, 2009; Saranya & Malathi, 2014 and Pratap, 2017 ). These methods are very helpful through investigation to procure the stages of tooth eruption from the human dentition. Various tools and techniques like computed axial tomography scan ( CAT ) for orthodontic assessment, computed tomography ( CT ), X-ray etc., these are the another development and advancement of science and technology that brought the light for the world and much more easier through employing these methods to unmask the doubts.

## Bite Marks Analysis

Tooth is one of the hardest tissues in the human body which attached to the maxillary and mandibular arch. Tooth enamel is the hardest part and it is the part from exoskeleton. Bite marks are injured or tissues wounded which makes physiological change through damaging the cells and first wounded or cut would be the first layer of the skin i.e., epidermis. Bite marks are indentation caused by the teeth on skin or objects and always associated with assaults, sex crimes and child abuse or sometimes wounded by the sexual arousal. Bite mark analysis encompass short duration, incomplete bites (Jayakrishnan *et al.,* 2022), and can be thorough investigation, examination in forensic field or identified based on the type of injury, duration of incident or crime scene, site, individual characteristics of dental part, color, size and shape through photographs or other appropriate methods, impressions and digital impressions. Analysis and comparison is a challenging job for the forensic odontologists, forensic anthropologists, forensic pathologists because their oneness and associated with the other related forensic in their department can facilitate them to crack the uphill task, bite mark can be analysed

through utilising the guidelines of American Board of Forensic odontology (ABFO). Haemorrhage, abrasion contusion, laceration, incision, avulsion, and artefact are the seven types of bite marks and are the essential aspect for the forensic department (Shamim, 2006 and Carvalho *et al.,* 2009 and Kumar & Deepthi, 2013).

## Sex Determination from Dental

Sex determination from dental characteristics is a branch of biological anthropology especially in the realm of forensic anthropology and forensic odontology and is an important aspect through dentition for the forensic identification regarding the gender, odontometrics method can also facilitates to identify the sex; skull, good one and a very helpful to recognise human dentition because the mandible, also known as lower jawbone which attached to temporal bone. In male, mandible is larger, thicker, and more robust but in female, mandible is smaller in size, shorter and thinner condyles; these are the clues or the piece of information or hint to identify from the dentition, and also standard deviation ( SD ) is very much helpful to recognize from the dental component ( Khangura, 2011 and Mohammad & Koralakunte, 2015 ). In morphological analysis, odontometrics and orthometric method are utilizing for the hard tissues, through these methods exhibit the differences of male and female; forensic odontology brought the light that mesiodistal ( MD ) and buccolingual ( BL ) never similar as camparison between the male and female dentition, craniofacial morphology and the incisors and canines are also help to identify the individual's gender which are the another clues to provide information ( Ramakrishnan *et al.,* 2015 and Moon *et al.,* 2021 ).

## Conclusion

Forensic odontology, a part of forensic anthropology which facilitates to unmask the hidden quiescent, through multifaceted tools and advance techniques like computed axial tomography scan ( CAT), X-ray etc., and employing of other methods, these can bring the light in the legal scenario. Forensic investigation, analysis and examination are the most authentic aspects to garner the information and the systematic dental notation helps to number the teeth from the dentition and for the forensic odontologists, all these are valuable source of information. Dental can be easily identified the gender through various methods like odontometrics and orthometric, radiographic method, visual method etc., because male teeth are larger than female, and the best way is to do comparison between these two bones, skull part and the mandible. Though, tooth is a small bone from the exoskeleton part but a significant part in the field of forensic aspect and plays a major role in the realm of forensic investigation.

## References

Ahuja, V. 2014. *Handbook for Foresic Odontology*. Selective & Scientific Books

Al-Amad S H. 2009. *Forensic odontology*. Smile Dent. 4:22 - 4

Capista, C.H; Matos, M.D; Queiroz, A.D; Maciel, C.S; Pecanha, M.M and Peruzzo, C.D .2023. *Dental Anatomy and Morphology*

Carvalho S P, Silva R H, Lopes C. 2009. Use of Images for Human Identification in Forensic Dentistry. *Radiol Bras*.42:125–30

David, J.T and Lewis, M.J. 2018. *Forensic Odontology: Principles and Practice*. Academic Press

Dineshkumar, L. 2017. Role of Forensic Odontologist in Dentistry. *Oral and Maxillofacial Pathology Journal*. 8 (2): 136 – 138

Elmehadwi H., Aljalali M. H. and Mahjoub E. H. 2024. The Use of Different Dental Notation Systems among Dental Practitioners in Benghazi. *International Journal of Research and Reviews*. Vol. 11 (5): 641 – 647

Jayakrishnan, J. M., Reddy, J and Kumar, R. B. V. 2022. Role of Forensic Odontology and Anthropology in the Identification of Human Remains. *Journal of Oral and Maxillofacial Pathology.* Vol. 25 (3): 543 - 547

Khangura, R. K., Sircar, K., Singh, S and Rastogi V. 2011. Sex Determination using Mesiodistal Dimension of Permanent Maxillary Incisors and Canines. *Journal of Forensic Dental Sciences*. Vol. 3 ( 2 ): 81 – 85

Kumar, S and Deepthi, B C . 2013. Role of Bite Mark in Forensic Odontology: A Review. International Journal of Science and Research. Vol. 5 (5): 1764 -1768

Mohammad, A and Koralakunte, R. P. 2015. Gender identification and Morphologic Classification of Tooth, Arch and Palatal Forms in Saudi Population. *Journal of Pharmacy and Bioallied Sciences*. Vol. 7

Moon, G. V., Sathawane, R. S., Chandak, R. M., Lanjekar, A. B., Bhakte, K and Sukhdeve, V. A. 2021. Sex Determination by Odontometric Diagonal Measurements Using Discriminant Function. *Journal of Indian Academy of Oral Medicine & Radiology.* Vol. 33 ( 2 ): 208 – 214

Nelson, J.S and Ash, M.M. 2010. *WHEELER'S DENTAL ANATOMY, PHYSIOLOGY, AND OCCLUSION*. Saunders Elsevier. 11830 Westline Industrial Drive St. Louis, Missouri 63146

Pendharkar, S.S. 2024. Forensic odontology: A New Dimension in Dentistry. *International Dental Journal of Student's Research*. Published by Innovative Publication. 12 (1): 3 – 6

Pratap, K. D. 2017. Age Determination in Forensic Odontology. *International Journal of Prosthodontics and Restorative Dentistry.* 7 (1):21-24

Ramakrishnan, K., Sharma, S., Sreeja, C., Pratima, D., Aesha, I and  Vijayabanu, B. 2015. Sex determination in Forensic Odontology: A Review. *Journal of Pharmacy and Bioallied Sciences*. Vol. 7

Riquieri, H. 2019. *Dental Anatomy and Morphology*. Queentessence Publication Co. Inc

Scheid, R.C and Weiss, G. 2012. *Woelfel's Dental Anatomy*. Lippincott William & Wilkins. 2001 Market Street. Philadelphia, PA 19103USA

Shanbhag,L K V. 2016. Significance of Dental Records in Personal Identification in Forensic Sciences. *Journal of Forensic Science and Medicine*. Vo. 2 (1). 32 – 43

Shamim, T. 2010. Forensic Odontology. *Journal of the College of Physicians and Surgeons Pakistan*. Vol. 20 (1): 1-2

Shamim T, Varghese VI, Shameena PM, Sudha S. 2006. Human Bite Marks: The Tool Marks of the Oral Cavity. *Journal of Indian Academy of Forensic Medicine*. 28:52-4

Saranya V, Malathi, N .2014. Forensic Odontology: A Brief Review. *Sri Ramachandra Journal of Medicine*. Vol.7 (2): 22 – 28

Sood,R., Mamachand, P., Sood, R and, Parasher, P. 2014. ROLE OF ODONTOLOGY IN DETERMINATION OF IDENTITY IN FORENSIC SCIENCE: AN OVERVIEW. *Journal of Advanced Medical and Dental Sciences Research*. Vol. 2 (4)

Tooth Atlas. 2013. *eHuman Inc*. 47865 Fremont Blvd. Fremont CA 94538