

Introduction to Forensic Dentistry

L0071 - 3 credits

Manual and Test developed by:
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Ellen Dietz-Bourguignon has disclosed that she has no significant financial or other conflicts of interest pertaining to this course book.

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INTRODUCTION

The most common role of the forensic dentist or forensic odontologist is the identification of deceased individuals. Forensic dentistry can be defined as the application of dental expertise to the justice system. Growing utilization of dental odontology in mass disasters, bitemark perpetrator identifications, crimes and confirmatory identification of newsworthy decedents have also stimulated media attention and public awareness.

Dental identification takes on two forms. First, the most frequently performed examination is a comparative identification used to establish (to a high degree of certainty) that the remains of a decedent and a person represented by antemortem (before death) dental records are the same individual. Information from the body or circumstances usually provides clues as to the identity of the decedent.

Second, in those cases where antemortem records are not available and no clues to the possible identity are available, a postmortem (after death) dental profile is completed by the forensic dentist suggesting characteristics of the individual likely to narrow the search for the antemortem materials.

Dental identification of humans occurs for a variety of reasons in a number of different situations. Victims of violent crimes, motor vehicle accidents, fires, airplane crashes and industrial accidents can be disfigured to such an extent that identification by a family member is neither reliable nor desirable.

Victims who have been deceased for some time prior to their discovery and those found in water also present unpleasant and difficult visual identifications. Dental identifications have always played a significant role in natural and man-made disaster situations and in particular the mass casualties associated with plane crashes. Due to the lack of a comprehensive national fingerprint database, dental identification becomes crucial.

COURSE OBJECTIVES

Upon the completion of this course the learner will be able to

1. Define forensic dentistry (odontology).
2. Describe the training required for forensic odontology and the role of the forensic dentist.
3. Discuss the examination procedure performed by the forensic dentist in making an identification.
4. Describe the process of dental profiling used to identify a decedent.
5. Distinguish the four categories for body identification defined in the guidelines of the American Board of Forensic Odontology.
6. Discuss the significance of bitemarks in victim identification.
7. Discuss the role of DNA in dental identification.
8. Describe the written report that the forensic dentist prepares for the judicial system.

INTRODUCTION TO FORENSIC DENTISTRY

THE SCOPE OF FORENSIC DENTISTRY

Today, forensic dentistry in the U.S. is performed by dentists from all types of practices. The American Society of Forensic Odontology is one of the largest organizations representing those interested in forensic dentistry. (See Appendix A: Dental Forensic Organizations.) The American Board of Forensic Odontology establishes standards of qualification for those who practice forensic odontology and offers board certification to qualified dentists.

The American Dental Association does not recognize forensic dentistry as one of its nine specialties but does support forensic involvement of dental professionals through workshops and literature.

Training in Forensic Dentistry

The initial exposure to forensic dentistry is often a lecture or elective course in dental school. Following graduation, formal education in forensic dentistry is often difficult to acquire. McGill University offers a Forensic Dentistry Program comprised of three online course modules and an intensive one-week laboratory component; University of Detroit Mercy School of Dentistry offers a four-day course on the subject. The University of Texas Health Science Center San Antonio Dental School offers a fellowship in Forensic Odontology that requires 220 hours of classwork that must be com-

pleted in a 14-month period. Membership in organizations such as the American Society of Forensic Odontology also provides additional educational opportunities in the field.

The dentist wishing to become further involved in forensic dentistry may offer his/her services to a local medical examiner, coroner or police department. The dentist may then consider offering professional presentations to potential solicitors of forensic dental services to inform them of his or her knowledge, interest and aptitude in providing forensic services.

Decedent Identification

Victim identification is important for emotional, legal and financial reasons. (See Appendix B: The Six Most Common Reasons and Rationales to Identify Found Remains.) For example, the family of a missing person will not be able to recover death benefits for up to seven years; remarriage of a surviving spouse will not be legally recognized. And in homicide cases, an investigation and conviction are unlikely because the connection to a perpetrator usually requires identification of the body.

Fingerprint comparisons are not always possible in decomposed, skeletonized or charred victims. DNA comparisons have significant potential in victim identification but are expensive and time consuming.

Teeth and jaws can verify identity because the dentition is unique, with its combination of missing and restored teeth and anatomic variations in the

population. Because enamel is the hardest substance in the human body, teeth survive fires, mutilation and decomposition. Also, due to the fact that most people have some prerecorded dental record, teeth serve as the most practical scientific method of decedent identification. In a 2006 study examining the effectiveness of the different methods used in identifying the victims of the devastating 2004 tsunami in Phuket, Thailand, researchers found that 73% of the victims were identified using forensic odontology.

Individuals with more sophisticated dental treatment are often easier to identify than those with little or no restorative treatment.

THE FORENSIC DENTAL EXAMINATION

Prior to conducting a forensic examination, the dentist typically exposes or removes the jaws in decomposing or burned victims. Victim identification is performed by comparing postmortem dental remains with antemortem dental records, including written notes, study cases and radiographs to confirm an identify.

The dentist examines the decedent and records the following:

- Teeth present, missing, impacted and lost after death
- Restorations (surfaces and material used)
- Prostheses and appliances
- Periodontal and orthodontic analysis
- Peculiarities, e.g., broken hypoplastic and discolored teeth, anatomic variation and pathology (See Appendix C: Features Examined During the Comparative Dental Identification)

The next step in victim identification is securing antemortem dental records. The family of the putative victim is contacted and asked to provide the name of the family dentist. In cases where there

is no known family or known dentist, dental records may be available from the military, from prisons, from nearby dental schools or from hospitals. Sometimes emergency rooms or chiropractors known to have treated the victim may have cranial radiographs depicting teeth.

Often, human remains are found and reported to the police who then begin a request for dental identification. Many times a presumptive or tentative identification is available, usually in a wallet or driver's license found with the body; this helps the search to locate antemortem records.

In some instances, removable prostheses are imprinted with the patient's name. (This is legally mandated in a number of states and in government institutions.) Unlabeled dentures have been recovered from deceased patients and then fitted to casts retained by the treating dentist or dental laboratory and are an accepted method of victim identification. Other dental appliances, such as removable retainers, have been used to confirm identification.

Palatal rugae patterns rendered on dental casts have also been used to compare with found remains and can provide a positive identification.

Dental materials can also provide clues as to the individual's identity. In one case the treating dentist had used SEM-EDX to treat the patient; identification of the composition of a glass-ionomer restoration made it possible to trace the restoration back to the prison where it was originally placed in the individual. In another case it was possible to confirm a positive identification by the presence of Kevlar fibers that had been used to reinforce a lower denture.

Occasionally, a high-quality photograph of the victim smiling, such as a wedding or graduation picture, may reveal a characteristic anterior dentition for comparison.

Dental and other physical findings can be entered into the National Crime Information Center (NCIC) computer, which stores data on large num-

bers of missing persons. The computer can generate matches between the decedent and any missing person(s) in the NCIC database who have similar dental characteristics. The forensic dentist can then carefully compare these.

After obtaining antemortem dental records, the forensic dentist employs radiography for the best opportunity to conclude a match; this is because each silhouette pattern of a restoration is unique and can often assure a positive identification. In the absence of restorations, anatomic features such as nutrient canals, trabecular patterns, cuspal and root anatomy can help confirm identity. Postmortem radiographs must duplicate the view, positioning and angulation of the antemortem film(s) to recreate comparable patterns.

Radiographs should be marked with a dental dam punch to indicate antemortem and postmortem to prevent confusion: one hole for antemortem films and two holes for postmortem films.

Postmortem Dental Profiling

In instances where antemortem dental records are unavailable or other methods of identification are not possible, the forensic dentist may assist in limiting the population pool to which the decedent is likely to belong, thus increasing the likelihood of locating antemortem dental records. This is referred to as postmortem dental profiling.

Typically, the postmortem dental profile provides information on the decedent's age, ancestral background, gender and socioeconomic background. Further information such as the decedent's occupation, dietary habits, habitual behaviors and occasionally dental or systemic diseases may be helpful in narrowing down the search.

A determination of gender and ancestry can be made from the skull shape and form. From the skull appearance, the forensic dentist can generally determine the decedent's race. Additional characteristics, such as cusps of Carabelli, shovel-shaped incisors and multi-cusped premolars, can assist in

determination of ancestry. Gender determination is most often based on cranial appearance. Microscopic examination of teeth can confirm gender by the presence or absence of Y-chromatin; DNA analysis can also determine gender.

Tooth structures are also helpful in providing clues about the individual's age. Third molar development is used by some forensic odontologists to determine age in young adults. Periodontal disease, excessive wear, multiple restorations, bone pathosis, extractions and complex restorative treatment may indicate an older individual.

Erosion of the teeth in the decedent can suggest alcohol or substance abuse, an eating disorder or a hiatal hernia; stains can indicate smoking, tetracycline ingestion or betel nut chewing. Unusual wear patterns of the teeth may result from pipe stems, hairpins, carpet tacks or previous orthodontic treatment.

FORENSIC ODONTOLOGY GUIDELINES

The American Board of Forensic Odontology has published body identification guidelines which provide direction to the forensic odontologist for greater accuracy in forensic dental identification of decedents. The following four categories for body identification are carefully defined in these guidelines.

Positive Identification

Positive identification is achieved when the antemortem and the postmortem data match in sufficient detail to establish that they are from the same individual. Additionally, there are no irreconcilable discrepancies.

Possible Identification

Possible identification is achieved when the antemortem and postmortem data have consistent features but because of the quality of either the postmortem remains or the antemortem evidence, it

is not possible to positively establish dental identification.

This category is most troubling to the forensic odontologist because it is a gray area in which there is either poor quality and/or quantity of antemortem or postmortem dental evidence.

Insufficient Evidence

This occurs when the information available is insufficient to form the basis for conclusion of the decedent's identify.

Exclusion

This occurs when the antemortem and post-mortem data are clearly inconsistent.

THE SIGNIFICANCE OF BITEMARKS IN FORENSIC ODONTOLOGY

Bitemark analysis poses an interesting and controversial concern of forensic odontology. The infliction of human bites upon individuals sometimes accompanies violent crimes, such as sexual assault, homicide or domestic partner or child abuse. Most often, the perpetrator bites the victim, however the victim may inflict the bite upon the perpetrator in self-defense.

In either instance, the bite suggests a violent encounter between individuals; the wound pattern life in the bitten individual can help identify the biter and corroborate the crime.

A bitemark injury is important even if the pattern does not implicate a specific perpetrator. More specifically, when an accusation of rape is countered by a defense of consensual intercourse, a bitemark tends to support rape. When the defense maintains accident in a case of child abuse, the presence of a bitemark wound points toward abuse.

Bitemarks also can be analyzed on inanimate objects associated with crime scene, such as foods,

chewing gum, Styrofoam cups and even on steering wheels.

The three objectives of conducting a bitemark analysis are to:

- Identify the patterned injury as a bitemark
- Compare the size and the pattern of the bitemark to the dentition of the suspect or suspects
- Form an opinion regarding the concordance between bitemark and suspect teeth

By definition, a cutaneous bitemark is an injury or trauma inflicted in the victim's skin and made visible by contusion, abrasion and/or laceration to form a characteristic pattern. This pattern most often reflects the contacting surfaces of the anterior teeth and may include variations caused by the individual's biting dynamics.

A typical bitemark might be 3 cm to 5 cm, circular or oval marking with two arches facing one another, both composed of aligned linear or rectangular incisor markings and circular or triangular cuspid markings. Sometimes there is an area of contusion in the center of the bitemark, caused by compression of the skin, with or without suction. Additionally, radial streaks at the periphery of the mark may indicate dragging or slipping of the perpetrator's teeth across the skin or the recording of lingual surfaces of the teeth.

During the bitemark analysis, the forensic dentist compares the unique characteristics of a suspected biter's dentition with the patterns in the bitten skin. In a bitemark analysis, two simultaneous and opposite paths develop.

The inclusive path is where the unique features of a suspected biter's dentition show a strong and consistent linking in a tooth-by-tooth and arch-to-arch comparison with the pattern recorded in the bitten skin. This linking is usually the strongest with a biter having a profoundly irregular dentition and a bitemark pattern in the skin that has recorded clean and distinct individual tooth patterns.

The exclusive path is one where the suspected biter's dentition does not show linking with the patterns recorded in the bitemark injury in an arch-to-arch and tooth-by-tooth analysis. In this case, the biter would be excluded as being responsible for causing the bitemark.

Photography is the best known method of preserving bitemarks, because they fade. Sometimes, impressions of the bitemark are required to recreate the contour and depth of tooth identification.

When making photographs, rules of evidence photography must be used by the forensic odontologist to insure precise, accurate (non-distorted) images that can be correctly sized, identified, and affirmed to be a true and accurate representation of the bitemark injury.

In custody, the alleged biter can be held to collect evidence as soon as informed consent or a court order is obtained by the authorities. At this time a dental examination and charting are conducted, followed by impressions, photographs and bite registrations. This information is then turned over to legal authorities. One must remember that bitemarks in the skin are not an impression of the teeth but a reaction of the skin to contact with the teeth.

Skin that bleeds and tears under an area of pressure does not precisely reproduce the incisal pattern of the teeth. Further, the skin is elastic and variable in texture and contour. Thus, the unpredictable movements produced during the biting dynamics can alter the appearance of the injury pattern. All of these variables that cause distortion of a bitemark can efface the subtle dental characteristics that make the human dentition unique. The injury must clearly show distinctive and unusual features that are reproduced in the suspect's teeth to conclude that a suspect in an open population made the bitemark.

Note: The provider of a bitemark opinion must adhere to the highest of ethical standards, guarding against prejudice, advocacy or unclear language that may tend to overstate the conclusion.

THE ROLE OF DNA IN DENTAL IDENTIFICATION

Teeth provide an excellent source of DNA material in victim identification, primarily due to their resistance to environmental trauma such as incineration, immersion, trauma, mutilation and decomposition. This biological material can provide the necessary link to prove identity when other methods fail.

Polymerase chain reaction (PCR), a technique that allows amplification of DNA at pre-selected, specific sites, is becoming an increasingly popular method of identification with investigators. DNA preserved in and extracted from the tooth or teeth of an unidentified victim can be compared to a known antemortem sample, such as stored blood, hair, skin, cervical smear, biopsy, clothing, etc., or to a biological parent or sibling.

Genomic DNA

A substance called genomic DNA is contained in the nucleus of each cell and represents the source of DNA for most forensic applications. Even after body tissues have decomposed, enamel, dentin and pulp complex remain. DNA is extracted from these calcified tissues; PCR-based analysis produces a DNA profile which the forensic dentist can use to compare with known antemortem samples of paternal DNA.

This method is not only used to identify deceased individuals. It is also used by criminal investigators to link victims to crime scenes once the body has been removed and incinerated.

Mitochondrial DNA

Besides genomic DNA, cells also contain mitochondrial DNA (mtDNA), which is the sequence of building blocks from which body identification can be determined. The primary advantage of mtDNA is that there is a high copy number in each cell caused by the high number of mitochondria present in most cells.

Thus, in cases where genomic DNA cannot be analyzed, possibly because the sample is too degraded, mtDNA may be present in sufficient quantity to make a match.

Because of its higher copy number, mtDNA is maternally inherited. This maternal inheritance pattern provides the same mtDNA sequence (barring mutations) among siblings and all their maternal relatives.

Mitochondrial DNA has important implications in the identification of individuals for whom no antemortem comparison samples are available. Mitochondrial DNA is a powerful technique likely to become commonplace in the future of forensic odontology.

DENTAL IDENTIFICATION IN MASS DISASTERS

A significant key to successful mass disaster victim identification is preparedness. Many rescue jurisdictions have retained dental identification teams and disaster plans in place; they periodically rehearse disasters through mock disaster drills and scenarios.

When identifying large numbers of casualties, physical and emotional hazards are present, although the identification process is the same as that in a routine comparative dental identification.

Additional problems inherent in mass disasters include:

- Body fragmentation
- Mutilation
- Co-mingling of body parts
- Incineration
- Idiosyncratic dental records from numerous sources
- Poor working conditions
- Psychological stress

PREPARATION OF A PROFESSIONAL OPINION AND SCIENTIFIC EVIDENCE FOR THE LEGAL SYSTEM

When the forensic dentist has formulated an expert opinion, a written report summarizing this opinion as the scientific basis must be prepared for the judicial system. The report should include the following information:

- The case number
- The jurisdiction where the case is based
- The person or agency who contacted the forensic dentist and the date
- An item by item listing of all the evidence and the case materials received
- The types of tests performed during the analysis
- The results of those tests
- The examining forensic odontologists professional opinion

In the event that the case moves further into the judicial system, the forensic dentist may be required to provide deposition or expert witness testimony about the scientific examination of the evidence and how the conclusions were reached in the statement of the opinion.

During deposition and expert testimony, the forensic dentist should be prepared to show what was conducted during the investigation including photographs, radiographs, bitemark analysis, DNA testing, etc. Enlargements of photographs, prepared courtroom displays, slides, computer projected presentations and any other means that demonstrate findings in the case may be required.

It is important for the forensic dentist to remember that his or her expert opinion in a case will have profound consequences upon the lives of all persons involved in the case. The scientific examination that provided the expert opinion may provide a key piece of evidence for the legal system; it may lead to conviction or acquittal of a suspect.



The Test

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EXAM QUESTIONS

Questions 1-20

Note: Choose the one option that BEST answers each question.

1. The most common role of the forensic dentist or forensic odontologist is the
 - a. identification of homicide victims.
 - b. identification of antemortem individuals.
 - c. identification of deceased individuals.
 - d. preparation of legal documents for criminal investigations.
2. Forensic dentistry can best be defined as the
 - a. utilization of DNA to identify deceased individuals.
 - b. identification of deceased individuals in mass disasters.
 - c. dentist's responsibility to perform saliva testing.
 - d. application of dental expertise to the justice system.
3. Dental identifications have always played a significant role in mass casualties associated with plane crashes due to the
 - a. difficulty of obtaining names of passengers who had boarded the plane.
 - b. lack of a comprehensive national fingerprint database.
 - c. time-consuming nature of DNA analysis.
 - d. prohibitive expense of DNA analysis.
4. Formal training in forensic dentistry is
 - a. often difficult to acquire.
 - b. offered extensively in dental schools.
 - c. recognized as one of the ADA's nine specialties.
 - d. actively taught at dental hygiene schools.
5. The majority of victims of the devastating 2004 tsunami in Thailand were identified by
 - a. DNA analysis.
 - b. forensic odontology.
 - c. fingerprint analysis.
 - d. loved ones.
6. Deceased individuals with more sophisticated dental treatment
 - a. provide more samples for DNA analysis.
 - b. are no more or less difficult to identify than other individuals.
 - c. are often easier to identify than those with little or no restorative treatment.
 - d. are usually more difficult to identify than those with little or no restorative treatment.

7. Prior to conducting a forensic examination, the dentist typically
 - a. secures antemortem dental records of the deceased individual.
 - b. performs a DNA analysis on the deceased individual.
 - c. takes a full set of oral radiographs of the deceased individual.
 - d. exposes or removes the jaws in decomposing or burned victims.
8. Because each silhouette pattern of a restoration is unique, the forensic dentist's best chance to conclude a "match" results from using
 - a. radiography.
 - b. impressions.
 - c. bitemark analysis.
 - d. DNA profiling.
9. In order to narrow the search in cases where no antemortem records can be located, a forensic dentist is best able to suggest characteristics of the individual by completing a(n)
 - a. autopsy.
 - b. DNA match.
 - c. dental profile.
 - d. saliva test.
10. Skull shape and form can help lead to a determination of the decedent's
 - a. socioeconomic background.
 - b. systemic diseases.
 - c. age.
 - d. ancestry.
11. Examples of tooth structures that can provide clues about the individual's age include
 - a. shovel-shaped incisors.
 - b. multi-cusped premolars.
 - c. third molar development.
 - d. cusps of Carabelli.
12. The forensic dentist's evaluation of the decedent's periodontal disease, excessive wear, multiple restorations, bone pathosis, extractions, and complex restorative treatment may help to identify
 - a. a younger individual.
 - b. an older individual.
 - c. an edentulous individual.
 - d. the sex of the individual.
13. Erosion of the teeth in the decedent can suggest
 - a. an eating disorder.
 - b. previous orthodontic treatment.
 - c. tetracycline ingestion.
 - d. smoking.
14. Which of the four potential categories for body identification is the most troubling to the forensic odontologist?
 - a. Possible identification
 - b. Positive identification
 - c. Insufficient evidence
 - d. Exclusion
15. If there is an area of contusion in the center of a bitemark, it is usually caused by
 - a. the maxillary incisors.
 - b. the mandibular incisors.
 - c. compression of the skin.
 - d. the presence of a tongue ring.
16. The best known method for preserving bitemarks is
 - a. impressions.
 - b. photography.
 - c. radiographs.
 - d. tracing.

17. During a bite mark injury, skin that bleeds and tears under an area of pressure
 - a. does not precisely reproduce the incisal pattern of the teeth.
 - b. provides an exact reproduction of the incisal pattern of the teeth.
 - c. makes it easier to identify the perpetrator with the cusps of the molars.
 - d. causes no obvious distortion of the representation of the suspect's teeth.

18. The technique that allows amplification of DNA at pre-selected specific sites is called
 - a. copolymer reactive DNA.
 - b. polymerase chain reaction.
 - c. mitochondrial DNA.
 - d. genomic DNA.

19. The primary advantage of mitochondrial DNA is that it
 - a. is the least expensive method of DNA analysis.
 - b. is present only in the dentin of a tooth.
 - c. may be present in sufficient quantity to make a match.
 - d. has a paternal inheritance pattern.

20. Once the forensic dentist has formulated an expert opinion, he or she must
 - a. offer his/her personal opinions about the crime committed.
 - b. make a presentation to each of the investigators.
 - c. prepare a written report for the judicial system.
 - d. provide deposition or expert witness testimony.

APPENDIX A

DENTAL FORENSIC ORGANIZATIONS

The following organization(s) may be of interest to those dental professions seeking additional information on forensic dentistry:

American Academy of Forensic Sciences

<http://www.aafs.org>

American Board of Forensic Odontology

<http://www.abfo.org>

American College of Forensic Examiners International

<http://www.acfei.com>

American Society of Forensic Odontology

<http://www.asfo.org/index.asp>

APPENDIX B

THE SIX MOST COMMON REASONS AND RATIONALES TO IDENTIFY FOUND REMAINS

Reason	Rationale
<i>Criminal</i>	Typically an investigation into a criminal death cannot begin until the victim has been positively identified.
<i>Marriage</i>	Individuals from many religious backgrounds may not remarry unless their spouses are confirmed deceased.
<i>Monetary</i>	The payment of pensions, life insurance and other benefits relies upon positive confirmation of death.
<i>Burial</i>	Many religions require that a positive identification be made prior to burial in a geographical site.
<i>Social</i>	Society's duty to preserve human rights and dignity beyond life begins with the basic premise of an identity.
<i>Closure</i>	The identification of individuals missing for prolonged periods can bring sorrowful relief to family members.

APPENDIX C

FEATURES EXAMINED DURING THE COMPARATIVE DENTAL IDENTIFICATION

The following is an extensive list that reflects the complexity of forensic cases, especially in those instances where restorative treatment is either absent or minimal.

Teeth

1. Teeth Present
 - Erupted
 - Unerupted
 - Impacted
2. Missing Teeth
 - Congenitally
 - Lost antemortem
 - Lost postmortem
3. Tooth Type
 - Permanent
 - Deciduous
 - Mixed
 - Retained primary
 - Supernumerary
4. Tooth Position
 - Malposition
5. Crown Morphology
 - Size and shape
 - Enamel thickness
 - Contact points
 - Racial variations
6. Crown Pathology
 - Caries
 - Attrition, abrasion, erosion
 - Atypical variations, enamel pearls, peg laterals, etc.
 - Dentigerous cyst
7. Tooth Morphology
 - Size
 - Shape
 - Number
 - Divergence
8. Root Morphology
 - Dilaceration
 - Root fracture
 - Hypercementosis
 - Root resorption
 - Root hemisection
9. Pulp Chamber/Root Canal Morphology
 - Size, shape and number
 - Secondary dentin
10. Pulp Chamber/Root Canal Pathology
 - Pulp stones, dystrophic calcification
 - Root canal therapy
 - Retrofills
 - Apicoectomy
11. Periapical Pathology
 - Abscess, granuloma or cysts
 - Cementomas
 - Condensing osteitis
12. Dental Restorations
 - Metallic
 - Non-full coverage
 - Full coverage
 - Non-metallic
 - Non-full coverage
 - Laminates
 - Full coverage
 - Dental implants
 - Bridges
 - Partial and full removable prosthesis(es)

Periodontal Tissues

1. Gingival Morphology and Pathology
 - Contour, recession, focal/diffuse, enlargements, interproximal craters
 - Color changes, physiological or pathological pigmentations
 - Plaque and calculus deposits
2. Periodontal Ligament Morphology and Pathology
 - Thickness
 - Widening
 - Lateral periodontal cysts
3. Alveolar Process and Lamina Dura
 - Height, contour, density of crestal bone
 - Thickness of interradicular bone
 - Exostoses, tori
 - Pattern of lamina dura
 - Bone loss (horizontal/vertical)
 - Trabecular bone pattern and bone islands
 - Residual root fragments

Anatomical Features

1. Maxillary Sinus
 - Size, shape, cysts
 - Foreign bodies, fistula
 - Relationship to teeth
2. Anterior Nasal Spine
 - Incisive canal (shape, size, cyst)
 - Median palatal suture
3. Mandibular Canal
 - Mental foramen
 - Diameter anomalous
 - Relationship to adjacent structures
4. Coronoid and Condylar Processes
 - Size and shape
 - Pathology
5. Temporomandibular Joint
 - Size, shape
 - Hypertrophy/atrophy
 - Ankylosis/fracture
 - Arthritic changes
6. Other Pathologies
 - Developmental cysts
 - Salivary gland pathology
 - Reactive/neoplastic
 - Metabolic bone disease
 - Focal or diffuse radiopacities
 - Evidence of surgery
 - Trauma: wires, surgical pins, etc.

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