

## 牙體形態學 Dental morphology

# Forensic Dentistry

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## 學習目標

能辨識及敘述牙齒之形態、特徵與功能意義，並能應用於臨床診斷與治療

1. 牙齒形態相關名辭術語之定義與敘述
2. 牙齒號碼系統之介紹
3. 牙齒之顎間關係與生理功能形態之考慮
4. 恆齒形態之辨識與差異之比較
5. 乳齒形態之辨識與差異之比較
6. 恆齒與乳齒之比較
7. 牙髓腔形態
8. 牙齒之萌出、排列與咬合
9. 牙體形態學與各牙科臨床科目之相關
10. 牙科人類學與演化發育之探討

## 參考資料

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## Summary

- I. Forensic dentistry defined
- II. Dentistry and human identification
- III. Civil litigation (including abuse and neglect)
- IV. Bite marks
- V. Mass disasters
- VI. Importance of forensic dentistry to practicing dentists

## OBJECTIVES

This chapter is designed to prepare the reader to perform the following:

- Cite examples of the importance of dentistry in human identification and crime investigation.
- Recognize the role of the dentist in identifying and reporting cases of abuse.

## Section I. Forensic Dentistry Defined

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Forensic dentistry, or forensic odontology, is the area of dentistry that encompasses concepts and practices related to the oral and maxillofacial structures in the context of the legal or judicial system.

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### Section I. Forensic Dentistry Defined

Forensic odontology is a part of the much larger field of forensic sciences, which includes all the areas of practice and activity used in a judicial setting. The forensic sciences are accepted by the legal system, as well as the scientific community as the means of separating truth and untruth.

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### Section I. Forensic Dentistry Defined

Forensic dentistry as a science is represented in the United States by numerous forensic dentistry teams on local levels, including the Odontology Section of the American Academy of Forensic Sciences, the American Board of Forensic Odontology, and the American Society of Forensic Odontology. Each year more dentists become involved as law enforcement becomes increasingly aware of dentistry's potential and reliable contribution.

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### Section I. Forensic Dentistry Defined

The forensic sciences include many areas of specialization and special interest. The American Academy of Forensic Sciences (AAFS) is the largest forensic professional organization in the world with over 5600 members worldwide ([www.aafs.org](http://www.aafs.org)). The AAFS recognizes 10 areas of forensic endeavors as noted below:

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### Section I. Forensic Dentistry Defined

1. Forensic anthropology is the study of skeletal evidence in a manner similar to the field of archeology. The forensic anthropologist examines evidence such as bones, teeth, hair, clothing, artifacts, and other aspects of the scene of a legal matter such as the crime of murder. This person addresses considerations such as time of death, age, sex, race, ethnicity, culture, body size and weight, and cause and manner of death.

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### Section I. Forensic Dentistry Defined

2. Forensic pathology and biology is the field that uses autopsy techniques and the analysis of tissues in the investigation of a crime or suspicious death such as homicide, suicide, and accidental death or if the subject is unidentified. This duty is legally the responsibility of a coroner or medical examiner with specialized training in pathology and forensic sciences. A forensic pathologist attempts to determine such matters as the cause and manner of death (for example, a gunshot wound to the chest resulting in laceration of the left ventricle, which resulted in cardiac arrest as a result of a homicide).

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**Section I. Forensic Dentistry Defined**

3. Criminalistics is the forensic science that analyzes fingerprints; ballistics; tool marks (knife, saw, hammer, etc.); and other physical evidence from the investigated scene to reconstruct the crime (or other event) and to confirm or eliminate the connection between suspects and victims.

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**Section I. Forensic Dentistry Defined**

4. Toxicology uses chemistry, photography, and biology to identify harmful substances in the victim such as medications, poisons, and illegal drugs.

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**Section I. Forensic Dentistry Defined**

5. Forensic psychiatry and behavioral sciences examine and provide legal opinions regarding such matters as sanity, human motivation, and personality profiles that are relevant to the investigation of an event such as a crime.

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**Section I. Forensic Dentistry Defined**

6. Forensic engineering investigates such events as airplane and other vehicular accidents, as well as structural collapse as part of the legal process.

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**Section I. Forensic Dentistry Defined**

7. Questioned documents is a field where technicians study and provide legal testimony about printing, handwriting, typewriting, ink, paper, and other features of documents.

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**Section I. Forensic Dentistry Defined**

8. General forensics involves other specialists who are qualified to analyze specific evidence such as designers, photographers, and technical experts. They might report, for example, in a case of product liability associated with death or injury.

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### Section I. Forensic Dentistry Defined

9. Forensic jurisprudence involves criminal and civil lawyers using the earlier described specialists, reports, and testimony to pursue their case in our system of justice.

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### Section I. Forensic Dentistry Defined

10. Forensic odontology is divided into five major areas:

- (a) human dental identification,
- (b) mass disaster human dental identification,
- (c) bite mark analysis,
- (d) human abuse, and
- (e) legal issues such as the standard of care considerations in personal injury cases.

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### Section II. Dentistry and Human Identification

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### Section II. Dentistry and Human Identification

Teeth are the most durable parts of the body, and dentitions are as individual as fingerprints. Therefore, individual tooth morphology, as well as the restorations that exist in teeth, are useful for human identification. Situations involving decomposition and skeletal remains may yield no recognizable facial features or fingerprints. Postmortem (after death) teeth, jaws, prostheses, and appliances can yield a positive identification, given the existence and accuracy of antemortem (before death) records. Even DNA, a popular and valuable identification tool, relies on accurate and complete antemortem (before death) records. Therefore, accurate, comprehensive, and current radiographs and dental charting are critical to the successful confirmation or elimination of an individual as a victim.

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### Section II. Dentistry and Human Identification

Even with the lack of antemortem records, evaluation of the dentition is a worthwhile aid for investigators to provide information regarding the age, sex, and estimated socioeconomic (sometimes called race or cultural heritage) grouping. This information is derived from tooth and dental arch morphology and anatomy, restorative materials, attrition patterns, periodontal status, eruption patterns, skeletal features, and serology (the study of body fluids like blood).

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### Section II. Dentistry and Human Identification

Forensic dental techniques most commonly include collection and preservation of dental and jaw remains, dental radiographs, photographs, impressions and casts, antemortem and postmortem charting, and the comparison of these records. Points of comparison (specific features) include (a) the number, class, and type of teeth, (b) tooth rotation, spacing, and malposition, (c) anomalies and general morphology (Fig. 15-1); (d) restorations (Fig. 15-2) and prostheses or appliances (Fig. 15-3); (e) caries and other pathology (in some situations); (f) endodontic treatment; (g) implants and surgical repairs; (h) bony trabecular patterns; and (i) occlusion, erosion, and attrition.

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## Section II. Dentistry and Human Identification

DNA can be recovered from periodontal and pulpal tissues, as well as the hard tissues, of the teeth. Although DNA analysis has become an important tool in the forensic science armamentaria, its limitations include high costs and lengthy processing times. And like all methods, the use of DNA requires antemortem information. A DNA collection kit is shown in [Figure 15-4](#). Forensic dentistry techniques retain a valuable place in the scope of forensic sciences because of the accuracy, low cost, generally available antemortem records, and speed with which a conclusion can be reached.

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## Section II. Dentistry and Human Identification

The forensic dentist must carefully organize all evidence, so that it is analyzed in a systematic manner using consistent and standardized methods that are easily understood by other professionals and defensible in a legal action. A well-organized and thorough approach results in accurate comparisons and minimizes the chance of error. The examiner should record each feature of the postmortem teeth, jaws, and radiographs on a standardized dental chart ([Fig. 15-5B](#)). The same is done for antemortem records, radiographs, casts, and pictures on a separate, but identical, chart ([Fig. 15-5A](#)).

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## Section II. Dentistry and Human Identification

Antemortem records vary widely in quality and completeness. Some dentists mount radiographs as viewed from the front of the patient (with the film bump facing toward the viewer), which is the standard in forensic dentistry, while others still prefer mounting them as viewed from the lingual (film bump facing away from the viewer). Charting tooth identification in dental offices (the antemortem record) is not always done using the Universal system.

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## Section II. Dentistry and Human Identification

A real test of the value of dental identification is found in the case of John Wayne Gacy of Chicago, convicted of 33 counts of murder. Only five of the human remains found still had soft tissue, making the identification process a challenge. However, 20 of the 33 known victims were identified through their dental records.

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## Section III. Civil Litigation including Human Abuse And Neglect

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## Section III. Civil Litigation including Human Abuse And Neglect

Civil litigation (violations of the standard of care or malpractice) and human abuse and/or neglect are two distinct areas of endeavor for the forensic dentist. Due to the focus of this text (the relevance of dental anatomy), only brief comments will be made about these topics.

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### Section III. Civil Litigation including Human Abuse And Neglect

In civil litigation cases, a person might claim that improper dental care was rendered (malpractice) as illustrated in the radiographs in [Figure 15-6](#); damage was sustained at the hands of another person (criminal assault and battery); damage was sustained due to food contaminated with a foreign body (glass, shell, etc.) (product or corporate liability); or a dentist failed to provide specific treatment that had been billed to the patient and/or third-party payor (fraud). Investigators of these situations often require examinations, comparisons, and testimony by expert witnesses including the forensic dentist. This may involve examining a person and studying records and radiographs from prior dentists. All of the techniques and careful comparisons described previously are useful.

### Section III. Civil Litigation including Human Abuse And Neglect

Dentists and other health caregivers have a responsibility to report suspected abuse and neglect of their patients by others. This includes recognition and differentiation of the signs, symptoms, and body areas involved in accidents compared to the injuries that are sustained by a child, a spouse (male or female), or an elderly or disabled individual. One abuse scenario is described here. A young adult male brought his girlfriend into the dental office for emergency treatment of several broken front teeth and lacerated lips. The woman was silent while the man related an accident as the cause of the injuries. The man insisted on being present during the treatment and was evasive about answering questions.

### Section III. Civil Litigation including Human Abuse And Neglect

As required by all state laws, the situation was reported immediately to the appropriate law enforcement agency. The dentist's suspicions had been aroused sufficiently regarding the incongruity of the story and the injuries sustained. Toward the end of treatment, the police arrived, and the man was arrested. Radiographs, the dental record, and the dentist's testimony were critical since the victim was fearful of future revenge from her abuser. Injuries the dentist might observe include fractured bones and teeth, bruises, lacerations, and bite marks.

### Section III. Civil Litigation including Human Abuse And Neglect

Neglecting dental pathology is also a reportable and potentially criminal offense. As often seen by this author, children may not be taken to a dentist for treatment of dental caries. This can result in pain and infection and in some cases may result in the loss of all teeth at an early age ([Fig. 15-7](#)).

### Section IV. Bite Marks

### Section IV. Bite Marks

Bite marks are in the category described as pattern injuries. Pattern injuries can result from teeth, belt buckles, and other blunt objects such as a hammer or pipe. Homicides and assault and battery cases have been solved by bite mark identification, analysis, and comparison. Many bites are severe and leave telltale marks long after an assault. One of several techniques of comparison and analysis is shown here, comparing bite mark tracings to the suspect's or defendant's tooth imprint pattern tracings. Dental casts and photographs from the suspect or suspects are made after obtaining a court-ordered search warrant ([Fig. 15-8A and B](#)).

#### Section IV. Bite Marks

In all cases of bite mark analysis, the forensic dentist must have a thorough knowledge and understanding of tooth morphology, occlusion, dental arch characteristics, and the physiology of jaw function. Teeth that are malpositioned, not in occlusion, fractured, or restored may not leave the same mark on a victim as teeth that are in ideal alignment. This aberration from normal (or differences from one suspect to another) could benefit the forensic dentist in analysis and identification.

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#### Section IV. Bite Marks

Although these techniques can be useful in solving some child abuse cases, assaults, and homicide, bite marks cannot generally be used to a level of absolute certainty in suspect identification. A potential suspect is either "ruled out or eliminated" as the perpetrator of the crime or "included" as a suspect. (See [Figure 15-8C and D.](#)) Additional evidence is usually required to obtain a firm conviction. However, in this author's experience, suspects often admit their guilt prior to trial when faced with a forensic dentist who would testify in court regarding the bite mark.

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#### Section IV. Bite Marks

Photography can be used to assist bite mark identification. Color and black-and-white film photography is still the standard, but digital photography has become fairly well accepted. The use of infrared photography can be used to identify subcutaneous evidence of damage from a bite mark that is not visible on the surface of the skin. Ultraviolet photography can serve to depict a bite mark in an area with extraneous other marks such as tattoos and skin damage.

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#### Section IV. Bite Marks

The forensic dentist must first establish the mark as a human bite mark, then identify, if possible, the teeth involved in the mark. Aberrations include teeth that are missing, extruded (supererupted), hypererupted or ankylosed, rotated (torsion), tilted, chipped, and anomalous. The chapter in this text on anomalies should be reason enough to remain open-minded and diligent when considering bite marks. The dental forensic examiner must also consider the possibility of animal bites, victim self-bites, and marks from foreign objects that might be mistaken for a bite mark. Separate analysis of those markings may be useful to law enforcement agencies by connecting the victim's injuries to a tool or instrument owned by a suspect.

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#### Section IV. Bite Marks

A bite mark may also provide DNA evidence of the perpetrator of the crime. Techniques are available to obtain this information. Today, when DNA can be collected, amplified, and analyzed with the standard accepted modern methods (for example, polymerase chain reaction [PCR] of mitochondrial or nuclear DNA), it is possible to quantify the numerical probability of the association between the biter and the bite mark injury.

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#### Section IV. Bite Marks

Law enforcement agencies are becoming increasingly aware of potential identifications from the dental profession. In a landmark bite mark case in California, *State v. Marx*, Dr. G. Vale, a forensic dentist, recognized bite marks on the autopsy photograph of a nose. After alerting investigators, the body was exhumed and studied with the resultant identification and conviction of the murderer based on the victim's nose bite mark and the suspect's dentition.

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#### Section IV. Bite Marks

An appeal was made to the Supreme Court on the grounds that the dental techniques were unique, untested, and not scientific. The appeal was denied, making this the first US bite mark case to withstand the appellate process. Thus, the reliability of this method of identification was legally verified [People (of California) versus Marx, 54 Cal. App. 3rd 100, 126 Cal. Repr. 350, Dec. 29, 1975]. Since the outcome of the decision in this landmark case, it has been cited many times in most state, federal, and military courts.

#### Section IV. Bite Marks

The notorious mass murderer Ted Bundy (executed January 1989) was positively identified as the perpetrator by his bite marks found on the buttocks of one of his young female victims.

#### Section V. Mass Disasters

#### Section V. Mass Disasters

Mass disasters are relatively common occurrences in our world and are of various forms. Most of us vividly recall the mass disaster that occurred on September 11, 2001, at the World Trade Center in New York City as well as at the Pentagon and in Pennsylvania. However, there are many natural disasters that cause mass fatalities. These include the August and September 2005 hurricanes (Katrina, Rita, and Wilma) affecting the Gulf Coast of the United States, the December 2004 tsunami in Indonesia and the Indian Ocean, and other hurricanes, earthquakes, floods, and tornados.

#### Section V. Mass Disasters

Manmade mass disasters include the various forms of terrorist acts, armed conflicts, building collapses, large freeway motor vehicle accidents, industrial accidents, airplane crashes, and train wrecks. Mass disasters cannot be predicted with any accuracy, but they will certainly continue to happen in our immediate future and beyond.

#### Section V. Mass Disasters

The role of the forensic dentist in mass disasters is primarily to identify human remains. Knowledge of dental anatomy is crucial to this role. Human fatalities in mass disasters can number from a relative handful of individuals to thousands or hundreds of thousands. Management of small disasters can be relatively easily managed while larger disasters are more complex. The management of any-size disaster will necessarily include considerations for harmful chemicals or other biologic agents (such as in bioterrorism).



### Section V. Mass Disasters

The dentist must be able to coordinate and function well in these situations from the initial occurrence of the disaster. This requires that the forensic dentist and the dental team be well trained, led by experienced individuals and completely integrated into the operation.

### Preparation and Training

A forensic dental team must be trained at the individual level and as a team. The Armed Forces Institute of Pathology (AFIP) course is the premier international training course held annually in Bethesda, Maryland (<http://www.afip.org>). The Southwest Symposium is offered biannually in June at the University of Texas Health Sciences Center at San Antonio (<http://www.uthscsa.edu>). Additionally, the American Society of Forensic Odontology (<http://www.asfo.org>) offers annual training and scientific programs and information on other courses nationally and internationally. All forensic dentists and teams who were initially called to New York City for the World Trade Center attack on 9/11/2001 were required to be AFIP trained and/or board certified by the American Board of Forensic Odontology.

### Initial Response

In the event of a mass disaster, local law enforcement agencies and emergency medical teams respond first. Legal authority and jurisdiction is by the legal entity such as city or county in which the disaster occurs. Rescue of injured individuals is the first priority for emergency medical services (EMS) personnel. Site security is the first priority for the law enforcement agency.

### Initial Response

The initial response may include the mobilization of federal and statewide assistance. Responding agencies may include the National Transportation and Safety Board (NTSB), the Federal Emergency Management Agency (FEMA), the Disaster Mortuary Operational Response Team (DMORT), the FBI, the National Disaster Medical System (NDMS), the Department of Homeland Security, and related state agencies.

### Initial Response

It is critical for a dentist to be available at the disaster site to identify human remains and dental components of human remains that may not be recognizable by a non-dental-trained person. There should be a dentist onsite during the entire operation of search and recovery. Obviously the knowledge of dental anatomy is critical to this aspect. A general recommendation is to have a forensic dentist accompany each body recovery team to ascertain that all relevant dental information necessary for identification is retained in a useful and trackable manner. All body parts are initially flagged on site and in situ, then photographed in place prior to removal. Extreme burn cases may require stabilization of the dentition with a spray lacquer such as polyurethane or even hair spray. This will stabilize the fragile dental evidence from damage during transport.

### Initial Response

All body parts are given separate identification numbers, which will often mean that several parts of a single individual's dentition may possess different and unique identifiers that will ultimately be connected to a single identified body. In New York City after the World Trade Center disaster, as many as 200 individually identified and numbered body parts were later associated with a single victim. A single tooth found separated from a portion of a jaw or body would have a different number than the jaw part from which it is later associated.

### Initial Response

An appropriate tracking method is used to locate within the site grid and diagram the original location of each body and part. Aspects of this process can be used later in the forensic determination of cause and method of progression of the disaster event.

### Morgue and Forensic Dental Identification Operations

The dental section of the morgue operation is divided into three major components: antemortem examination, postmortem examination, and a comparison of each. Each of the three major sections has two forensic dentists. There is a minimum of one experienced forensic dentist in each of the teams. A team leader generally functions in a supervisory capacity as a shift commander. There are usually additional secretarial support personnel for overall coordination. [Figure 15-9](#) depicts the dental radiographs and actual dissected jaws with dentition used to identify an actual aircraft incident victim for which a dental identification was required.

### Morgue and Forensic Dental Identification Operations

A critical component for dental identification procedures is the computer-based WinID program developed by Dr. James McGivney. An example of the document used for gathering information for this program is seen in [Figure 15-9D](#). It is a database program that utilizes specific codes of antemortem and postmortem dental findings and identifies records that have a possible identification match. The hardcopy records are then examined by the forensic dental team for final verification. This program can be downloaded at no cost from <http://www.winid.com>.

### Morgue and Forensic Dental Identification Operations

Dental records could be provided in a language other than English, so translation may be necessary. When reviewing the antemortem chart, it is important, as noted earlier, to convert any numbering systems used by the dentist of record (Palmer, FDI, etc.) to the Universal numbering system common in the United States (numbered 1-32 for permanent teeth and A-T for primary teeth). One should also be attentive to esthetic treatments (composites, veneers, etc.) that could be missed on postmortem examination of remains that are covered with debris or damaged by fire and trauma. Finally, in reviewing dental records, the quality of the handwriting and/or completeness of the record may pose significant barriers to determining accurate antemortem information.

### Morgue and Forensic Dental Identification Operations

A thorough postmortem examination is performed by a team of two forensic dentists who verify each other to reduce the chance of errors. In severe burn cases, resection of the jaws may be required to accurately observe and take radiographs of the dental conditions ([Fig. 15-9B](#)). The victim's condition is recorded photographically, radiographically, and in written notes as received in the morgue area. The process of postmortem dental examination, both clinical and radiographic, must consider numerous factors. On clinical examination, the forensic personnel must prepare the specimens by careful cleaning of debris, with care taken not to destroy fragile tooth fragments or the relation of teeth and tooth fragments to the rest of the dental arch. This is most critical in the burned victim.

### Morgue and Forensic Dental Identification Operations

As noted earlier, the preservation of fragile dentition can be aided with spray lacquer or hair spray. Failure to do so can cause enamel to separate from the dentin, restoration loss, and/or destruction of porcelain restorations. The use of disclosing solution or transillumination can aid in the identification of composite restorations or other esthetic restorations.

### **Morgue and Forensic Dental Identification Operations**

The postmortem examination must also take into account the following: (a) identification of existing and missing teeth; (b) developmental and eruption stage; (c) estimated dental age; (d) occlusion and alignment of teeth; (e) structure of tooth crown (basic dental anatomy, anthropologic features, restorations, wear patterns, appliances, etc.); (f) root structure (such as apical development, dilacerations, root numbers, and endodontic therapy); (g) pulpal anatomy (pulp stones, recession of pulp chamber); (h) pathologic changes; (i) retained primary and supernumerary teeth, impactions, and retained root tips; (j) anatomy of sinuses; (k) bony architecture and trabeculation as seen radiographically; (l) bony pathology (exostoses, cysts, tumors, periodontal condition, periapical pathology, fractures, and foreign objects); (m) bone plates, screws and wires, etc.; and (n) evidence of systemic diseases and conditions as well as congenital abnormalities.

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### **Morgue and Forensic Dental Identification Operations**

At this time, the postmortem record can be completed according to the appropriate coding as shown on the forms. Coding used in the WinID program is slightly different from that used in the average dental practice. Failure to use the appropriate codes will prevent the comparison feature of WinID from functioning properly. As a result, a match may not be found and a victim may not be properly identified.

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### **Morgue and Forensic Dental Identification Operations**

The final step is comparison of the antemortem and postmortem records. In cases of individual identifications or the review of a few charts, this may be done manually. However, in large disasters the use of a comparison program such as WinID is critical. In the management of a disaster on the scale of the World Trade Center disaster in 2001 involving the analysis of several thousand antemortem records and over 1000 postmortem dental examination records, WinID and computerized assistance are mandatory.

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### **Morgue and Forensic Dental Identification Operations**

In the comparison process, there are three outcomes possible. Ideally a positive identification is obtained. The other possible outcomes are either "consistent with" or "not a match or unidentified." If any of the following conditions exist in the antemortem record but not in the postmortem record, there is an immediate nonmatch: missing teeth, restored tooth surfaces, unusual root morphology, or chronic pathology. However, it is possible for teeth to be removed, restored, or even orthodontically moved between the date of antemortem information and time of death (recall Fig. 15-2A compared to B).

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### **Morgue and Forensic Dental Identification Operations**

These postmortem findings would not rule out a match between a person and an unknown victim. Pathology present in antemortem information could have been treated, or pathology present in the postmortem condition may not have existed in antemortem information. All of these situations must be readily and reliably explained. Final "sign-off" of the comparison is legally the responsibility of a licensed dentist with appropriate forensic odontology credentials.

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### **Forensic Anthropology**

Another component of forensic identification may involve determining the age, race (cultural heritage), and sex of the victim. Age can be estimated in some cases by the evaluation of the teeth, especially during the time of primary or mixed dentition as described in detail in Chapter 10. Growth and development of the dentition is complete by about 18 years of age. Once all primary teeth are exfoliated and third molars are fully developed, whether impacted or erupted, the ability to gauge age by dental development is no longer reliable.

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### Forensic Anthropology

Wear patterns and pulp chamber changes such as pulp stones and pulpal recession are not accurate. This author has worked with forensic cases where dental wear and pulpal recession appeared to indicate a person of 35-50 years of age when in reality the victim was in the early 20s. In another homicide case a known 21-year-old female presented with an impacted tooth #16, which suggested a developmental age of 15 years, and an impacted tooth #17, which suggested a developmental age of at least 18. (See [Figure 15-10](#)).

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### Forensic Anthropology

Other anthropologic aspects of the dentition can provide indicators of racial or cultural backgrounds. Shovel-shaped incisors may indicate a person of Asian or Mongolian background. Other indicators of this ancestry include prominent zygomatic processes, moderate prognathism, rotation of the incisors, buccal pitting, an elliptical dental arch form, a straight mandibular border, and a wide and vertical ascending ramus. The presence of a cusp of Carabelli is most often an indicator of Caucasian ancestry. Other traits of Caucasian ancestry include a parabolic dental arch form, bilobate (two-lobed) and/or prominent chin, slanted and pinched vertical ramus, canine fossae, retreating zygomatic bones, and lack of prognathic mandible.

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### Forensic Anthropology

The African American population may show vertical zygomatic bones, a noticeably prognathic mandible, molar crenulations (scalloped or notched), hyperbolic dental arch form, blunt and vertical chin, and a pinched and slanting ascending ramus. However, one must be cautious when making an ancestral determination due to the increasing number of mixed racial and ethnic backgrounds that can blur these findings.

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### Forensic Anthropology

Anthropologic determinants also include overall skull characteristics for ethnic, as well as sexual determination. The cranial sutures will ossify and obliterate as a person ages and can be used for age determination.

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### Mass Disaster Case Studies

Several disasters highlight the value of a forensic dental team in the accurate identification of bodies. On the July 17, 1996, off East Moriches, New York, TWA flight 800 (a Boeing 747 air-craft) bound for Paris, France, exploded with 230 passengers aboard. Within the first 12 hours, a team of 30 dentists began the painstaking work of identifying the recovered bodies, which were devoid of clothing. Two and a half weeks later, 208 of the 210 recovered bodies and body parts had been positively identified.

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### Mass Disaster Case Studies

Ninety-five bodies were identified by dental records alone, and another 60 by dental records along with medical records (radiographs, magnetic resonance images, etc.), medical anomalies, and fingerprints.

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### Mass Disaster Case Studies

For the first time ever, all relatives were screened for DNA samples to compare with the more than 400 recovered body parts, enabling the return of each to the families for an appropriate resting place. Nuclear DNA samples were extracted from both bone and dental pulps (which was all that remained after the first week). Mitochondrial DNA was also extracted from ground tooth structure, but it is only effective in matching maternal family connections. One victim was identified by examining DNA on toothbrushes in his home (Columbus Dispatch, Columbus, Ohio, April 1, 1997) since, during toothbrushing, microscopic bits of tissue from the gums and mucosa are scrubbed off and collect on the brush bristles. In all, seven people were identified by DNA alone because no other method was available.

### Mass Disaster Case Studies

One month later, Norwegian researchers were able to identify 139 of 141 people who died in a plane crash in Spitsbergen, Norway, in August 1996 (Journal of Nature Genetics, April 1997). They proved that 257 recovered body parts belonged to 141 people. They collected DNA samples from close relatives. When relatives were not available, investigators collected DNA from hairbrushes, dirty laundry, and toothbrushes in the victims' homes.

### Mass Disaster Case Studies

On September 11, 2001, both towers of the World Trade Center in New York City were destroyed by terrorist hijacked aircraft, and 2726 people were killed in the disaster, more than those who died at the attack of Pearl Harbor by the Japanese Navy in 1941. The dental identification team consisted of over 200 dental personnel working for more than 1 year to identify bodies and body parts by dental records. Approximately 50% of all known victims (less than 1500) were identified, about half of those by dental records and half by DNA means.

### Mass Disaster Case Studies

On November 12, 2001, American Airlines flight 587 crashed in Queens on Long Island due to mechanical failures and air turbulence. All 265 victims were processed for dental identification through the same facility serving the victims of the World Trade Center disaster. The identification process was completed in approximately 1 month and attention returned to World Trade Center victims by the Dental Identification Unit of the Office of the Chief Medical Examiner of New York City.

### Mass Disaster Case Studies

On December 26, 2004, the tsunami struck many communities around the Indian Ocean, causing an estimated death toll in excess of 212,000 people. The challenges for dental identification in this situation included the loss of dental records from destroyed dental offices and the socioeconomic and cultural situation that precluded many people from visiting a dentist and having antemortem information available for comparison. On August 29, 2005, Hurricane Katrina, which had slightly weakened from a Category 5 to Category 4 storm, struck the New Orleans, Louisiana, area of the Gulf Coast of the United States. At least 1386 people lost their lives. The primary challenge for the dental identification teams was obtaining antemortem records. Many dental offices had been destroyed in the hurricane, and records were either lost entirely or too damaged by water to be usable.

### Mass Disaster Case Studies

Only a minority of victims have been identified by any of the available techniques. [Figures 15-11](#) through [15-13](#) provide three additional examples of dental evidence that was useful for identifying the victim of a mass disaster. [Figure 15-11](#) shows a denture, [Figure 15-12](#) shows a two-tooth jaw fragment with a unique restoration, and [Figure 15-13](#) shows a radiograph of a uniquely impacted tooth.

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## Section VI. Importance of Forensic Dentistry to Practicing Dentists

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### Section VI. Importance of Forensic Dentistry to Practicing Dentists

Forensic dentistry is a large area of special interest. This short chapter could only provide a brief overview of the importance of dental anatomy as a foundation for the effective practice of the specialty.

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### Section VI. Importance of Forensic Dentistry to Practicing Dentists

All dental professionals must maintain accurate and comprehensive dental records for legal, standard-of-care, and forensic purposes. This includes written records, radiographs, and models that accurately describe or reproduce the oral anatomic and anthropologic form in detail. The weakest link in the dental identification process (subsequent to locating the antemortem dentist of record) is the quality of the dental written and radiographic record. These records are the first step in the practice of forensic dentistry by every dental professional.

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### Section VI. Importance of Forensic Dentistry to Practicing Dentists

Even if the average dentist does not intend to be involved in forensic dentistry, the probability is that eventually he or she will be contacted regarding questions about quality of care or observed injuries (such as suspected child or spousal abuse), or from law enforcement agencies requesting help. A valuable contribution can be made by understanding the role of dentistry in forensic science, by recognizing dental evidence or a bite mark, and by helping to properly preserve crucial evidence for later analysis.

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### Section VI. Importance of Forensic Dentistry to Practicing Dentists

The dental professional must understand how dental anatomy knowledge is valuable in forensic procedures. Other chapters of this text describe in more detail some of these anatomic features. The presence of a cusp of Carabelli on a maxillary first molar will identify a person as Caucasian heritage. Shovel-shaped incisors will identify a person of mongoloid or Asian origin. Tooth root apex development is an age indicator. Cuspal contours of lower premolars assist in the orientation of bites in a bite mark case when one understands cuspal anatomy of lower versus upper premolars.

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### Section VI. Importance of Forensic Dentistry to Practicing Dentists

Root dilacerations, pulp stones, pulpal recession in the elderly or bruxing patient, maxillary sinus morphology, and virtually all aspects of dental anatomy are useful in the forensic identification of an individual or for assessing standard-of-care issues. In some cases, as in the World Trade Center disaster, the ability to identify a single tooth as a maxillary versus mandibular premolar was the key to the ability to search the database of antemortem records and confirm an identification.

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**Section VI. Importance of Forensic Dentistry to Practicing Dentists**

You will find dental anatomy the foundation or basis for any forensic dentistry investigation. The references offered within this chapter were selected to give the novice a practical and representative introduction to the field and techniques of forensic dentistry.

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