

accident to help determine what happened, when it happened, where it happened, why it happened, how fast the vehicles were traveling, who was involved, and ultimately, who was at fault.

In hit-and-run situations, the car is gone, but the tire marks leave clues leading to its identity. Tire marks at an accident scene can also provide clues to the speed and direction of the vehicle or vehicles involved in the accident. For example, a head-on collision between an innocent driver and a drunk driver would likely show only one set of skid marks on the correct side of the road leading to the impact site. A quick getaway is noted by a skid pattern left behind when the tires spin during acceleration and leave rubber markings on the pavement.

There are three basic types of tire marks:

1. Skid marks:

- Formed when someone brakes suddenly and lock the wheels.
- Provides evidence of the distance brakes were applied.
- Calculation of velocity can be made from skid marks.

Figure 15-15. Skid marks.

Note the skid marks in Figure 15-15.

2. Yaw marks:

- Produced when a vehicle travels in a curved path faster than the vehicle can handle and skids sideways.
- Tires and road surface melt from extreme temperatures.
- Audible squeal and often smoke occurs.

3. Tire scrubs:

- Produced by a damaged or overloaded tire or tires during or immediately after impact.
- Usually curved, irregular in width
- May have striations that look like stripes
- Determine area of impact



Through experience and experimentation, investigators can also estimate speeds of vehicles using the “skid-to-stop” formula. Measuring the weight of the car, the texture of the road surface, and the length of the skid marks, investigators can calculate the approximate speed of the vehicle when the brakes were pressed. This provides information, such as if the car that caused the accident was going over the speed limit. In such a case, more charges could be filed against the driver.

DENTAL IMPRESSIONS

Obj. 15.5

Locard's *principle of exchange* refers to an exchange of materials between a suspect and a victim or a suspect and a crime scene. Occasionally, a perpetrator will leave behind a bite mark. Like fingerprints, bite marks are considered to be individual evidence. Factors that contribute to the individuality of our teeth include the number, size, coloration, alignment, unique fillings, crowns, caps, the distance between teeth, and the overall condition of our teeth. In an older person, the teeth may have a unique pattern of





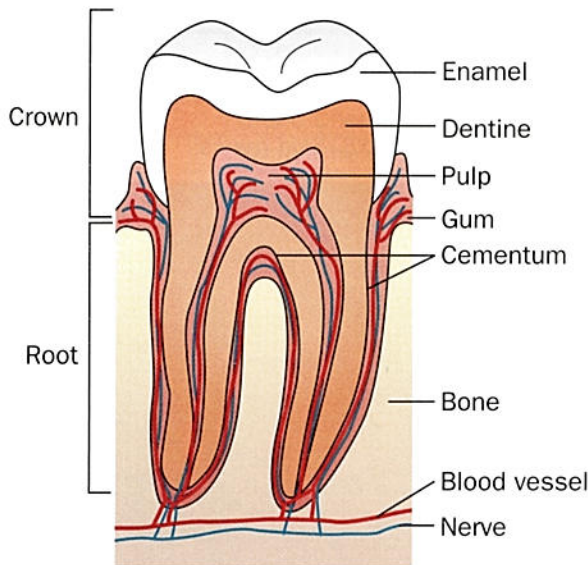
Tooth enamel can endure crushing pressure of approximately 100,000 pounds per square inch.

fillings, breakage, crowns, and caps. Certain antibiotics taken by children have been known to discolor their teeth.

STRUCTURE OF TEETH

The solid, white part of teeth is composed of two different kinds of tissue: a tough covering of *enamel* that protects the living *dentin* tissue underneath (Figure 15-16). Dentin is similar to bone and is composed largely of calcium and phosphorus. Enamel, also composed of calcium and phosphorus, is the hardest substance in the human body, which protects teeth at high temperatures.

Figure 15-16. Cross-sectional view of a human tooth.



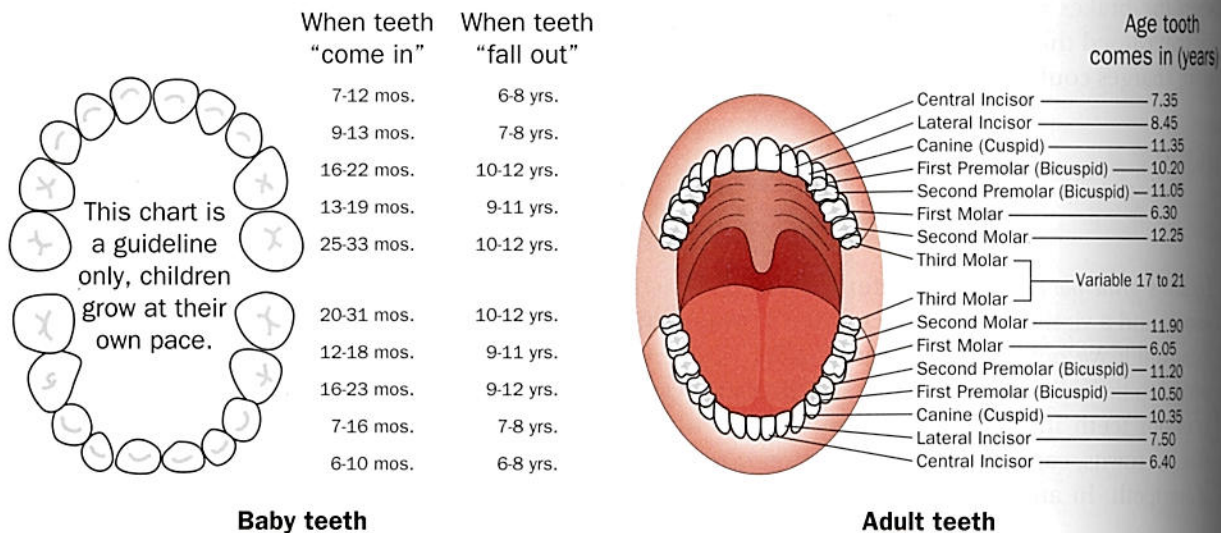
THE DEVELOPMENT OF TEETH

The appearance of 20 primary, baby teeth follows a predictable pattern beginning in the first 7 to 12 months of life. Gradually, the primary teeth are replaced by 32 permanent, adult teeth. The last teeth to develop are the wisdom teeth, which emerge between the ages of 17 and 21. The approximate age of a child can be estimated by viewing the child's teeth (Figure 15-17). An older child may have a mixture of baby and adult teeth. The presence of wisdom teeth usually indicates an age of over 17.

The complete, adult set of teeth encompasses 32 teeth, including wisdom teeth. There are eight incisors at the very front—four on the upper jaw and four on the lower jaw. These are straight teeth that work well in cutting food. The incisors are sandwiched between sharp, pointy canine teeth. There are four canines in total, one on each side of the incisors. Canines are also

good for cutting and tearing. Next come eight premolars, two on each side. Premolars are flatter than canines, with ridges on them. There are 12 molars that are even flatter and wider and are involved in chewing and grinding. The shape of a set of teeth (the *dentition pattern*) varies from person to person. Differences in the size of teeth and jaws, position, and crowding make the inside of each person's mouth unique (Figure 15-18).

Figure 15-17. Pathologists can determine the approximate age of a person from an impression of his or her teeth.



Baby teeth

Adult teeth

DENTAL PATTERNS IN FORENSICS

The individual pattern of teeth is used in forensic investigations in two ways. First, teeth can be used to identify remains, such as those of Adolf Hitler, Joseph Mengele, and the victims of the Waco Branch Davidian Church disaster (1993). Teeth can also be used in profiling and identifying a suspect from unique bite patterns or bite marks left at the scene of the crime.

The bite pattern of a suspect can be matched to the bite marks associated with a crime scene, just as fingerprints of suspects can be matched to fingerprints at a crime scene (Figure 15-19). Up to 76 points of comparison may be used when comparing bite marks, including dental chipping, surface indentations, distances between teeth, individual tooth dimensions, alignment of teeth, and the angle of the mouth arch. The presence or absence of certain teeth can be an indication of age, diet, economic status, and country of origin. Dental procedures and materials may also vary from country to country. All of these factors can provide clues leading to a crime suspect.

If an assailant bites a victim, it is important that the bite marks be photographed while the impression is still visible. The photographs should include a ruler to establish a reference for size to better compare bite marks to a suspect's bite pattern. When an attacker bites a victim, saliva may be left on the victim's skin. If the bite mark is swabbed with a sterile cotton swab, DNA from the saliva may be collected and analyzed. The DNA profile can then be compared to the DNA of suspects.

Figure 15-18. The difference in teeth placement is used to individualize an impression.

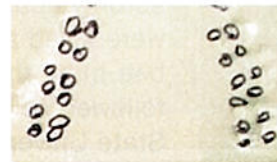


©Cengage Learning

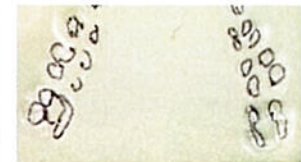


Dental remains have been studied since the time of Neru (66 A.D.)

Figure 15-19. Overlaying a transparent tracing of the teeth points with the impression reveal when there is a match.



Dental impressions on overlay—no match



Dental impressions on overlay—match

©Cengage Learning

SUMMARY

- There are three types of impressions: patent impressions, latent impressions, and plastic impressions.
- Generally, any impression evidence made by an object will be considered class evidence unless it has individualizing features, such as wear or damage.
- Tire impressions at a crime scene can lead to the identification of a vehicle and can provide evidence pertaining to events that occurred before an accident.
- Tire impressions are classified as skid, yaw, or tire scrub impressions.
- Impressions from teeth are considered individual evidence and, like fingerprints, reliability depends on the number of points of comparison and the clarity of the impression.
- Impression evidence must be carefully documented before it is moved. Photographs of the original impression always accompany the cast or record, such as a gel lift, used in court.



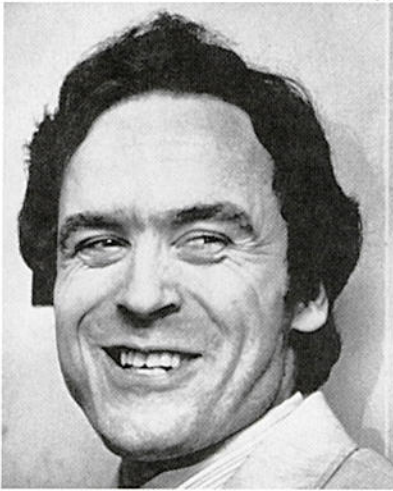
Dental technician James Kim has patented an identification method that is based on embedding information in crowns, bridgework, or other dental work. The dental record may help identify individuals killed in plane crashes, explosions, or other disasters when other identification methods fail.

- Impressions may be used two ways: (1) to identify a person or object and (2) to determine actions that occurred in committing the crime. Identification is usually done by first matching the pattern and then the individual characteristics. A story is told by the series of footprints and/or tire marks that when carefully observed or recreated can illustrate what actions happened before the crime or accident.

CASE STUDIES

Gordon Hay (1967)

In Scotland, the dead body of 15-year-old Linda Peacock was found with a distinct bite mark on her body. Bite mark impressions were taken from the residents of a nearby boy's detention facility, and a match was found. Gordon Hay became the first person convicted of murder based on a bite mark.



©J.R. Eyerman/Time Life Pictures/Getty Images

Theodore Bundy (1978)

A man wearing a stocking cap entered a Florida State University sorority house and attacked some of the women inside. Two women were killed and two more seriously injured. One of the women had a bite mark that was photographed as evidence. Subsequent attacks followed in other states. Ted Bundy was charged with the Florida State University attacks after his dental impressions were compared to those left on a victim. The FBI's Behavioral Science Unit had profiled Bundy as a very neat, organized, serial killer. Bundy was so meticulous that he never left fingerprints even in his own apartment. Bundy escaped from police twice, only to be recaptured. Bundy was found guilty of murder and was executed in 1989. Before his execution, he implied having committed approximately 50 murders.

Lemuel Smith (1983)

Lemuel Smith had a history of violence, which started while he was a teenager. After spending 17 years in prison for multiple violent crimes, Smith was released. Six weeks later, the bodies of two people were found murdered in the neighborhood where Smith was living. Another rape and murder occurred later the same year. Seven months later, the mutilated body of another female victim was found.

Smith was finally arrested during the kidnapping of another female. A bite mark on the nose of one of his victims matched an imprint of his teeth. In March 1978, Smith confessed to five murders. His defense included that he might be suffering from a multiple personality disorder. Based partly on the bite mark evidence, Smith was ultimately found guilty of multiple murders, kidnappings, and rapes and sentenced to more than 100 years of prison time.

In 1981, in the Green Haven Correctional Facility, a female corrections officer named Donna Payant disappeared. Her mutilated body was found in a Dumpster. This was the first time in the United States that a female corrections officer was killed on duty. On examination, Payant's body showed a bite mark. Dr. Lowell Levine, a forensic odontologist who worked on one of Smith's earlier convictions, recognized the bite mark pattern. Smith was charged, convicted, and sentenced to die.) On a legal technicality, his sen-

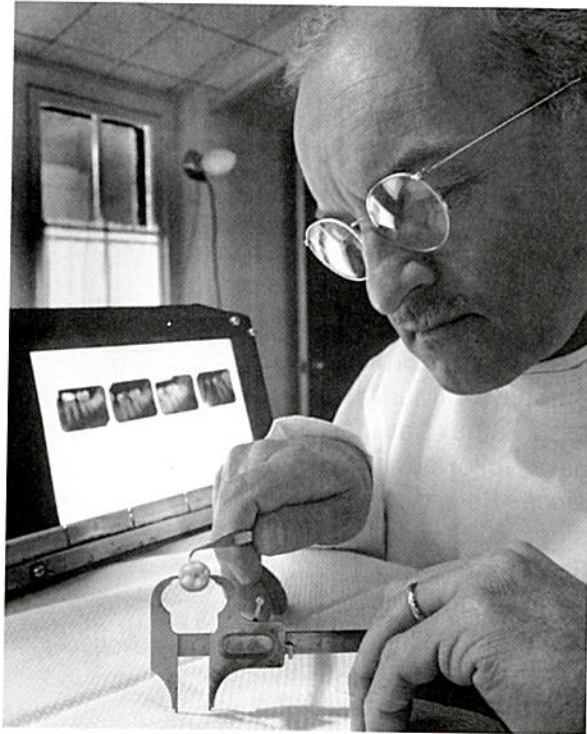
tence was changed to life imprisonment. Levine still works at the crime lab in Albany, New York.

Tire Evidence Solves a Murder

In Largo, Florida, tire tracks were found next to a dead woman's body. Police sent photographs of the tracks to Pete McDonald, former Firestone Tire & Rubber Co. tire design engineer. McDonald helps police all over the United States solve crimes by analyzing photographs of tire impressions. McDonald can determine the type, size, and brand of the tire that made the impression, as well as the vehicle that was likely to be fitted with the tire.

In the Florida case, McDonald was able to identify the brand and size of the tire and the likely vehicle. Police checked purchase records for local tire dealerships and found a match. A woman who purchased the tire lived with a man who had recently served time in prison for violent crime. Using the tire impression information, police found a suspect.

The police asked the tire dealer who sold the tire for help in gathering evidence against the suspected murderer. The dealer agreed and called the suspect and told him his tires had been recalled. The dealer offered new tires to replace the old ones. The suspect came to the shop and traded for the new set of tires. The old tires were sent to McDonald for further analysis. The tire impression, combined with other evidence, convinced a jury to convict the man and send him back to prison for murder.



©J.R. Eyerman/Time Life Pictures/Getty Images

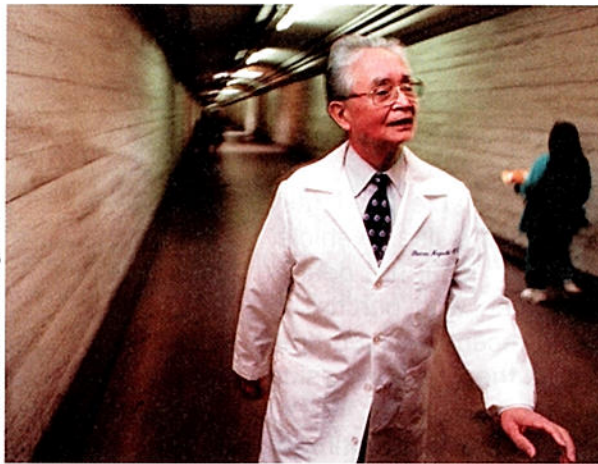


Think Critically Although they might seem easy to cover up, why might footprints, tire tracks, and bite marks be hard to conceal?



Before *CSI*, there was *Quincy*; before *Quincy*, there was Thomas Noguchi

In 1961, Thomas Noguchi emigrated from Japan and was hired as a medical examiner with Los Angeles County. Just a year into the job, he performed the autopsy on Marilyn Monroe. Fame and fortune have followed him ever since. He did the autopsies on Senator Robert F. Kennedy, Sharon Tate, Natalie Wood, and John Belushi. If a case seemed particularly important or perplexing,



Thomas Noguchi.

Dr. Noguchi was called. Before the age of big forensic labs, Dr. Noguchi was a forensic investigator, going over every crime scene with a fine-toothed comb. With a career as a coroner spanning decades, Dr. Noguchi has numerous stories to tell about how his forensic investigations have helped the dead tell their tales.

In an interview with *Omni* magazine, Dr. Noguchi told of “one homicide I investigated, the homeowner returned early, surprising the burglar, so the burglary ended in murder. But the burglar was hungry, so he had a bite to eat before leaving. We found distinct teeth marks in the cheese!” In another case, Dr. Noguchi examined the body right at the crime scene, to determine if a truck had dumped her, as it appeared. The corpse told Dr. Noguchi otherwise. She had been brought to the site alive, and later shot. Because the murderer had to get out of the van to shoot the victim, the area was searched

for footprints. When the footprints were found, an arrest was made.

One of Dr. Noguchi's claims to fame was that he invented a unique technique to cast a stab wound. Through trial and error, Dr. Noguchi found just what he needed: a substance that was liquid at the boiling temperature of water, but quickly hardened into a solid. He used mercury, which is injected into the stab wound, and five minutes

later can pull out a detailed three-dimensional replica of the weapon. You can read more about Dr. Noguchi's cases in his book, *Coroner*, published in 1983, in which he demonstrates one of his favorite sayings, “let the dead speak for himself.”

The career of Thomas Noguchi has its own tales to tell. He was fired from his job as coroner for L.A. County twice because of his willingness to openly talk to the media about a case. In each instance, he was reinstated. In fact, Dr. Noguchi has been very outspoken about the consequences of drug use and speaks of drug designers as mass murderers. Dr. Noguchi is now in his eighties, but he continues to write and to educate. He feels death—and its study—is very important. He has said: “There are lessons to be learned from death. And because these death events are repeated over and over again, we must strive to understand them.”



Learn More About It

To learn more about careers casting impressions at crime scenes, go to school.cengage.com/forensicscience.