REACTION OF THE TOOTH TO TRAUMA
PULPAL HYPEREMIA
A trauma of even a so-called minor nature is immediately followed by pulpal hyperemia. Congestion of blood within the pulp chamber a short time after the injury can often be detected in the clinical examination. If a strong light is directed to the labial surface of the injured tooth and the lingual surface is viewed in a mirror, the coronal portion of the tooth will often appear reddish compared with the adjacent teeth. The color change may be evident for several weeks after the accident and often indicates a poor prognosis.

INTERNAL HEMORRHAGE
The dentist will occasionally observe temporary discoloration of a tooth after injury. Hyperemia and increased pressure may cause the rupture of capillaries and the escape of red blood cells, with subsequent breakdown and pigment formation. The extravasated blood may be reabsorbed before gaining access to the dentinal tubules, in which case little if any color change will be noticeable and what does appear will be temporary. In more severe cases there is pigment formation in the dentinal tubules. The change in color is evident within 2 to 3 weeks after the injury, and although the reaction is reversible to a degree, the crown of the injured tooth retains some of the discoloration for an indefinite period. In cases of this type, there is some chance that the pulp will retain its vitality, although the likelihood of vitality is apparently low in primary teeth with dark-gray discoloration. Traumatized teeth with gray-black discoloration were necrotic. Dark-gray coronal discoloration as the primary diagnostic sign before pulpectomy. Discoloration that becomes evident for the first time months or years after an accident, however, is evidence of a necrotic pulp.

CALCIFIC METAMORPHOSIS OF THE DENTAL PULP (PROGRESSIVE CANAL CALCIFICATION OR DYSTROPHIC CALCIFICATION)
A frequently observed reaction to trauma is the partial or complete obliteration of the pulp chamber and canal. Although the radiograph may give the illusion of complete obliteration, an extremely fine root canal and remnants of the pulp will persist. The crowns of teeth that have undergone this reaction may have a yellowish, opaque color. Primary teeth demonstrating calcific metamorphosis will usually undergo normal root resorption, although calcific metamorphosis subsequently showed evidence of significant internal resorption in the root.
Permanent teeth will often be retained indefinitely. However, a permanent tooth showing signs of calcific changes as a result of trauma should be regarded as a potential focus of infection. A small percentage of such teeth demonstrate pathologic change many years after the injury.
INTERNAL RESORPTION
Internal resorption is a destructive process generally believed to be caused by odontoclastic action. It may be observed radiographically in the pulp chamber or canal within a few weeks or months after an injury. The destructive process may progress slowly or rapidly. If progression is rapid, it may cause a perforation of the crown or root within a few weeks. This condition described as “pink spot” because when the crown is affected, the vascular tissue of the pulp shines through the remaining thin shell of the tooth. The occurrence referred of a perforation as “perforating hyperplasia of the pulp.” If evidence of internal resorption is detected early, before it becomes extensive with resulting perforation, the tooth may possibly be retained when endodontic procedures are instituted.

PERIPHERAL (EXTERNAL) ROOT RESORPTION
Trauma with damage to the periodontal structures may cause peripheral root resorption. This reaction starts from without, and the pulp may not become involved. Usually the resorption continues unabated until gross areas of the root have been destroyed. In exceptional cases the resorption may become arrested, and the tooth may be retained. Peripheral root resorption is most often observed in cases of severe trauma in which there has been some degree of displacement of the tooth.

PULPAL NECROSIS
Little relationship exists between the type of injury to the tooth and the reaction of the pulp and supporting tissues.
A severe blow to a tooth causing displacement often results in pulpal necrosis. The blow may cause a severance of the apical vessels, in which case the pulp undergoes autolysis and necrosis. In a less severe type of injury, the hyperemia and slowing of blood flow through the pulpal tissue may cause eventual necrosis of the pulp. In some cases the necrosis may not occur until several months after the injury.
A tooth receiving an injury that causes coronal fracture may have a better pulpal prognosis than a tooth that sustains a severe blow without fracturing the crown. Part of the energy of the blow dissipates as the crown fractures, rather than all of the energy’s being absorbed by the tooth’s supporting tissues. Thus the periodontium and the pulp of the injured tooth sustain fewer traumas when the crown fractures. The prognosis for long-term retention of the tooth and for maintenance of pulp vitality may then improve. However, because some teeth do not recover from traumatic blows that seem relatively minor, all injured teeth should be closely monitored. Injured teeth with subsequent pulpal necrosis are commonly asymptomatic, and the radiograph is essentially normal. These teeth are probably infected and that acute symptoms and clinical evidence of infection will inevitably develop at a later date. The tooth with a necrotic pulp should therefore be extracted or treated with endodontic procedures, whichever is indicated. A necrotic pulp in an anterior primary tooth may be successfully treated if no extensive root resorption or bone loss has occurred. The treatment technique is essentially the same as that for permanent teeth. However, trauma to the periapical tissues during canal instrumentation must be carefully avoided. After the canal of primary teeth has been properly prepared is filled with
slow-setting zinc oxide–eugenol. The canal walls are first lined with a thin mix of the canal filling material. A thicker mix should then be placed in the pulp chamber. Over this is placed a pledget of cotton, and the material is forced into the canal with a small amalgam plugger.

ANKYLOSIS
A reaction observed after trauma to anterior primary or permanent teeth, a condition caused by injury to the periodontal ligament and subsequent inflammation, which is associated with invasion by osteoclastic cells. The result is irregularly resorbed areas on the peripheral root surface. In histologic sections, repair can be seen that may cause anechanical lock or fusion between alveolar bone and the root surface. Clinical evidence of ankylosis is seen as a difference in the incisal plane of the ankylosed tooth and adjacent teeth. The adjacent teeth continue to erupt, whereas the ankylosed tooth remains fixed in relation to surrounding structures. The radiograph may show an interruption in the periodontal membrane of the ankylosed tooth, and often the dentin may appear to be continuous with alveolar bone. The ankylosed anterior primary tooth should be removed, if there is evidence of its causing delayed or ectopic eruption of the permanent successor. If ankylosis of a permanent tooth occurs during active eruption, eventually a discrepancy between the position of this tooth and its adjacent ones will be obvious. The uninjured teeth will continue to erupt and may drift mesially, with a loss of arch length. Therefore either surgical repositioning or the removal of a permanent tooth that becomes ankylosed is often necessary, especially if the ankylosis occurs during the preteen or early teen years.

RESTORATION OF FRACTURED TEETH
The restoration of a fractured tooth is as important as the emergency treatment designed to aid in the recovery of the pulp after the trauma. Several restorations have been advocated, and although the dentist has a wide choice of techniques and types of restorations, the circumstances surrounding the case often dictate the type of restoration for a given patient. The prognosis of pulp healing, the amount of tooth structure remaining, the stage of eruption of the tooth and adjacent teeth, the size of the dental pulp and degree of root closure, the normalcy of the occlusion, and the wishes of the patient must all be considered in the selection of a temporary restoration, an intermediate restoration, or the permanent restoration. In the young patient, although it is often desirable to wait for continued eruption of the tooth or to determine the outcome of a vital pulp procedure, a delay of even a few weeks is often sufficient to allow the tipping of adjacent teeth, over eruption of opposing teeth, or other undesirable changes in the occlusion.

REACTION OF PERMANENT TOOTH BUDS TO INJURY
The dentist who provides emergency care for a child after an injury to the anterior primary teeth must be aware of the possibility of damage to the underlying developing permanent teeth. The close anatomic relationship between the apices of primary teeth and their developing permanent successors explains why injuries to primary teeth may involve the permanent dentition. The dentist and the physician should also be aware of the possibility of trauma to permanent tooth buds from other unusual injuries so that parents may be informed of the possibility of defective
permanent tooth development. Some injuries to the face and jaws may not appear to have caused any dental injuries initially, but the problem may be noticed several months or years later.

**HYPOCALCIFICATION AND HYPOPLASIA**
The presence of a small, pigmented hypoplastic area has been referred to as *Turner tooth*. Small hypoplastic defects may be restored by the resin-bonding technique.

**REPARATIVE DENTIN PRODUCTION**
In cases in which the injury to the developing permanent tooth is severe enough to remove the thin covering of developing enamel or cause destruction of the ameloblasts, the subjacent odontoblasts have been observed to produce a reparative type of dentin. The irregular dentin bridges the gap where there is no enamel covering to aid in protecting the pulp from further injury.

**DILACERATION**
Occasionally occurs after the intrusion or displacement of an anterior primary tooth. The developed portion of the tooth is twisted or bent on itself, and in this new position growth of the tooth progresses. Germination may appear in the part of the tooth formed after the injury.