AAE POSITION STATEMENT

Recommended Guidelines of the American Association of Endodontists for the Treatment of Traumatic Dental Injuries

Asgeir Sigurdsson, DDS, MS,[*] Brooke Blicher, DMD,[†] Andrew J. Miller, DMD,[‡] Varun Singh, BDS, MS,[§] Fabricio B. Teixeira, DDS, MS, PhD,[‖] Anne E. Williamson, DDS, MS,[¶] and Cecilia Bourguignon, DDS[#]

The Recommended Guidelines of the American Association of Endodontists (AAE) for the Treatment of Traumatic Dental Injuries are intended to aid the practitioner in the management and treatment of dental injuries. Although it is impossible to guarantee permanent retention of a traumatized tooth, timely treatment of the tooth using recommended procedures can maximize the chances for success.

The guidelines are not fixed protocols. Variations in an individual patient's health, age, teeth, physical condition, and personal preferences are important factors in an endodontist's treatment decisions. Individual endodontists may deviate from the guidelines when, in their sound dental judgement, the condition of the patient so requires. Practitioners cannot guarantee treatment outcomes.

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From the *Department Endodontics, New York University College of Dentistry, New York, New York; †Private Endodontic Practice, White River Junction, Vermont; ‡General Dentistry, BU School of Dental Medicine, Boston, Massachusetts; §Private Endodontic Practice, Edina, Minnesota; ‖Department of Endodontics, Texas A&M University, Dallas, Texas; ¶Private Endodontic Practice, Lincoln, Nebraska; and #Private Endodontic Practice, Paris, France

Address requests for reprints to Asgeir Sigurdsson, New York University College of Dentistry, 345 East 24th Street, New York, NY 10010.
E-mail address: Asgeir.sigurdsson@nyu.edu
0099-2399

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TABLE 1 - Treatment Guidelines for Tooth Fractures and Alveolar Fractures in the Permanent Dentition

	Crown fracture		Crown/root fracture	Root fracture	Alveolar fracture
	Uncomplicated	**Complicated**			
Definition and diagnosis	Enamel or enamel-dentin fracture without pulp exposure	Enamel-dentin fracture with pulp exposure.	A fracture involving enamel, dentin and cementum with loss of tooth structure. Crown fracture extends below gingival margin. The pulp may or may not be exposed.	A fracture involving the root structure. It can be localized in the apical, middle or cervical third of the root.	The bone segment containing the involved tooth/teeth is fractured and likely mobile.
Clinical assessment and findings	Pulp is likely responsive to sensibility testing. Tooth mobility is normal. Percussion test: not tender. If tenderness is observed, evaluate the tooth for possible associated luxation or root fracture injury.	Pulp is likely responsive to sensibility testing. Exposed pulp sensitive to stimuli. Tooth mobility is normal. Percussion test: not tender. If tenderness is observed, evaluate the tooth for possible associated luxation or root fracture injury.	Pulp is likely responsive to sensibility testing. Tooth is tender to percussion. If still present, the coronal fragment is likely to be mobile.	The coronal fragment may be mobile and sometimes displaced. The apical segment is usually not displaced. Bleeding from the gingival sulcus may be seen. Tooth is tender to percussion. Pulp may initially be unresponsive to sensibility testing, indicating pulpal damage that may be transient.	Fracture lines may be located at any level, from the marginal bone to the root apex. There might be displacement of an alveolar segment. Mobility of the teeth may be segmental if the fracture involves more than one alveolar socket. Occlusal interference is often present due to misalignment of the fracture alveolar segment. Teeth in the fractured segment may initially be unresponsive to pulp sensibility testing.
Radiographic assessment and findings	Intraoral radiographs are recommended after an injury, for diagnostic purposes and as a baseline for follow-ups. Positioning devices should be used, aiming for imaging standardization essential to future comparisons. The set of suggested radiographs below allows a thorough examination of the injured or potentially injured area, usually the maxillary or mandibular incisor teeth. It provides visualization of each tooth through different angulations. • Three intraoral parallel periapical radiographs centered on the 2 central incisors, the right lateral incisor and the left lateral incisor. • One occlusal angulation radiograph (a periapical size film or sensor may be used, as its size is often sufficient to visualize the injured incisor area).				In addition to the 3 parallel periapical angulations and occlusal image, additional views such as a panoramic radiograph can be helpful in determining the course and position of the fracture lines. CBCT may also be useful for diagnosis of alveolar fractures, especially in cases involving the palatal or both cortical plates
	Radiograph of lip or cheek lacerations to search for embedded tooth fragments or foreign materials.		Limited field of view (FOV) CBCT imaging should be strongly considered as it exhibits greater sensitivity in detecting dental and dentoalveolar fractures. It is also ideal for determining and differentiating fracture location and extent. This information can assist the practitioner in obtaining the most accurate diagnosis to guide treatment decisions that could ultimately lead to the most favorable clinical outcomes.		

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TABLE 1 - Continued

	Crown fracture				
	Uncomplicated	**Complicated**	**Crown/root fracture**	**Root fracture**	**Alveolar fracture**
Treatment	If a tooth fragment is available, it can be bonded to the tooth. The fragment should first be rehydrated in water or saline for 15–20 min if it was stored dry. Otherwise perform a provisional treatment by covering the exposed dentin with glass ionomer or a long-term restoration using a bonding agent and composite resin. If the exposed dentin is within 0.5 mm of the pulp (dentin is pink but there is no pulpal bleeding), place a calcium hydroxide base and cover with a material such as glass ionomer. The definitive treatment for the fractured crown is restoration with accepted dental restorative materials.	In young patients with open apices, it is important to preserve pulp vitality by pulp capping or partial pulpotomy to secure further root development. These treatments are also the treatment of choice in patients with closed apices. Calcium hydroxide compounds and non-staining calcium silicate cements are suitable materials for such procedures. If tooth fragment is available, it can be bonded to the tooth after pulp capping procedure or partial pulpotomy. The fragment should first be rehydrated in water or saline for 15–20 min if it was stored dry. Future treatment for the fractured crown may be restoration with accepted dental restorative materials. If a post is required for crown retention in a mature tooth with complete root formation, endodontic treatment is the preferred treatment.	Until a treatment plan is finalized, a few days of temporary stabilization of the loose fragment to the adjacent tooth/teeth or to the non-mobile fragment can be attempted for esthetic reasons. • *Without* pulp exposure: fragment removal with or without gingivectomy and restoration. • *With* pulpal exposure *and* immature root: perform a partial pulpotomy to preserve pulp vitality. • *With* pulpal exposure *and* mature root: perform endodontic treatment then restore with a post retained crown. Orthodontic or surgical extrusion of apical fragment may be indicated to expose the margins prior to permanent restoration. Extraction with immediate or delayed implant-retained crown restoration or a conventional/bonded bridge are alternatives for adult patients. Root submergence, intentional replantation with or without rotation of the root or auto-transplantation might also be alternatives.	For root fractures where the coronal fragment has been avulsed out of the socket, please refer to treatment guidelines for avulsion (Tables 6–8). Otherwise, proceed as described below. Rinse exposed root surface with saline before repositioning. If displaced, reposition the coronal segment of the tooth as soon as possible. Check radiographically that correct position has been reached. Stabilize the tooth with a flexible splint for 4 wk. If the fracture line is near the tooth's cervical area, stabilization is beneficial for a longer period (up to 4 mo). In mature teeth where the cervical fracture line is located above the alveolar crest and the coronal fragment is very mobile, removal of the coronal fragment, followed by endodontic treatment and restoration with a post-retained crown will likely be required. Additional procedures such as orthodontic extrusion of the apical segment, crown lengthening surgery, surgical extrusion or even extraction may be required as future treatment options (similar to those outlined for crown-root fractures). Monitor healing for at least 1 y to determine pulpal status.	Reposition any displaced segment and then splint the involved teeth with a flexible and passive splint for 4 wk. Suture gingival and soft tissue lacerations if present. Endodontic treatment is contraindicated at the emergency visit. Monitor the pulp condition of all teeth involved, both initially and at follow ups, to determine if or when endodontic treatment becomes necessary.

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TABLE 1 - Continued

	Crown fracture		Crown/root fracture	Root fracture	Alveolar fracture
	Uncomplicated	**Complicated**			
				There is a good likelihood that the pulp will survive or spontaneously revascularize if the coronal half was well repositioned. Therefore, endodontic treatment should not be initiated until later if there are clear signs of pulpal necrosis and infection. Transient internal root resorption in the fracture line area has been reported as part of the healing process and does not indicate need for endodontic treatment. If pulp necrosis and infection develop, endodontic treatment of the coronal tooth segment to the fracture line is indicated. The apical segment rarely requires endodontic treatment.	
Patient instructions Follow-up	Soft diet, brush teeth with a soft toothbrush after each meal, use a 0.12% chlorhexidine mouth rinse twice a day for 1–2 wk. Follow-up as indicated in Table 2. If the crown fracture injury is combined with a luxation injury, the follow-up regimen of Table 5 applies. If the crown fracture injury is combined with an avulsion injury, the follow-up regimen of Table 8 applies.				

CBCT, cone-beam computed tomography.

TABLE 2 - Follow-up Procedures for Fractured Permanent Teeth and Alveolar Fractures

Time	Crown fracture		Crown/root fracture		Root fracture	Alveolar fracture
	Uncomplicated	Complicated	Uncomplicated	Complicated		
1 wk			Clinical and radiographic examination.			
4 wk	When the pulp is unresponsive to sensibility testing immediately after trauma, clinical, and radiographic examination should be considered at 4 wk.				Clinical and radiographic examination. Splint removal for apical third and mid root fractures.	Clinical and radiographic examination. Splint removal.
6–8 wk	Clinical and radiographic examination.					
4 mo			Clinical and radiographic examination.		Clinical and radiographic examination. Splint removal when root fracture is located cervically.	Clinical and radiographic examination.
6 mo		Clinical and radiographic examination.				
1 y	Clinical and radiographic examination.					
Yearly for at least 5 y		Clinical and radiographic examination.				

Important general considerations on follow-ups

Regarding combined injuries:
- When a crown fracture injury is combined with a luxation injury, the follow-up regimen of Table 5 applies.
- When a crown fracture injury is combined with an avulsion injury, the follow-up regimen of Table 8 applies.

Regarding radiographic examination:
- Intraoral parallel radiographs should be taken at follow-ups. Occlusal angulation radiographs may also be taken. Positioning devices should be used, aiming for imaging standardization essential to comparisons.

Regarding discolorations and sensibility testing:
- Discolorations or nonresponsiveness to sensibility testing are insufficient signs to assert the diagnosis of pulp necrosis. However, a lack of response to sensibility testing of a mature tooth by 3 months after trauma is strongly indicative of pulp necrosis.

Practitioners should inform the patients (and/or their parents or guardians) about:
- Potential post-traumatic complications
- The necessity to comply with the follow-up regimen
- Unfavorable outcomes requiring prompt endodontic treatment
- The necessity to return to the clinic if they observe any unfavorable outcomes in the interval between follow-up visits.

TABLE 3 - Treatment Guidelines for Concussion, Subluxation, and Luxation of Permanent Teeth

	Concussion	Subluxation	Extrusive luxation	Lateral luxation	Intrusive luxation
Definition and diagnosis	Patients commonly report tooth tenderness to touch/biting. Tooth is not displaced or abnormally mobile.	Patients commonly report tooth tenderness to touch/biting. Tooth is not displaced, but is tender to percussion and palpation and slightly mobile.	Displacement of the tooth outward or incisally.	Displacement of the tooth in any lateral direction except axially; usually associated with a fracture of the facial cortical bone.	Displacement of the tooth inward into the alveolar bone.
Clinical assessment and findings	Pulp is likely responsive to sensibility testing. Tooth is tender to percussion and palpation.	Pulp may initially be unresponsive to sensibility testing, indicating transient pulpal damage that may heal gradually. Tooth is tender to percussion.	The tooth appears elongated and is excessively mobile. Pulp is likely non-responsive to sensibility testing. Tooth is tender to percussion.	The tooth is displaced, usually in a palatal/lingual or labial direction. The tooth appears immobile or locked into bone. Fracture of the alveolar process may be palpable. Pulp is likely unresponsive to sensibility testing. Tooth is tender to percussion and palpation.	The tooth appears partially or totally infra-occluded, immobile, and locked. Fracture of the alveolar process may be palpable and palpation sensitive. Pulp is likely unresponsive to sensibility testing. Tooth is tender to percussion with high metallic (ankylotic) sound.
Radiographic assessment and findings	One parallel periapical radiograph. Additional radiographs are indicated if clinical signs or symptoms of other potential injuries are present.	Intraoral radiographs are recommended after an injury, for diagnostic purposes and as a baseline for follow-ups. Positioning devices should be used, aiming for imaging standardization essential to future comparisons. The set of suggested radiographs below allows a thorough examination of the injured or potentially injured area, usually the maxillary or mandibular incisor teeth. It provides visualization of each tooth through different angulations. • Three intraoral parallel periapical radiographs centered on the 2 central incisors, the right lateral incisor and the left lateral incisor. • One occlusal angulation radiograph (a periapical size film or sensor may be used, as its size is often sufficient to visualize the injured incisor area).			
	No radiographic abnormalities are expected.	No radiographic abnormalities are expected.	Periodontal ligament (PDL) space appears enlarged. Limited FOV CBCT imaging should be strongly considered as it exhibits greater sensitivity in detecting dental and dentoalveolar fractures. It is also ideal for determining and differentiating fracture location and extent. This information can assist the practitioner in obtaining the most accurate diagnosis to guide treatment decisions, that could ultimately lead to the most favorable clinical outcomes. *Please read***	PDL space appears enlarged. Limited FOV CBCT imaging should be strongly considered as it exhibits greater sensitivity in detecting dental and dentoalveolar fractures. It is also ideal for determining and differentiating fracture location and extent. This information can assist the practitioner in obtaining the most accurate diagnosis to guide treatment decisions, that could ultimately lead to the most favorable clinical outcomes. *Please read* **	The periodontal ligament space may be absent from all or part of the root. The cemento-enamel junction is located more apically than the adjacent, non-injured teeth. If the tooth is totally intruded, a lateral radiograph should be considered to evaluate its penetration into the nasal cavity. Limited FOV CBCT imaging should be strongly considered as it exhibits greater sensitivity in detecting dental and dentoalveolar fractures. It is also ideal for determining and differentiating fracture location and extent. This

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TABLE 3 - Continued

	Concussion	Subluxation	Extrusive luxation	Lateral luxation	Intrusive luxation
					information can assist the practitioner in obtaining the most accurate diagnosis to guide treatment decisions, that could ultimately lead to the most favorable clinical outcomes. *Please read* **
	A CBCT study is inherently higher effective radiation dose than intraoral imaging; however, CBCT imaging maintains a higher diagnostic utility for certain entities over traditional intraoral images. The safety of such three-dimensional imaging modalities must be considered, especially given that traumatic dental injuries disproportionately affect children and adolescents under the age of 18 who are more susceptible to radiation during their physiologic growth. Therefore, the practitioner should make strong efforts towards individualized CBCT protocols which balance diagnostic efficacy with dose reduction aimed at dose optimization consistent with ALADA (as low as diagnostically acceptable) As per the AAE and AAOMR Joint Position Statement on the use of cone-beam computed tomography in endodontics, **CBCT should only be performed after a thorough history taking, clinical examination, and the need for imaging cannot be met by lower dose two-dimensional radiographs. Patients, especially children, should be properly instructed and positioned to prevent any movements during image acquisition in order to avoid the need for a repeat exposure(s). Practitioners should be aware of operator-dependent settings specific to their particular CBCT imaging machine with the appropriate resolution settings and smallest FOV selected for the given patient-specific factors. Practitioners might also consider obtaining informed consent from the patient or their legal guardian prior to proceeding with CBCT imaging.				
Immediate treatment	No treatment	Usually, no treatment is needed. Splint may be indicated for patient comfort, stabilizing the tooth for 2 wk using a flexible and passive splint.	Rinse the affected area with saline. Reposition the tooth by gently reinserting it into the socket. Stabilize the tooth for 2 wk using a flexible and passive splint. Suture gingival and soft tissue lacerations, especially in the tooth's cervical area. Repositioning of an extruded tooth should be done as soon as possible. After 12–24 h orthodontics or intentional replantation with prior curettage of the socket could be considered in select cases.	Rinse the affected area with saline. Reposition the tooth by gently pulling it incisally digitally or with extraction forceps to disengage it from its bony lock and delicately reposition it into its original location. Alternatively, palpate the buccal gingiva to feel the apex of the tooth. Use one finger to push the apex downwards then use another finger or thumb to first rotate and then push the tooth upwards back into its socket. Splint for 4 wk using a flexible and passive splint. Suture gingival and soft tissue lacerations, especially in the tooth's cervical area. Repositioning of a laterally luxated tooth should be done as soon as possible.	Rinse the affected area with saline. Teeth with **incomplete** root formation: - Up to 7 mm intrusion, allow for re-eruption without intervention. If no movement, initiate orthodontic repositioning within 4 weeks. - In cases of intrusion >7 mm, reposition surgically or orthodontically within 4 weeks. Teeth with **complete** root formation: - Up to 3 mm intrusion, allow for re-eruption without intervention. If no movement after 8 wk, reposition surgically or orthodontically before ankylosis develops. - Between 3–7 mm intrusion, reposition surgically or orthodontically. - In cases of >7 mm, reposition surgically. After orthodontic or surgical repositioning, splint for 2 wk

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TABLE 3 - Continued

	Concussion	Subluxation	Extrusive luxation	Lateral luxation	Intrusive luxation
				After 12–24 h orthodontics or intentional replantation with prior curettage of the socket could be considered in select cases.	using a flexible and passive splint. If displacement is extensive, splint for 4 wk. Suture gingival and soft tissue lacerations, especially in the tooth's cervical area.
Endodontic treatment and considerations	Monitor pulpal response until a definitive pulpal diagnosis can be made.	Monitor pulpal response until a definitive pulpal diagnosis can be made.	Teeth with complete root formation: - Pulp necrosis and infection are common complications. If diagnosed, endodontic treatment is indicated. Teeth with incomplete root formation: - Monitor closely for pulp vitality.	Teeth with complete root formation: - Pulp necrosis and infection are common complications. If diagnosed, endodontic treatment is indicated. Teeth with incomplete root formation: - Monitor closely for pulp vitality	Teeth with **complete** root formation: - The pulp will likely become necrotic and endodontic treatment should be initiated 2 wk after the injury (or as soon as rubber dam isolation is possible) - After canal cleaning and disinfection, a temporary dressing with calcium hydroxide is recommended for up to 4 wk. Teeth with **incomplete** root formation: - Monitor closely for pulp vitality.
	• Apexification or regenerative endodontic treatments are indicated when the pulp of teeth with incomplete root formation becomes necrotic. • Endodontic treatment should be initiated immediately when there is evidence of infection-related (inflammatory) external root resorption. The canal should be medicated with calcium hydroxide for 3 weeks, followed by its replacement every 3 months until there is radiographic evidence of periradicular bone healing. Final obturation of the root canal system can then be performed. Gradual re-establishment of the lamina dura and periodontal ligament space with arrest of the resorption process usually ensue and should be monitored.				
Patient instructions	Soft diet, brush teeth with a soft toothbrush after each meal, use a 0.12% chlorhexidine mouth rinse twice a day for 1–2 wk.				
Follow-up	Follow-up as indicated in Table 5.				

TABLE 4 - Differential Diagnosis of Concussion, Subluxation, and Luxation of Permanent Teeth

	Concussion	Subluxation	Luxation (extrusive, lateral)
Percussion	Yes	Yes	Yes
Mobility	No	Yes	Yes
Displacement	No	No	Yes

TABLE 5 - Follow-up Procedures for Luxated Permanent Teeth

Time	Concussion/ subluxation	Extrusion	Lateral luxation	Intrusion
2 wk	Splint removal (if applied for subluxation). Clinical and radiographic examination.	Splint removal. Clinical and radiographic examination.	Clinical and radiographic examination.	Clinical and radiographic examination.
4 wk	Clinical and radiographic examination.	Clinical and radiographic examination.	Splint removal. Clinical and radiographic examination.	Splint removal if tooth was repositioned surgically or orthodontically. Clinical and radiographic examination.
6–8 wk	Clinical and radiographic examination.			
3 mo	If other signs of pulp necrosis are absent, but the pulp is unresponsive to sensibility testing at 6–8 wk after the trauma, clinical and radiographic examination at 3 mo should be considered.	Clinical and radiographic examination.		
6 mo	Clinical and radiographic examination.			
1 y	Clinical and radiographic examination.			
Yearly for at least 5 y	Clinical and radiographic examination.			

Important general considerations on follow-ups

Regarding radiographic examination

- In the absence of clinical signs and symptoms, intraoral parallel radiographs should be taken. Occlusal angulation radiographs may also be taken. Positioning devices should be used, aiming for imaging standardization essential to comparisons.

Regarding discolorations and sensibility testing:

- Discolorations or nonresponsiveness to sensibility testing are insufficient signs to assert the diagnosis of pulp necrosis. However, a lack of response to sensibility testing of a mature tooth by 3 mo after trauma is strongly indicative of pulp necrosis.

Regarding infection-related (inflammatory) external root resorption:

- Endodontic treatment should be initiated immediately when there is evidence of infection-related (inflammatory) external root resorption. The canal should be medicated with calcium hydroxide for 3 wk, followed by its replacement every 3 mo until there is radiographic evidence of periradicular bone healing, usually accompanied by gradual reestablishment of the lamina dura and periodontal ligament space with arrest of the resorption process. The final obturation of the root canal system can then be performed.

Regarding CBCT utilization:

- Limited FOV CBCT may be the appropriate modality for follow-up if it was indicated for the initial evaluation. However, CBCT should not be performed routinely at every follow-up visit but may be considered when clinical findings or complications suggest that additional three-dimensional information is needed.
- The same precautions as stated previously regarding safety of CBCT imaging should be followed, including:
  - CBCT should only be performed after a thorough history taking, clinical examination and the need for imaging cannot be met by lower dose two-dimensional radiography
  - If CBCT three-dimensional examination is decided upon, the patient-specific proper resolution and smallest possible FOV should be selected considering the ALADA principles (as low as diagnostically achievable)
  - Patients, especially children, should be properly instructed and positioned to prevent any movements during image acquisition in order to avoid the need for a repeat exposure(s).

Practitioners should inform the patients (and/or their parents or guardians) about:

- Potential post-traumatic complications
- The necessity to comply with the follow-up regimen
- Unfavorable outcomes requiring prompt endodontic treatment
- The necessity to return to the clinic if they observe any unfavorable outcomes in the interval between follow-up visits.

CBCT, cone-beam computed tomography.

TABLE 6 - Treatment Guidelines for Avulsed Mature Permanent Teeth with Closed Apex

Clinical situation	Tooth has already been replanted	Extra-oral *dry* time 60 minutes or less – or – extra-oral *dry* time 60 minutes or less and tooth kept in physiologic storage medium (milk, hanks balanced salt solution [HBSS], saline) or saliva for several hours	Extra-oral *dry* time longer than 60 minutes
Immediate treatment	Leave tooth in place. Clean affected area with water, saline or 0.12% chlorhexidine. Verify normal position of the replanted tooth clinically and radiographically. If the tooth or teeth were replanted in the wrong socket or rotated, consider repositioning into the proper location up to 48 h after the traumatic accident. Apply a flexible and passive splint for 1–2 wk. In cases of associated alveolar or jawbone fracture, a more rigid splint is indicated and should be left for about 4 wk. Suture gingival and soft tissue lacerations, especially in the tooth's cervical area.	Place or leave the tooth in a storage medium while taking a history, examining the patient clinically and radiographically, and preparing the patient for the replantation. Administer local anesthesia, preferably without a vasoconstrictor. Irrigate the alveolar socket with saline. Examine the alveolar socket. If there is a fracture of the socket wall, reposition the fractured fragment into its original position with a suitable instrument. Removal of the coagulum with a saline stream may allow better repositioning of the tooth. Hold the tooth by the crown and gently clean the root surface and apical foramen with saline. Replant the tooth slowly using slight digital pressure. Verify normal position of the replanted tooth clinically and radiographically. Apply a flexible and passive splint for 1–2 wk. In cases of associated alveolar fracture, a more rigid splint is indicated and should be left for about 4 wk. Suture gingival and soft tissue lacerations, especially in the tooth's cervical area.	Remove loose debris and visible contamination by agitating the tooth in physiologic storage medium, or with gauze soaked in saline. Tooth should be placed in storage medium while taking a history, examining the patient clinically and radiographically, and preparing the patient for the replantation. Administer local anesthesia, preferably without a vasoconstrictor. Irrigate the alveolar socket with saline. Examine the alveolar socket. If there is a fracture of the socket wall, reposition the fractured fragment into its original position with a suitable instrument. Removal of the coagulum with a saline stream may allow better repositioning of the tooth. Hold the tooth by the crown and gently clean the root surface and apical foramen with saline. Replant the tooth slowly using slight digital pressure. Verify normal position of the replanted tooth clinically and radiographically. Apply a flexible and passive splint for 1–2 wk. In cases of associated alveolar fracture, a more rigid splint is indicated and should be left for about 4 wk. Suture gingival and soft tissue lacerations, especially in the tooth's cervical area.

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TABLE 6 - Continued

Clinical situation	Tooth has already been replanted	Extra-oral *dry* time 60 minutes or less – or – extra-oral *dry* time 60 minutes or less and tooth kept in physiologic storage medium (milk, hanks balanced salt solution [HBSS], saline) or saliva for several hours	Extra-oral *dry* time longer than 60 minutes
Radiographic assessment and findings	Intraoral radiographs are recommended after an injury, for diagnostic purposes and as a baseline for follow-ups. Positioning devices should be used, aiming for imaging standardization essential to future comparisons. The set of suggested radiographs below allows a thorough examination of the injured or potentially injured area, usually the maxillary or mandibular incisor teeth. It provides visualization of each tooth through different angulations. • Three intraoral parallel periapical radiographs centered on the 2 central incisors, the right lateral incisor and the left lateral incisor. • One occlusal angulation radiograph (a periapical size film or sensor may be used, as its size is often sufficient to visualize the injured incisor area). An intraoral parallel periapical and an occlusal radiograph can be taken to confirm the proper repositioning. CBCT is usually not needed to confirm the proper repositioning of the avulsed tooth. CBCT may however be considered if there are clinical signs indicating a possible alveolar bone fracture and if the additional information it could provide will likely change the anticipated treatment plan. Limited FOV CBCT imaging may then be cautiously used as an additional exam. It is important to consider that current dental CBCTs can expose patients, to a higher effective radiation dose than an intra-oral radiograph. *Please read* **		
	****Regarding CBCT utilization:** Although a CBCT study is inherently higher effective radiation dose than intraoral imaging, CBCT imaging maintains a higher diagnostic utility over traditional intraoral images. The practitioner should consider the benefits and risks of such three dimensional imaging modalities, given that traumatic dental injuries disproportionately affect children and adolescents under the age of 18 who are more susceptible to radiation during their physiologic growth. Therefore, the practitioner should make strong efforts towards individualized CBCT protocols which balance diagnostic efficacy with dose reduction aimed at dose optimization consistent with ALADA (as low as diagnostically acceptable) As per the AAE and AAOMR Joint Position Statement on the use of cone-beam computed tomography in endodontics, **CBCT should only be performed after a thorough history taking, clinical examination, and the need for imaging cannot be met by lower dose two-dimensional radiographs.** Patients, especially children, should be properly instructed and positioned to prevent any movements during image acquisition in order to avoid the need for a repeat exposure(s). Practitioners should be aware of operator-dependent settings specific to their particular CBCT imaging machine with the appropriate resolution settings and smallest FOV selected for the given patient-specific factors. Practitioners might also consider obtaining informed consent from the patient or their legal guardian prior to proceeding with CBCT imaging.		
Endodontic treatment and considerations	Endodontic treatment should be initiated 7–14 d after replantation and before splint removal. Calcium hydroxide is recommended as an intracanal medication for up to 4 wk followed by root canal filling.		
Antibiotics	Clinicians can consider antibiotic use based on individual risk factors such as patient's immune status, level of contamination during the tooth's extra-alveolar time and the presence of severe gingival and soft tissue lacerations. If the clinician deems systemic antibiotics necessary, penicillin class of antibiotics should be considered for 7 d at the appropriate dose according to patient's age and weight. If the avulsed tooth has been in contact with soil, and if tetanus coverage is uncertain, refer to a physician for a tetanus booster.		
Patient instructions	Avoid participation in contact sports for at least 2 wk. Soft diet, brush teeth with a soft toothbrush after each meal, use a 0.12% chlorhexidine mouth rinse twice a day for 1–2 wk.		
Follow-up	Splint removal and clinical and radiographic examination after 1–2 wk. Clinical and radiographic examination at 4 wk, 6–8 wk, 3 mo, 6 mo, 1 y and then yearly thereafter for at least 5 y, aiming to detect radiolucencies or signs of root resorptions. Intraoral parallel radiographs should be taken using positioning devices to allow imaging standardization essential to comparisons. Ankylosis is likely to occur, particularly after delayed replantation and must be taken into consideration. Especially in children and adolescents, ankylosis is frequently associated with infraposition of the tooth. Decoronation may be necessary when infra-position (>2–3 mm) is seen and depending on the patient's growth pattern. Establishing good communication with the patient and guardian about this likely outcome and other possible post-traumatic complications is necessary to ensure their cooperation for careful follow ups. Please also see follow-up Table 8.		

TABLE 7 - Treatment Guidelines for Avulsed Permanent Teeth with Open Apex

Diagnosis and clinical situation	Tooth has already been replanted	Extra-oral *dry* time 60 minutes or less – or – extra-oral *dry* time 60 minutes or less and tooth kept in physiologic storage medium (milk, HBSS, saline) or saliva for several hours	Extra-oral dry time longer than 60 minutes
Immediate treatment	Leave tooth in place. Clean affected area with water, saline or 0.12% chlorhexidine. Verify normal position of the replanted tooth clinically and radiographically. If the tooth or teeth were replanted in the wrong socket or rotated, consider repositioning the tooth/teeth into the proper location for up to 48 h after the trauma. Apply a flexible and passive splint for 1–2 wk. In cases of associated alveolar or jawbone fracture, a more rigid splint is indicated and should be left for about 4 wk. Suture gingival and soft tissue lacerations, especially in the tooth's cervical area.	If contaminated, clean the root surface and apical foramen with a stream of saline. Do not handle the root, hold the avulsed tooth by its crown. Place or leave the tooth in a storage medium while taking the history, examining the patient clinically and radiographically and preparing the patient for the replantation. Administer local anesthesia preferably without vasoconstrictor. Irrigate the alveolar socket with saline. Examine the alveolar socket. If there is a fracture of the socket wall, reposition the fractured fragment into its original position with a suitable instrument. Removal of the coagulum with a saline stream may allow better repositioning of the tooth. Replant the tooth slowly using slight digital pressure. Verify normal position of the replanted tooth clinically and radiographically. Apply a flexible and passive splint for 1–2 wk. In cases of associated alveolar fracture, a more rigid splint is indicated and should be left for about 4 wk. Suture gingival and soft tissue lacerations, especially in the tooth's cervical area.	Check the avulsed tooth and remove debris from its surface by gently agitating it in the storage medium. Alternatively, a stream of saline can be used to rinse its surface. Place or leave the tooth in a storage medium while taking the history, examining the patient clinically and radiographically and preparing the patient for the replantation. Administer local anesthesia preferably without vasoconstrictor. Irrigate the alveolar socket with saline. Examine the alveolar socket. If there is a fracture of the socket wall, reposition the fractured fragment into its original position with a suitable instrument. Removal of the coagulum with a saline stream may allow better repositioning of the tooth. Replant the tooth slowly using slight digital pressure. Verify normal position of the replanted tooth clinically and radiographically. Apply a flexible and passive splint for 1–2 wk. In cases of associated alveolar fracture, a more rigid splint is indicated and should be left for about 4 wk. Suture gingival and soft tissue lacerations, especially in the tooth's cervical area. Although in delayed replantation the outcomes tend to be less favorable due to increased likelihood of ankylosis and root resorption, the main goal is to temporarily maintain the child's or adolescent's tooth for esthetic, functional and psychological reasons and to preserve alveolar bone.

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TABLE 7 - Continued

Diagnosis and clinical situation	Tooth has already been replanted	Extra-oral *dry* time 60 minutes or less – or – extra-oral *dry* time 60 minutes or less and tooth kept in physiologic storage medium (milk, HBSS, saline) or saliva for several hours	Extra-oral dry time longer than 60 minutes
Radiographic assessment and findings	Intraoral radiographs are recommended after an injury, for diagnostic purposes and as a baseline for follow-ups. Film-holders should be used, aiming for imaging standardization essential to future comparisons. The set of suggested radiographs below allows a thorough examination of the injured or potentially injured area, usually the maxillary or mandibular incisor teeth. It provides visualization of each tooth through different angulations. • Three intraoral parallel periapical radiographs centered on the 2 central incisors, the right lateral incisor and the left lateral incisor. • One occlusal angulation radiograph (a periapical size film or sensor may be used, as its size is often sufficient to visualize the injured incisor area). An intraoral parallel periapical and an occlusal radiograph can be taken to confirm the proper repositioning. CBCT is usually not needed to confirm the proper repositioning of the avulsed tooth. CBCT may however be considered if there are clinical signs indicating a possible alveolar bone fracture and if the additional information it could provide will likely change the anticipated treatment plan. Limited FOV CBCT imaging may then be cautiously used as an additional exam. It is important to consider that current dental CBCTs can expose patients to a higher effective radiation dose than an intra-oral radiograph. *Please read* **		
	****Regarding CBCT Utilization:** Although a CBCT study is inherently higher effective radiation dose than intraoral imaging, CBCT imaging maintains a higher diagnostic utility over traditional intraoral images. The practitioner should consider the benefits and risks of such three dimensional imaging modalities, given that traumatic dental injuries disproportionately affect children and adolescents under the age of 18 who are more susceptible to radiation during their physiologic growth. Therefore, the practitioner should make strong efforts towards individualized CBCT protocols which balance diagnostic efficacy with dose reduction aimed at dose optimization consistent with ALADA (as low as diagnostically acceptable) As per the AAE and AAOMR Joint Position Statement on the use of cone-beam computed tomography in endodontics, **CBCT should only be performed after a thorough history taking, clinical examination, and the need for imaging cannot be met by lower dose two-dimensional radiographs.** Patients, especially children, should be properly instructed and positioned to prevent any movements during image acquisition to avoid the need for a repeat exposure(s). Practitioners should be aware of operator-dependent settings specific to their particular CBCT imaging machine with the appropriate resolution settings and smallest FOV selected for the given patient-specific factors. Practitioners might also consider obtaining informed consent from the patient or their legal guardian prior to proceeding with CBCT imaging.		
Endodontic treatment and considerations	The goal for replanting developing and immature teeth in children is to allow for possible spontaneous pulp space revascularization. For teeth with open apex endodontic treatment should be avoided unless there are clinical and/or radiographic signs of endodontic infection or infection-related (inflammatory) external root resorption on follow-ups. Apexification or regenerative endodontic treatment is indicated when the pulp of teeth with incomplete root formation becomes necrotic. Endodontic treatment should be initiated immediately when there is evidence of infection-related (inflammatory) external root resorption. The canal should be medicated with calcium hydroxide for 3 wk, followed by its replacement every 3 mo until there is radiographic evidence of periradicular bone healing. Final obturation of the root canal system can then be performed. Gradual re-establishment of the lamina dura and periodontal ligament space with arrest of the resorption process usually ensues and should be monitored.		
Antibiotics	Clinicians can consider antibiotic use based on individual risk factors such as patient's immune status, level of contamination during the tooth' extra-alveolar time and the presence of severe gingival and soft tissue lacerations. If the clinician deems systemic antibiotics necessary, penicillin class of antibiotics should be considered for 7 d at the appropriate dose according to patient's age and weight. If the avulsed tooth has been in contact with soil, and if tetanus coverage is uncertain, refer to a physician for a tetanus booster.		

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TABLE 7 - Continued

Diagnosis and clinical situation	Tooth has already been replanted	Extra-oral *dry* time 60 minutes or less – or – extra-oral *dry* time 60 minutes or less and tooth kept in physiologic storage medium (milk, HBSS, saline) or saliva for several hours	Extra-oral dry time longer than 60 minutes
Patient instructions	Avoid participation in contact sports for at least 2 wk. Soft diet, brush teeth with a soft toothbrush after each meal, use a 0.12% chlorhexidine mouth rinse twice a day for 1–2 wk.		
Follow-up	Splint removal and clinical and radiographic examination after 1–2 wk. Clinical and radiographic examination at 4 wk, 6–8 wk, 3 mo, 6 mo, 1 y, and then yearly thereafter for at least 5 y, aiming to detect radiolucencies or signs of root resorptions. Intraoral parallel radiographs should be taken using positioning devices to allow imaging standardization essential to comparisons. Endodontic treatment should be initiated immediately when there is evidence of infection-related (inflammatory) external root resorption. The canal should be medicated with calcium hydroxide for 3 wk, followed by its replacement every 3 mo until there is radiographic evidence of periradicular bone healing. Final obturation of the root canal system can then be performed. Gradual re-establishment of the lamina dura and periodontal ligament space with arrest of the resorption process usually ensues and should be monitored. Ankylosis is likely to occur, particularly after delayed replantation and must be taken into consideration. Especially in children and adolescents, ankylosis is frequently associated with infraposition of the tooth. Decoronation may be necessary when infraposition (>2–3 mm) is seen and depending on the patient's growth pattern. Establishing good communication with the patient and guardian about this likely outcome and other possible post-traumatic complications is necessary to ensure their cooperation for careful follow ups. Please also see follow-up Table 8.		

TABLE 8 - Follow-up Procedures for Avulsed Permanent Teeth with Closed and Open Apices

Time	Closed apex Extra-oral dry time 60 minutes or less – or –extra-oral dry time 60 minutes or less and tooth was kept in physiologic storage medium (milk, HBSS, saline) or saliva for several hours	Closed apex Extraoral *Dry* time > 60 minutes	Open apex Regardless of extraoral dry time
2 wk	Endodontic treatment with placement of calcium hydroxide for up to 4 wk should be initiated. Clinical and radiographic examination. Splint removal. Weight and height measurements as a baseline for growth. This may become critical to determine the time of decoronation, if needed. Establishing good communication with the patient and guardian about likely outcomes such as ankylosis and other post-traumatic complications is necessary to ensure their cooperation for careful follow ups.		Clinical and radiographic examination. Splint removal. Continued root development is one of the favorable outcomes desired after replantation of an avulsed immature tooth and must be monitored. No endodontic treatment of an avulsed immature tooth should be initiated unless clinical or radiographic signs of pulp necrosis and infection and/or infection-related (inflammatory) external root resorption are evident on follow-ups. *See box below "Regarding Infection-Related (Inflammatory) External Root Resorption"* Endodontic treatment of necrotic immature teeth involves apexification or regenerative endodontic treatment. Weight and height measurements as a baseline for growth. This may become critical to determine the time of decoronation, if needed. Establishing good communication with the patient and guardian about likely complications such as pulp necrosis, infection-related (inflammatory) external root resorption and ankylosis is necessary to ensure their cooperation for careful follow ups.
4 wk	Clinical and radiographic examination. Endodontic filling may be carried out.		Clinical and radiographic examination.
6–8 wk	Clinical and radiographic examination.		Clinical and radiographic examination. Endodontic treatment should be initiated immediately when there is evidence of infection-related (inflammatory) external root resorption. The canal should be medicated with calcium hydroxide. See box below "Regarding Infection-Related (Inflammatory) External Root Resorption)
3 mo	Clinical and radiographic examination.		
6 mo	Clinical and radiographic examination.		

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TABLE 8 - Continued

Time	Closed apex Extra-oral dry time 60 minutes or less – or –extra-oral dry time 60 minutes or less and tooth was kept in physiologic storage medium (milk, HBSS, saline) or saliva for several hours	Closed apex Extraoral *Dry* time > 60 minutes	Open apex Regardless of extraoral dry time
1 y	Clinical and radiographic examination.		
Annually for at least 5 y	Clinical and radiographic examination.		

Important general considerations on follow-ups

Regarding radiographic examination:
Intraoral parallel radiographs should be taken. Positioning devices should be used, aiming for imaging standardization essential to comparisons.

Regarding infection-related (inflammatory) external root resorption:

Endodontic treatment should be initiated immediately when there is evidence of infection-related (inflammatory) external root resorption. The canal should be medicated with calcium hydroxide for 3 wk, followed by its replacement every 3 mo until there is radiographic evidence of periradicular bone healing, usually accompanied by gradual reestablishment of the lamina dura and periodontal ligament space with arrest of the resorption process. The final obturation of the root canal system can then be performed.

Regarding ankylosis (replacement root resorption):
Avulsed teeth are at high risk for ankylosis, particularly after delayed replantation.
Ankylosis and potential infra-positioning of the tooth should be monitored while considering patient's overall growth pattern.
A decoronation procedure might become necessary when infra position (>2–3 mm) is seen and depending on the patient's growth pattern.

Practitioners should Inform the Patients (and/or their parents or guardians) about:
- Potential post-traumatic complications
- The necessity to comply with the follow-up regimen
- Unfavorable outcomes requiring prompt endodontic treatment
- The necessity to return to the clinic if they observe any unfavorable outcomes in the interval between follow-up visits