1. Treatment guidelines for fractures of teeth and alveolar bone

				Followup Procedures for fractures of teeth and alveolar bone[+]	**Favorable and Unfavorable outcomes include some, but not necessarily all, of the following:**	
INFRACTION	**Clinical findings**	**Radiographic findings**	**Treatment**	**Follow-Up**	**Favorable Outcome**	**Unfavorable Outcome**
	● An incomplete fracture (crack) of the enamel without loss of tooth structure. ● Not tender. If tenderness is observed evaluate the tooth for a possible luxation injury or a root fracture.	● No radiographic abnormalities. ● Radiographs recommended: a periapical view. Additional radiographs are indicated if other signs or symptoms are present.	● In case of marked infractions, etching and sealing with resin to prevent discoloration of the infraction lines. Otherwise, no treatment is necessary.	● No follow-up is generally needed for infraction injuries unless they are associated with a luxation injury or other fracture types.	● Asymptomatic ● Positive response to pulp testing. ● Continuing root development in immature teeth.	● Symptomatic ● Negative response to pulp testing. ● Signs of apical periodontitis. ● No continuing root development in immature teeth. ● Endodontic therapy appropriate for stage of root development is indicated.

ENAMEL FRACTURE	**Clinical findings**	**Radiographic findings**	**Treatment**	**Followup**	**Favorable Outcome**	**Unfavorable Outcome**
	● A complete fracture of the enamel. ● Loss of enamel. No visible sign of exposed dentin. ● Not tender. If tenderness is observed evaluate the tooth for a possible luxation or root fracture injury. ● Normal mobility. ● Sensibility pulp test usually positive.	● Enamel loss is visible. ● Radiographs recommended: periapical, occlusal and eccentric exposures. They are recommended in order to rule out the possible presence of a root fracture or a luxation injury. ● Radiograph of lip or cheek to search for tooth fragments or foreign materials.	● If the tooth fragment is available, it can be bonded to the tooth. ● Contouring or restoration with composite resin depending on the extent and location of the fracture.	6-8 weeks C^{++} 1 year C^{++}	● Asymptomatic ● Positive response to pulp testing. ● Continuing root development in immature teeth. ● Continue to next evaluation.	● Symptomatic ● Negative response to pulp testing. ● Signs of apical periodontitis ● No continuing root development in immature teeth. ● Endodontic therapy appropriate for stage of root development is indicated.

[+] = for crown fractured teeth with concomitant luxation injury, use the luxation followup schedule.
C^{++} = clinical and radiographic examination.

				Follow-Up Procedures for fractures of teeth and alveolar bone[+]	Favorable and Unfavorable outcomes include some, but not necessarily all, of the following:	
ENAMEL-DENTIN-FRACTURE	**Clinical findings**	**Radiographic findings**	**Treatment**	**Follow-Up**	**Favorable Outcome**	**Unfavorable Outcome**
	● A fracture confined to enamel and dentin with loss of tooth structure, but not exposing the pulp. ● Percussion test: not tender. If tenderness is observed, evaluate the tooth for possible luxation or root fracture injury. ● Normal mobility. ● Sensibility pulp test usually positive.	● Enamel-dentin loss is visible. ● Radiographs recommended: periapical, occlusal and eccentric exposure to rule out tooth displacement or possible presence of root fracture. ● Radiograph of lip or cheek lacerations to search for tooth fragments or foreign materials.	● If a tooth fragment is available, it can be bonded to the tooth. Otherwise perform a <u>provisional treatment</u> by covering the exposed dentin with glass-Ionomer or a more permanent restoration using a bonding agent and composite resin, or other accepted dental restorative materials ● If the exposed dentin is within 0.5mm of the pulp (pink, no bleeding) place calcium hydroxide base and cover with a material such as a glass ionomer.	6-8 weeks C^{++} 1 year C^{++}	● Asymptomatic ● Positive response to pulp testing. ● Continuing root development in immature teeth ● Continue to next evaluation	● Symptomatic ● Negative response to pulp testing. ● Signs of apical periodontitis. ● No continuing root development in immature teeth. ● Endodontic therapy appropriate for stage of root development is indicated.

ENAMEL-DENTIN-PULP FRACTURE	**Clinical findings**	**Radiographic findings**	**Treatment**		**Favorable Outcome**	**Unfavorable Outcome**
	● A fracture involving enamel and dentin with loss of tooth structure and exposure of the pulp. ● Normal mobility ● Percussion test: not tender. If tenderness is observed, evaluate for possible luxation or root fracture injury. ● Exposed pulp sensitive to stimuli.	● Enamel – dentin loss visible. ● Radiographs recommended: periapical, occlusal and eccentric exposures, to rule out tooth displacement or possible presence of root fracture. ● Radiograph of lip or cheek lacerations to search for tooth fragments or foreign materials.	● In young patients with immature, still developing teeth, it is advantageous to preserve pulp vitality by pulp capping or partial pulpotomy. Also, this treatment is the choice in young patients with completely formed teeth. ● Calcium hydroxide is a suitable material to be placed on the pulp wound in such procedures. ● In patients **with mature apical development**, root canal treatment is usually the treatment of choice, although pulp capping or partial pulpotomy also may be selected. ● If tooth fragment is available, it can be bonded to the tooth. ● Future treatment for the fractured crown may be restoration with other accepted dental restorative materials.	6-8 weeks C^{++} 1 year C^{++}	● Asymptomatic. ● Positive response to pulp testing. ● Continuing root development in immature teeth. ● Continue to next evaluation.	● Symptomatic. ● Negative response to pulp testing. ● Signs of apical periodontitis. ● No continuing root development in immature teeth. ● Endodontic therapy appropriate for stage of root development is indicated.

[+] = for crown fractured teeth with concomitant luxation injury, use the luxation followup schedule

C^{++} = clinical and radiographic examination.

				Follow-Up Procedures for fractures of teeth and alveolar bone +	Favorable and Unfavorable outcomes include some, but not necessarily all, of the following:	
CROWN-ROOT FRACTURE WITHOUT PULP EXPOSURE	**Clinical findings**	**Radiographic findings**	**Treatment**	**Follow-Up**	**Favorable Outcome**	**Unfavorable Outcome**
	● A fracture involving enamel, dentin and cementum with loss of tooth structure, but not exposing the pulp. ● Crown fracture extending below gingival margin. ● Percussion test: Tender. ● Coronal fragment mobile. ● Sensibility pulp test usually positive for apical fragment.	● Apical extension of fracture usually not visible. ● Radiographs recommended: periapical, occlusal and eccentric exposures. They are recommended in order to detect fracture lines in the root.	**Emergency treatment** ● As an emergency treatment a temporary stabilization of the loose segment to adjacent teeth can be performed until a definitive treatment plan is made. **Non-Emergency Treatment Alternatives** **Fragment removal only** ● Removal of the coronal crown-root fragment and subsequent restoration of the apical fragment exposed above the gingival level. **Fragment removal and gingivectomy** (sometimes ostectomy) ● Removal of the coronal crown-root segment with subsequent endodontic treatment and restoration with a post-retained crown. This procedure should be preceded by a gingivectomy, and sometimes ostectomy with osteoplasty. **Orthodontic extrusion of apical fragment** ● Removal of the coronal segment with subsequent endodontic treatment and orthodontic extrusion of the remaining root with sufficient length after extrusion to support a post-retained crown. **Surgical extrusion** ● Removal of the mobile fractured fragment with subsequent surgical repositioning of the root in a more coronal position. **Root submergence** ● Implant solution is planned. **Extraction** ● Extraction with immediate or delayed implant-retained crown restoration or a conventional bridge. Extraction is inevitable in crown-root fractures with a severe apical extension, the extreme being a vertical fracture.	6-8 weeks C^{++} 1 year C^{++}	● Asymptomatic ● Positive response to pulp testing. ● Continuing root development in immature teeth ● Continue to next evaluation	● Symptomatic ● Negative response to pulp testing. ● Signs of apical periodontitis. ● No continuing root development in immature teeth. ● Endodontic therapy appropriate for stage of root development is indicated.

+=for crown fractured teeth with concomitant luxation injury, use the luxation followup schedule.
C++ =clinical and radiographic examination

				Follow-Up Procedures for fractures of teeth and alveolar bone +	Favorable and Unfavorable outcomes include some, but not necessarily all, of the following:	
CROWN-ROOT FRACTURE WITH PULP EXPOSURE	**Clinical findings**	**Radiographic findings**	**Treatment**	**Follow-Up**	**Favorable Outcome**	**Unfavorable Outcome**
	● A fracture involving enamel, dentin, and cementum and exposing the pulp. ● Percussion test: tender. ● Coronal fragment mobile.	● Apical extension of fracture usually not visible. ● Radiographs recommended: periapical and occlusal exposure.	**Emergency treatment** ● As an emergency treatment a temporary stabilization of the loose segment to adjacent teeth. ● In patients with open apices, it is advantageous to preserve pulp vitality by a partial pulpotomy. This treatment is also the choice in young patients with completely formed teeth. Calcium hydroxide compounds are suitable pulp capping materials. In patients with mature apical development, root canal treatment can be the treatment of choice. **Non-Emergency Treatment Alternatives** ● **Fragment removal and gingivectomy (sometimes ostectomy)** Removal of the coronal fragment with subsequent endodontic treatment and restoration with a post-retained crown. This procedure should be preceded by a gingivectomy and sometimes ostectomy with osteoplasty. This treatment option is only indicated in crown-root fractures with palatal subgingival extension. ● **Orthodontic extrusion of apical fragment** Removal of the coronal segment with subsequent endodontic treatment and orthodontic extrusion of the remaining root with sufficient length after extrusion to support a post-retained crown. ● **Surgical extrusion** Removal of the mobile fractured fragment with subsequent surgical repositioning of the root in a more coronal position. ●**Root submergence** An implant solution is planned, the root fragment may be left in situ. ●**Extraction** Extraction with immediate or delayed implant-retained crown restoration or a conventional bridge. Extraction is inevitable in very deep crown-root fractures, the extreme being a vertical fracture	6-8 weeks C^{++} 1 year C^{++}	● Asymptomatic ● Positive response to pulp testing. ● Continuing root development in immature teeth ● Continue to next evaluation	● Symptomatic ● Negative response to pulp testing. ● Signs of apical periodontitis. ● No continuing root development in immature teeth. ● Endodontic therapy appropriate for stage of root development is indicated.

$^{+}$= for crown fractured teeth with concomitant luxation injury, use the luxation followup schedule
C^{++} = clinical and radiographic examination;

				Follow-Up Procedures for fractures of teeth and alveolar bone	Favorable and Unfavorable outcomes include some, but not necessarily all, of the following:++	
ROOT FRACTURE	**Clinical findings**	**Radiographic findings**	**Treatment**		**Favorable Outcome**	**Unfavorable Outcome**
	●The coronal segment may be mobile and may be displaced. ● The tooth may be tender to percussion. ● Bleeding from the gingival sulcus may be noted. ● Sensibility testing may give negative results initially, indicating transient or permanent neural damage. ● Monitoring the status of the pulp is recommended. ● Transient crown discoloration (red or grey) may occur.	● The fracture involves the root of the tooth and is in a horizontal or oblique plane. ● Fractures that are in the horizontal plane can usually be detected in the regular periapical 90^{o} angle film with the central beam through the tooth. This is usually the case with fractures in the cervical third of the root. ● If the plane of fracture is more oblique which is common with apical third fractures, an occlusal view or radiographs with varying horizontal angles are more likely to demonstrate the fracture including those located in the middle third.	● Reposition, if displaced, the coronal segment of the tooth as soon as possible. ● Check position radiographically. ● Stabilize the tooth with a flexible splint for 4 weeks. If the root fracture is near the cervical area of the tooth, stabilization is beneficial for a longer period of time (up to 4 months). ● It is advisable to monitor healing for at least one year to determine pulpal status. ● If pulp necrosis develops, root canal treatment of the coronal tooth segment to the fracture line is indicated to preserve the tooth.	4 Weeks S^{+}, C^{++} 6-8 Weeks C^{++} 4 Months S^{++}*, C^{++} 6 Months C^{++} 1 Year C^{++} 5 Years C^{++}	● Positive response to pulp testing (false negative possible up to 3 months). ● Signs of repair between fractured segments. ● Continue to next evaluation.	● Symptomatic ● Negative response to pulp testing (false negative possible up to 3 months). ● Extrusion of the coronal segment. ● Radiolucency at the fracture line. ● Clinical signs of periodontitis or abscess associated with the fracture line. ● Endodontic therapy appropriate for stage of root development is indicated.

ALVEOLAR FRACTURE	Clinical findings	Radiographic findings	Treatment	**Follow-Up**	Favorable Outcome	Unfavorable Outcome
	● The fracture involves the alveolar bone and may extend to adjacent bone. ● Segment mobility and dislocation with several teeth moving together are common findings. ● An occlusal change due to misalignment of the fractured alveolar segment is often noted. ● Sensibility testing may or may not be positive.	● Fracture lines may be located at any level, from the marginal bone to the root apex. ● In addition to the 3 angulations and occlusal film, additional views such as a panoramic radiograph can be helpful in determining the course and position of the fracture lines.	● Reposition any displaced segment and then splint. ● Suture gingival laceration if present. ● Stabilize the segment for 4 weeks.	4 Weeks S^{+}, C^{++} 6-8 Weeks C^{++} 4 Months C^{++} 6 Months C^{++} 1 Year C^{++} 5 Years C^{++}	● Positive response to pulp testing (false negative possible up to 3 months). ● No signs of apical periodontitis. ●Continue to next evaluation.	● Symptomatic ● Negative response to pulp testing (false negative possible up to 3 months). ● Signs of apical periodontitis or external inflammatory root resorption. ● Endodontic therapy appropriate for stage of root development is indicated.

S^{+}=splint removal; S^{++}=splint removal in cervical third fractures.
C^{++} = clinical and radiographic examination.
++=Whenever there is evidence of external inflammatory root resorption, root canal therapy should be initiated immediately, with the use of calcium hydroxide as an intra-canal medication.

2. Treatment Guidelines for Luxation Injuries

				Follow-Up Procedures for luxated permanent teeth	Favorable and Unfavorable outcomes include some, but not necessarily all, of the following:++	
CONCUSSION	**Clinical findings**	**Radiographic findings**	**Treatment**		**Favorable Outcome**	**Unfavorable Outcome**
	● The tooth is tender to touch or tapping; it has not been displaced and does not have increased mobility. ● Sensibility tests are likely to give positive results.	●No radiographic abnormalities	● No treatment is needed. ● Monitor pulpal condition for at least one year.	4 Weeks C^{++} 6-8 Weeks C^{++} 1 Year C^{++}	● Asymptomatic ● Positive response to pulp testing ● False negative possible up to 3 months. ● Continuing root development in immature teeth ● Intact lamina dura	● Symptomatic ● Negative response to pulp testing ● False negative possible up to 3 months ●No continuing root development in immature teeth, signs of apical periodontitis. ● Endodontic therapy appropriate for stage of root development is indicated.
SUBLUXATION	**Clinical findings**	**Radiographic findings**	**Treatment**	**Follow-Up**	**Favorable Outcome**	**Unfavorable Outcome**
	● The tooth is tender to touch or tapping and has increased mobility; it has not been displaced. ● Bleeding from gingival crevice may be noted. ● Sensibility testing may be negative initially indicating transient pulpal damage. ● Monitor pulpal response until a definitive pulpal diagnosis can be made.	●Radiographic abnormalities are usually not found.	● Normally no treatment is needed, however a flexible splint to stabilize the tooth for patient comfort can be used for up to 2 weeks.	2 Weeks S^{+}, C^{++} 4 Weeks C^{++} 6-8 Weeks C^{++} 6 Months C^{++} 1 Year C^{++}	● Asymptomatic ● Positive response to pulp testing ● False negative possible up to 3 months. ● Continuing root development in immature teeth ● Intact lamina dura	● Symptomatic ● Negative response to pulp testing ● False negative possible up to 3 months ● External inflammatory resorption. ● No continuing root development in immature teeth, signs of apical periodontitis. ● Endodontic therapy appropriate for stage of root development is indicated.
EXTRUSIVE LUXATION	**Clinical Findings**	**Radiographic findings**	**Treatment**	**Follow-Up**	**Favorable Outcome**	**Unfavorable Outcome**
	● The tooth appears elongated and is excessively mobile. ● Sensibility tests will likely give negative results.	●Increased periodontal ligament space apically.	● Reposition the tooth by gently re-inserting It into the tooth socket. ● Stabilize the tooth for 2 weeks using a flexible splint. ● In mature teeth where pulp necrosis is anticipated or if several signs and symptoms indicate that the pulp of mature or immature teeth became necrotic, root canal treatment is indicated.	2 Weeks S^{+}, C^{++} 4 Weeks C^{++} 6-8 Weeks C^{++} 6 Months C^{++} 1 Year C^{++} Yearly 5 years C^{++}	● Asymptomatic ● Clinical and radiographic signs of normal or healed periodontium. ● Positive response to pulp testing (false negative possible up to 3 months). ● Marginal bone height corresponds to that seen radiographically after repositioning. ● Continuing root development in immature teeth.	● Symptoms and radiographic sign consistent with apical periodontitis. ● Negative response to pulp testing (false negative possible up to 3 months). ● If breakdown of marginal bone, splint for an additional 3-4 weeks. ● External inflammatory root resorption. ● Endodontic therapy appropriate for stage of root development is indicated.

S^{+}=splint removal;
C^{++} = clinical and radiographic examination.
++=Whenever there is evidence of external inflammatory root resorption, root canal therapy should be initiated immediately, with the use of calcium hydroxide as an intra-canal medication.

				Follow-Up Procedures for luxated permanent teeth	Favorable and Unfavorable outcomes include some, but not necessarily all, of the following:++	
LATERAL LUXATION	**Clinical findings**	**Radiographic findings**	**Treatment**		**Favorable Outcome**	**Unfavorable Outcome**
	● The tooth is displaced, usually in a palatal/lingual or labial direction. ● It will be immobile and percussion usually gives a high, metallic (ankylotic) sound. ● **Fracture of the alveolar process present.** ● Sensibility tests will likely give negative results	● The widened periodontal ligament space is best seen on eccentric or occlusal exposures.	● Reposition the tooth digitally or with forceps to disengage it from its bony lock and gently reposition it into its original location. ● Stabilize the tooth for 4 weeks using a flexible splint. ● Monitor the pulpal condition. ● If the pulp becomes necrotic, root canal treatment is indicated to prevent root resorption.	2 Weeks, C^{++} 4 Weeks S+, C^{++} 6-8 Weeks C^{++} 6 Months C^{++} 1 Year C^{++} Yearly for 5 years C^{++}	● Asymptomatic ● Clinical and radiographic signs of normal or healed periodontium. ● Positive response to pulp testing (false negative possible up to 3 months). ● Marginal bone height corresponds to that seen radiographically after repositioning. ●Continuing root development in immature teeth	● Symptoms and radiographic signs consistent with apical periodontitis. ● Negative response to pulp testing (false negative possible up to 3 months). ● If breakdown of marginal bone, splint for an additional 3-4 weeks. ● External inflammatory root resorption or replacement resorption ● Endodontic therapy appropriate for stage of root development is indicated.

INTRUSIVE LUXATION	**Clinical findings**	**Radiographic findings**	**Treatment**	**Follow-Up**	**Favorable Outcome**	**Unfavorable**
	● The tooth is displaced axially into the alveolar bone. ● It is immobile and percussion may give a high, metallic (ankylotic) sound. ● Sensibility tests will likely give negative results.	●The periodontal ligament space may be absent from all or part of the root. ● The cemento-enamel junction is located more apically in the intruded tooth than in adjacent non-injured teeth, at times even apical to the marginal bone level.	<u>Teeth with incomplete root formation</u> ● Allow eruption without intervention ● If no movement within few weeks, initiate orthodontic repositioning. ● If tooth is intruded more than 7mm, reposition surgically or orthodontically. <u>Teeth with complete root formation</u>: ● Allow eruption without intervention if tooth intruded less than 3mm. If no movement after 2-4 weeks, reposition surgically or orthodontically **before ankylosis can develop.** ● If tooth is intruded 3-7 mm, reposition surgically or orthodontically. ● If tooth is intruded beyond 7mm, reposition surgically. ● The pulp will likely become necrotic in teeth with complete root formation. Root canal therapy using a temporary filling with calcium hydroxide is recommended and treatment should begin 2-3 weeks after repositioning. ● Once an intruded tooth has been repositioned surgically or orthodontically, stabilize with a flexible splint for 4 weeks.	2 Weeks, C^{++} 4 Weeks S+, C^{++} 6-8 Weeks C^{++} 6 Months C^{++} 1 Year C^{++} Yearly for 5 years C^{++}	● Tooth in place or erupting. ● Intact lamina dura ● No signs of resorption. ● Continuing root development in immature teeth.	● Tooth locked in place/ankylotic tone to percussion. ● Radiographic signs of apical periodontitis ● External inflammatory root resorption or replacement resorption. ● Endodontic therapy appropriate for stage of root development is indicated.

S^{+}=splint removal;
C^{++} = clinical and radiographic examination.
++= whenever there is evidence of external inflammatory root resorption, root canal therapy should be initiated immediately, with the use of calcium hydroxide as an intra-canal medication.