Virtual PediaRaRe 5.0

Crown and crown-root fractures in permanent teeth and their management

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REGISTRATION

CONTENTS

FAQs

- Describe the sequelae following crown fractures in permanent teeth
- Enumerate and discuss the management strategies for crown-root fractures in permanent teeth
- Short note – Fragment reattachment
- Discuss the success of vital pulp therapy in complicated crown fracture

RISK FACTORS

Received: 9 August 2019 | Revised: 4 March 2020 | Accepted: 10 August 2020

DOI: 10.1111/cdoe.12574

Check for updates

UNSOLICITED SYSTEMATIC REVIEW

Community Dentistry and Oral Epidemiology WILEY

Associations and risk factors for dental trauma: A systematic review of systematic reviews

Marcela Baraúna Magno[1] | Patricia Nadelman[1] | Karla Lorene de França Leite[1] | Daniele Masterson Ferreira[2] | Matheus Melo Pithon[1,3] | Lucianne Cople Maia[1]

Total of 22 risk factors evaluated and grouped into:

Sociodemographic factors

Clinical factors

Socio-economic indicators

Factors associated with sports habits

Behavioral habits

Special needs status

Previous history of TDIs

Greater chance of TDI

1. Sociodemographic - Male gender, younger age and lower income
2. Clinical - Inadequate lip coverage and increased overjet
3. Environmental factors

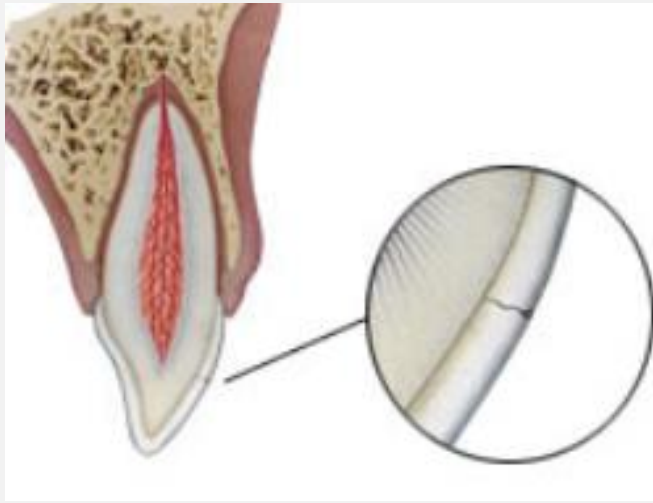
INTRODUCTION

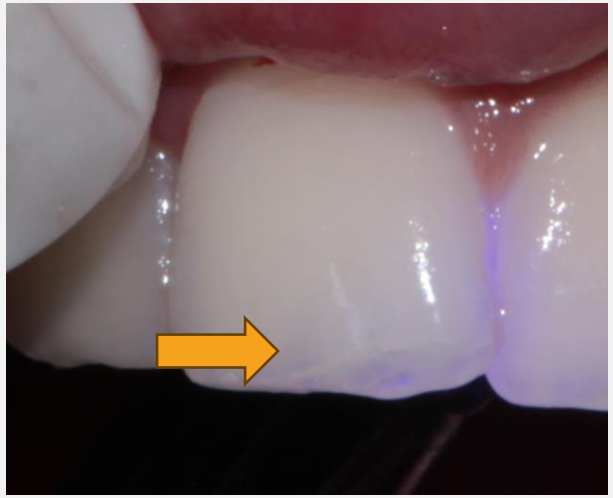
- Crown - fracture - A fracture involving enamel and dentin with or without pulp exposure
- Prevalence – Ranges from 26 - 76% of TDI in permanent teeth
- Classification –

Andreasen, J.O., Andreasen, F.M. and Andersson, L. (2019a) *Textbook and color atlas of traumatic injuries to the teeth*. Hoboken, NJ: Wiley-Blackwell

ENAMEL INFRACTION

- An incomplete fracture (crack or crazing) of the enamel, without loss of tooth structure (N 502.50)
- Etiology – Direct impact to the enamel (fall, RTA)
- Fracture extent : Commonly extend till the dentino-enamel junction.
- Difference in the elastic modulus of enamel and dentine prevents these cracks from reaching into the underlying dentin

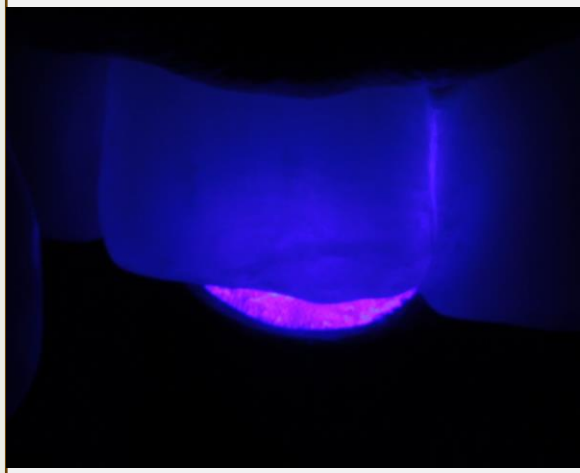




Andreasen, J.O., Andreasen, F.M. and Andersson, L. (2019a) *Textbook and color atlas of traumatic injuries to the teeth*. Hoboken, NJ: Wiley-Blackwell

DIAGNOSIS – CLINICAL

- Visible crack on the tooth
(especially using fibro-optic light sources and trans-illumination)
- Normal mobility
- No sensitivity to percussion and palpation
- If tenderness is observed, evaluate the tooth for possible luxation or root fracture injury.



DIAGNOSIS – RADIOGRAPHIC

No radiographic abnormalities

DIAGNOSIS –PULP SENSIBILITY TESTING

Pulp sensibility tests usually positive

May JJ, Cohenca N, Peters OA. Contemporary management of horizontal root fractures to the permanent dentition: diagnosis—radiologic assessment to include cone-beam computed tomography. J Endod. 2013;39:S20–5.

HEALING

- Infractions can create pathways for invasion of the root canal system by bacteria.
- Pulp necrosis was observed in 3.5% of teeth when infraction was the sole injury. However, this figure rose to 34.5% with associated supportive tissue damage such as subluxation

MANAGEMENT

No treatment necessary

In case of severe Infractions

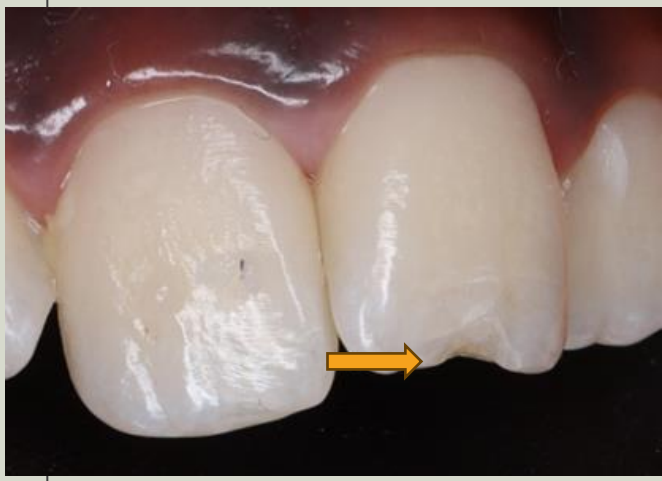
Etching and sealing with bonding resin

No F/U strictly recommended

Güngör, H. C. (2013). Management of crown-related fractures in children: an update review. Dental Traumatology, 30(2), 88–99. doi:10.1111/edt.12079

UNCOMPLICATED CROWN FRACTURE (ENAME-ONLY FRACTURE)

- A complete fracture of enamel without visible sign of exposed dentin is referred to as enamel-only crown fracture (N 502.50)
- 2nd most common type of crown fracture after enamel-dentine fracture.
- Diagnosis – Clinical
  - Loss of enamel
  - No visible sign of exposed dentin.
  - No abnormal mobility
  - No sensitivity to percussion and palpation
  - If tenderness is observed, evaluate the tooth for possible luxation or root fracture injury.



Andreasen, J.O., Andreasen, F.M. and Andersson, L. (2019a) *Textbook and color atlas of traumatic injuries to the teeth*. Hoboken, NJ: Wiley-Blackwell

DIAGNOSIS- RADIOGRAPHIC

- Enamel loss is visible
- If fragment is missing and there are soft tissue injuries - radiographs of the lip and/or cheek are indicated

DIAGNOSIS- PULP TESTING

- Sensibility test usually positive.

Andreasen, J.O., Andreasen, F.M. and Andersson, L. (2019a) *Textbook and color atlas of traumatic injuries to the teeth*. Hoboken, NJ: Wiley-Blackwell

SEQUELAE

In enamel-only fractures of the permanent dentition

- The risk of pulp necrosis is approximately 1.7%
- The risk of pulp canal obliteration is approximately 0.5%
- The risk of root resorption is approximately 0.2%

Güngör, H. C. (2013). Management of crown-related fractures in children: an update review. Dental Traumatology, 30(2), 88–99. doi:10.1111/edt.12079

MANAGEMENT

If the tooth fragment is available → Bonded back on to the tooth

If the tooth fragment is not available → Extent / Location → Smoothening of tooth edges; Composite resin restoration

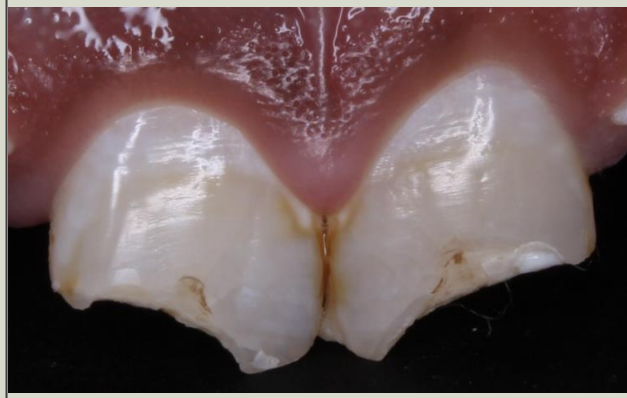
Andreasen, J.O., Andreasen, F.M. and Andersson, L. (2019a) *Textbook and color atlas of traumatic injuries to the teeth*. Hoboken, NJ: Wiley-Blackwell

UNCOMPLICATED CROWN FRACTURE (ENAMEL-DENTIN FRACTURE)

- Enamel–dentin fractures result in the loss of enamel and dentin without exposing the pulp.
- WHO classification – N 502.51

DIAGNOSIS - CLINICAL

- No abnormal mobility
- No sensitivity to percussion or palpation
- If tenderness is observed, evaluate the tooth for possible luxation or root fracture injury.



Andreasen, J.O., Andreasen, F.M. and Andersson, L. (2019a) *Textbook and color atlas of traumatic injuries to the teeth*. Hoboken, NJ: Wiley-Blackwell

DIAGNOSIS – RADIOGRAPHIC

- Enamel-dentin loss is visible.
- If fragment is missing and there are soft tissue injuries, radiographs of the lip and/or cheek are indicated

DIAGNOSIS – PULP TESTING

- Sensibility test usually positive

Andreasen, J.O., Andreasen, F.M. and Andersson, L. (2019a) *Textbook and color atlas of traumatic injuries to the teeth*. Hoboken, NJ: Wiley-Blackwell

FACTORS AFFECTING HEALING

- This injury exposes a considerable amount of dentinal tubules, whose numbers vary from 15000 (at the DEJ) to 45000 (pulp) per mm2 , depending on the location of the fracture line.
- The number of exposed dentinal tubules is a major point of concern, as they constitute a potential pathway of invasion for bacteria and subsequent pulpal disease.

Love RM, Jenkinson HF. Invasion of dentinal tubules by oral bacteria. Crit Rev Oral Biol Med 2002;13:171–83.

MANAGEMENT

Dentinal sealing

Exposed dentin is within 0.5 mm of the pulp (pink but no bleeding)

Calcium hydroxide lining and cover with a material such as glass-ionomer

Esthetics

If the tooth fragment is available and intact, it can be bonded back on to the tooth.

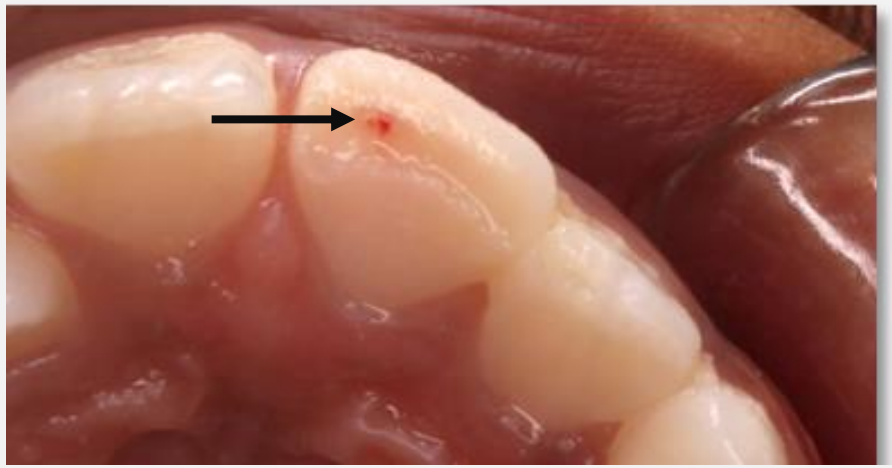
OR

Cover the exposed dentin with glass-ionomer or use a bonding agent and composite resin

F/U – 6-8 weeks; 1 year

COMPLICATED CROWN FRACTURE

- Complicated crown fracture: A fracture confined to enamel and dentin with pulp exposure
- WHO Classification – N502.52
- Complicated crown fractures need to be treated as emergencies with the utmost care given to the preservation of pulp vitality, especially in young patients with underdeveloped teeth



Diagnosis- Clinical

No abnormal mobility

- No sensitivity to percussion or palpation
- If tenderness present - Evaluate for a possible associated luxation injury or root fracture
- Exposed pulp is sensitive to stimuli (Eg: Air, Cold, Sweets)

Diagnosis- Radiographic

- Enamel-dentin loss is visible
- If the fragment is missing and there are soft tissue injuries, radiographs of the lip and/or cheek are indicated to search for tooth fragments

FACTORS INFLUENCING MANAGEMENT

- Severity of the initial injury
- Amount of loss of crown structure
- Pulpal status of the traumatised teeth
- Extent of pulpal exposure
- Stage of tooth development
- Concomitant luxation injury
- Time interval between accident and treatment

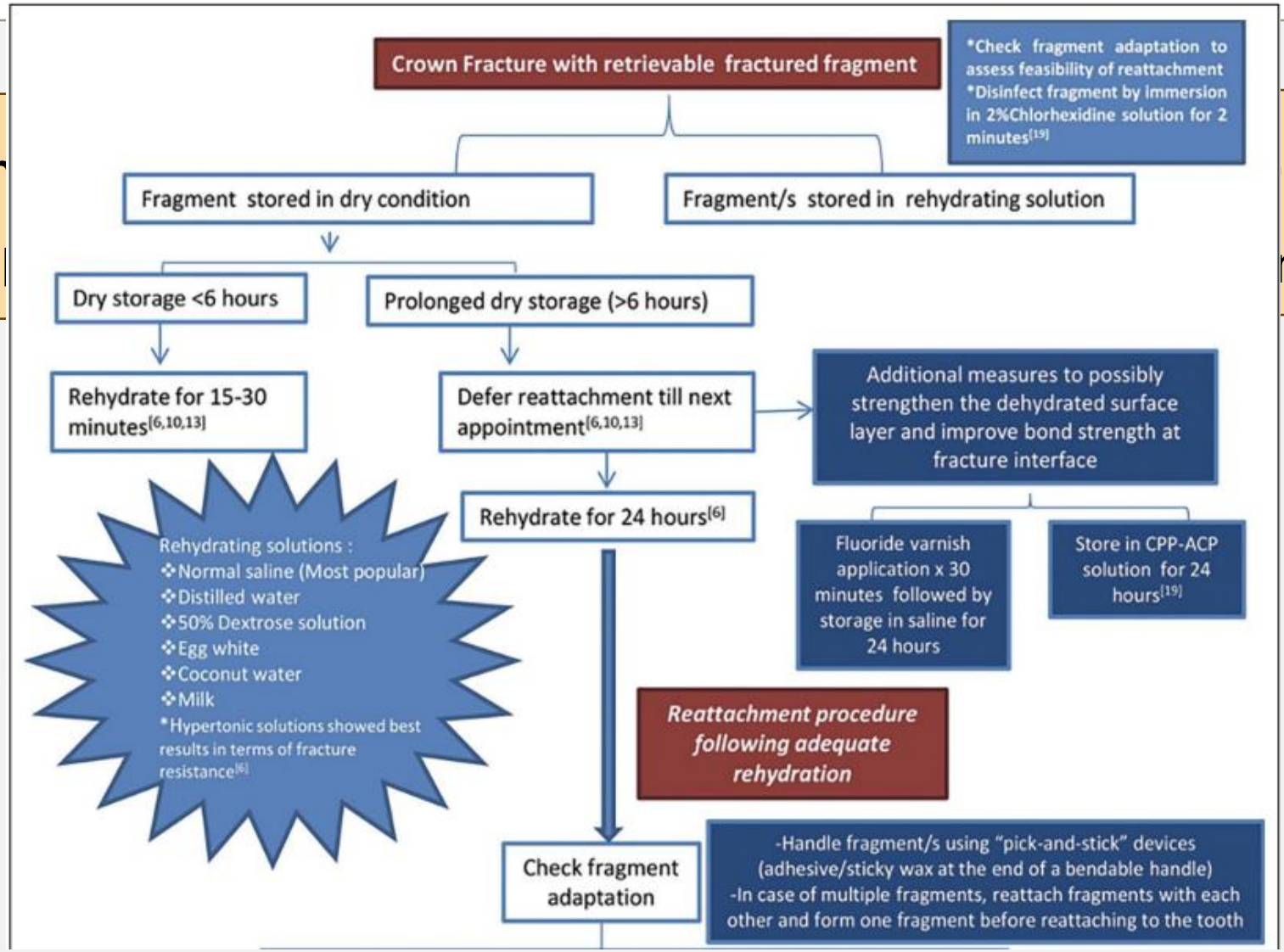
MANAGEMENT (Vital pulp)

Pulp capping	Vital pulp, immediately after trauma, minimal pulp exposure (1.0 mm or less), both mature and immature teeth, with sufficient crown structure remaining.
Pulpotomy • Partial/complete	Vital pulp, generally up to 72 hrs of trauma, pulp exposure (4 mm or less for partial pulpotomy), both mature and immature teeth, sufficient crown structure remaining

MANAGEMENT (Pulp deemed non-vital)

RET	Nonvital pulp, delayed treatment, immature teeth with sufficient crown structure remaining, post-reinforcement not indicated
RCT/Apical plug	Non-vital pulp, delayed treatment, Insufficient crown structure remaining, need for post in immature teeth

MANAGEMENT (Aesthetic)



Goyal A, Rathore M, Devi P, Singh SK. Fragment Reattachment of Immature Permanent Incisors: Clinical Procedures and the Development of an Algorithm. J Pediatr Dent 2022;8(1):51-58

Dental Traumatology

ORIGINAL ARTICLE

Effect of dehydration and rehydration intervals on fracture resistance of reattached tooth fragments using a multimode adhesive

Déborah L. N. Poubel, Júlio César F. Almeida, Ana P. Dias Ribeiro, Guilherme B. Maia, Jesús Maurício G. Martinez, Fernanda Cristina P. Garcia

First published: 17 April 2017 | https://doi.org/10.1111/edt.12344 | Citations: 23

Dental Traumatology

ORIGINAL ARTICLE

Comparative evaluation of fracture resistance using two rehydration protocols for fragment reattachment in uncomplicated crown fractures

Aripirala Madhubala, Nitesh Tewari, Vijay Prakash Mathur, Kalpana Bansal

First published: 01 April 2019 | https://doi.org/10.1111/edt.12473 | Citations: 17

- Rehydration of fragments for 15 minutes in the humidification chamber significantly increased fracture resistance.

Dental Traumatology

COMPREHENSIVE REVIEW | Free Access

Tooth fragment reattachment techniques—A systematic review

Fernanda Cristina P. Garcia, Déborah L. N. Poubel, Júlio César F. Almeida, Isabela P. Toledo, Wilson R. Poi, Eliete N. S. Guerra, Liliana V. M. L. Rezende

First published: 07 March 2018 | https://doi.org/10.1111/edt.12392 | Citations: 47

- Simple tooth fragment reattachment was the preferred reattachment technique
- An increase in the bond strength between tooth fragment and dentin was observed when an intermediate material was used.

EVIDENCE

Survival analysis of fragment reattachments and direct composite restorations in permanent teeth after dental traumatic injuries

Dental Traumatology | 2022

Franziska Haupt | Christopher Meyerdiercks | Philipp Kanzow | Annette Wiegand

- Evaluated the restorative and biological survival of reattached fragments and composite restorations after crown fractures in permanent teeth
- 164 patients with 235 teeth (uncomplicated crown fracture: N = 201, complicated crown fracture: N = 34) were included
- Fragment reattachment in 59 teeth and composite restoration in 176 teeth
- Cumulative survival after 2 years –Direct composite – 65%

  Fragment reattachment – 42.9%
  (Restoration failure/pulp necrosis)

PULPAL SEQUELAE

Damage to, or interference with the neurovascular supply can lead to altered pulp function.

Pulp necrosis with infection	Pulp canal obliteration	Root resorption
Prevalence: 7.5% (1-6%)	**2.8% (3.7-40%)**	**2.3%**

Median time for clinical and/or radiographic manifestations:

Pulp Necrosis – 2 months

Pulp Canal Obliteration – 9.5 months

Bratteberg M, Thelen DS, Klock KS, Bårdsen A. Traumatic dental injuries and pulp sequelae in an adolescent population. Dental traumatology. 2021 Apr;37(2):294-301.

Risk factors associated with pulpal sequelae

Mild TDI rarely lead to adverse pulp reactions and is considered less important in regard to tooth survival.

Moderate and severe TDIs however, represent a higher risk for several adverse sequelae, such as Pulp necrosis and root resorption.

A higher proportion of teeth with immature root developed pulp necrosis.

Teeth with luxation injuries are more prone to pulp necrosis because of the compromised blood supply to the pulp after luxation

Bratteberg M, Thelen DS, Klock KS, Bårdsen A. Traumatic dental injuries and pulp sequelae in an adolescent population. Dental traumatology. 2021 Apr;37(2):294-301.

RATIONALE OF FOLLOW-UP INTERVALS

Type of TDI	6 weeks	8 weeks	3 months	6 months	1 year
Enamel infarction	--	--	--	--	--
Uncomplicated crown fracture	To evaluate the quality of restoration and any periapical radiographic changes		--	--	To evaluate the quality of restoration and any periapical radiographic changes
Complicated crown fracture	To evaluate the quality of restoration and any periapical radiographic changes		To look for early signs of periapical changes/ankylotic changes	Restoration loss within 6 months predisposes to periapical sequalae	To evaluate the quality of restoration and any periapical radiographic changes

MUST READ ARTICLES - EPIDEMIOLOGY

Dental Traumatology

Epidemiology of traumatic dental injuries – a 12 year review of the literature

Ulf Glendor

First published: 18 November 2008 | https://doi.org/10.1111/j.1600-9657.2008.00696.x | Citations: 393

Dental Traumatology

COMPREHENSIVE REVIEW | Free Access

World traumatic dental injury prevalence and incidence, a meta-analysis—One billion living people have had traumatic dental injuries

Stefano Petti, Ulf Glendor, Lars Andersson

First published: 18 February 2018 | https://doi.org/10.1111/edt.12389 | Citations: 223

Review > Indian J Dent Res. 2020 Jul-Aug;31(4):601-614. doi: 10.4103/ijdr.IJDR_953_19.

Prevalence of traumatic dental injuries in India: A systematic review and meta-analysis

Nitesh Tewari [1], Vijay Prakash Mathur [1], Ishrat Siddiqui [1], Rahul Morankar [1], Ankita R Verma [1], Ravindra Mohan Pandey [2]

Community Dentistry and Oral Epidemiology

UNSOLICITED SYSTEMATIC REVIEW

Associations and risk factors for dental trauma: A systematic review of systematic reviews

Marcela Baraúna Magno, Patricia Nadelman, Karla Lorene de França Leite, Daniele Masterson Ferreira, Matheus Melo Pithon, Lucianne Cople Maia

First published: 06 September 2020 | https://doi.org/10.1111/cdoe.12574 | Citations: 17

MUST READ ARTICLES – DIAGNOSIS AND PROGNOSIS

Dental Traumatology

ORIGINAL ARTICLE

Pulp prognosis following conservative pulp treatment in teeth with complicated crown fractures—A retrospective study

Guiyan Wang, Chao Wang, Man Qin

First published: 24 February 2017 | https://doi.org/10.1111/edt.12332 | Citations: 33

- Risk of pulp necrosis after direct pulp capping was significantly higher than that with pulpotomy.
- If coronal restoration broke down within 6 months, the pulp had a lower survival rate
- Incidence of pulp necrosis and infection in mature teeth was significantly higher.

Clin Oral Investig. 2021 Jan;25(1):133-143. doi: 10.1007/s00784-020-03344-y. Epub 2020 Jul 23.

Treatment outcomes after uncomplicated and complicated crown fractures in permanent teeth

Ricarda Bissinger [1], Daniel David Müller [1], Marcel Reymus [1], Yegane Khazaei [1], Reinhard Hickel [1], Katharina Bücher [1], Jan Kühnisch [2]

Affiliations + expand

PMID: 32705398 PMCID: PMC7785561 DOI: 10.1007/s00784-020-03344-y

In cases of uncomplicated crown fractures, the tooth survival rate was 100%.

High clinical success rates in terms of survival of pulp vitality and restoration.

No loss of pulp vitality or restoration was observed in 82.3%

Proportions of non-vital pulps amounted to 6.2%

Review > J Endod. 2022 Apr;48(4):457-478.e4. doi: 10.1016/j.joen.2022.01.013. Epub 2022 Jan 25.

Factors Related to Pulp Survival After Complicated Crown Fracture Following Vital Pulp Therapy: A Systematic Review and Meta-analysis

Giorgos N Tzanetakis [1], Ourania Tsiouma [2], Eleni Mougiou [2], Despina Koletsi [3]

MUST READ ARTICLES - MANAGEMENT

CLINICAL ORAL INVESTIGATIONS, 2023

Treatment outcomes after uncomplicated and complicated crown fractures in permanent teeth

Ricarda Bissinger[1] · Daniel David Müller[1] · Marcel Reymus[1] · Yegane Khazaei[1] · Reinhard Hickel[1] · Katharina Bücher[1] · Jan Kühnisch[1]

- Uncomplicated crown fractures has high success of 82.3% over 2 year F/U
- Direct restorations survived significantly better than did adhesively reattached crown fragments.
- Approximately 85.5% of all complications occurred within 2 years after the accident.

INTERNATIONAL ENDODONTIC JOURNAL
The official journal of the British Endodontic Society and the European Society of Endodontology

REVIEW | Open Access

Pulpotomy for treatment of complicated crown fractures in permanent teeth: A systematic review

Aisling Donnelly, Federico Foschi, Paul McCabe, Henry F. Duncan

First published: 25 January 2022 | https://doi.org/10.1111/iej.13690 | Citations: 7

Overall success range for partial or complete pulpotomy ranging from 75% to 96%.

INTERNATIONAL ENDODONTIC JOURNAL
The official journal of the British Endodontic Society and the European Society of Endodontology

REVIEW ARTICLE | Open Access

Vital pulp treatment for traumatized permanent teeth: A systematic review

Manal Matoug-Elwerfelli, Ahmed S. ElSheshtawy, Monty Duggal, Huei Jinn Tong, Hani Nazzal

First published: 29 March 2022 | https://doi.org/10.1111/iej.13741 | Citations: 6

Radiographic and Clinical success rate
Calcium hydroxide 78.4%-100%
Biodentine: 80-91%
MTA: 80-100%
IRootBP: 90-100%

IADT GUIDELINES -2020

Dental Traumatology

COMPREHENSIVE REVIEW | Open Access

International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 1. Fractures and luxations

Cecilia Bourguignon, Nestor Cohenca, Eva Lauridsen, Marie Therese Flores, Anne C. O'Connell, Peter F. Day, Georgios Tsilingaridis, Paul V. Abbott, Ashraf F. Fouad, Lamar Hicks, Jens Ove Andreasen, Zafer C. Cehreli, Stephen Harlamb, Bill Kahler, Adeleke Oginni, Marc Semper, Liran Levin

First published: 31 May 2020 | https://doi.org/10.1111/edt.12578 | Citations: 177

TABLE 2 Permanent teeth: Tr

Uncomplicated crown fracture (enamel-only fracture)	Clinical findi			e outcomes	Unfavorable outcomes
 A coronal fracture involving enamel only, with loss of tooth structure	• Loss of en • No visible exposed d • Evaluate th a possible luxation in fracture, e tenderness • Normal mo • Pulp sensil usually pos			otomatic e response sensibility quality ation ued root pment in ure teeth	• Symptomatic • Pulp necrosis and infection • Apical periodontitis • Loss of restoration • Breakdown of the restoration • Lack of further root development in immature teeth

TABLE 3 Permanent teeth: Treatm

Uncomplicated crown fracture (enamel-dentin fracture)	Clinical findings	and findings	Treatment	Follow up	Favorable outcomes	Unfavorable outcomes
 A fracture confined to enamel and dentin without pulp exposure	• Normal mobility • Pulp sensibility tests usually positive • No sensitivity to percussion or palpation • Evaluate the tooth for a possible associated luxation injury or root fracture, especially if tenderness is present	• Enamel-dentin loss is visible. • Missing fragments should be accounted for: - If fragment is missing and there are soft tissue injuries, radiographs of the lip and/or cheek are indicated to search for tooth fragments and/or foreign materials • Recommended radiographs: - One parallel periapical radiograph - Additional radiographs are indicated if signs or symptoms of other potential injuries are present	• If the tooth fragment is available and intact, it can be bonded back on to the tooth. The fragment should be rehydrated by soaking in water or saline for 20 min before bonding • Cover the exposed dentin with glass-ionomer or use a bonding agent and composite resin • If the exposed dentin is within 0.5 mm of the pulp (pink but no bleeding), place a calcium hydroxide lining and cover with a material such as glass-ionomer	Clinical and radiographic evaluations are necessary: • after 6-8 wk • after 1 y • If there is an associated luxation, root fracture or the suspicion of an associated luxation injury, the luxation follow-up regimen prevails and should be used. Longer follow ups will be needed	• Asymptomatic • Positive response to pulp sensibility testing • Good quality restoration Continued root development in immature teeth	• Symptomatic • Pulp necrosis and infection • Apical periodontitis. • Lack of further root development in immature teeth • Loss of restoration • Breakdown of the restoration

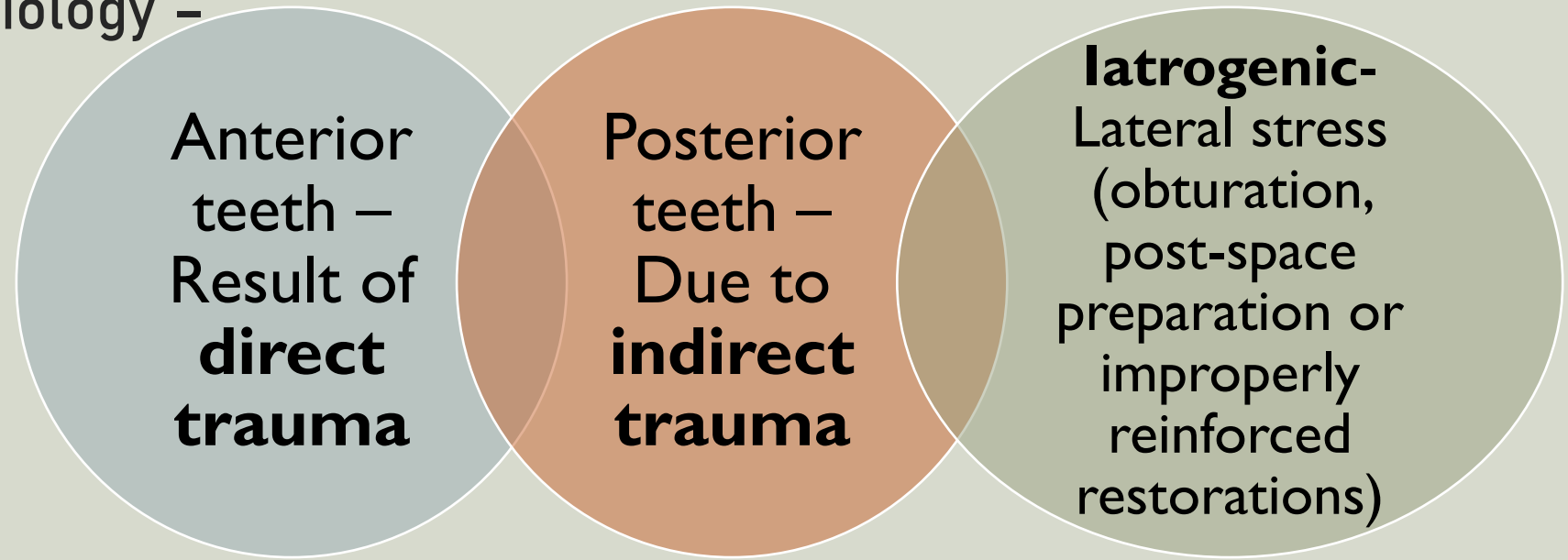
TABLE 4 Permanent teeth: Treatment guidelines for complicated crown fractures

Complicated crown fracture (enamel-dentin fracture with pulp exposure)	Clinical findings	Imaging, radiographic assessment, and findings	Treatment	Follow up	Favorable outcomes	Unfavorable outcomes
 A fracture confined to enamel and dentin with pulp exposure	• Normal mobility • No sensitivity to percussion or palpation. • Evaluate the tooth for a possible associated luxation injury or root fracture, especially if tenderness is present • Exposed pulp is sensitive to stimuli (eg, air, cold, sweets)	• Enamel-dentin loss is visible • Missing fragments should be accounted for: - If fragment is missing and there are soft tissue injuries, radiographs of the lip and/or cheek are indicated to search for tooth fragments and/or foreign debris • Recommended radiographs: - One parallel periapical radiograph - Additional radiographs are indicated if signs or symptoms of other potential injuries are present	• In patients where teeth have immature roots and open apices, it is very important to preserve the pulp. Partial pulpotomy or pulp capping are recommended in order to promote further root development • Conservative pulp treatment (eg, partial pulpotomy) is also the preferred treatment in teeth with completed root development • Non-setting calcium hydroxide or non-staining calcium silicate cements are suitable materials to be placed on the pulp wound • If a post is required for crown retention in a mature tooth with complete root formation, root canal treatment is the preferred treatment • If the tooth fragment is available, it can be bonded back on to the tooth after rehydration and the exposed pulp is treated • In the absence of an intact crown fragment for bonding, cover the exposed dentin with glass-ionomer or use a bonding agent and composite resin	Clinical and radiographic evaluations are necessary: • after 6-8 wk • after 3 mo • after 6 mo • after 1 y • If there is an associated luxation, root fracture or the suspicion of an associated luxation injury, the luxation follow-up regimen prevails and should be used. Longer follow ups will be needed	• Asymptomatic • Positive response to pulp sensibility testing • Good quality restoration • Continued root development in immature teeth	• Symptomatic • Discoloration • Pulp necrosis and infection • Apical periodontitis • Lack of further root development in immature teeth • Loss of restoration • Breakdown of the restoration

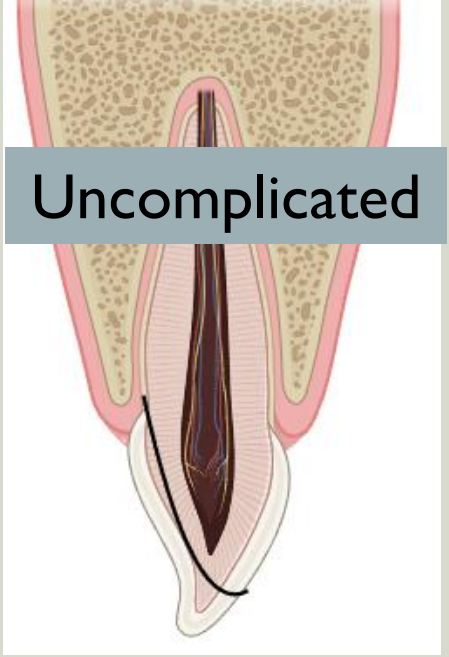
CROWN–ROOT FRACTURES IN PERMANENT TEETH

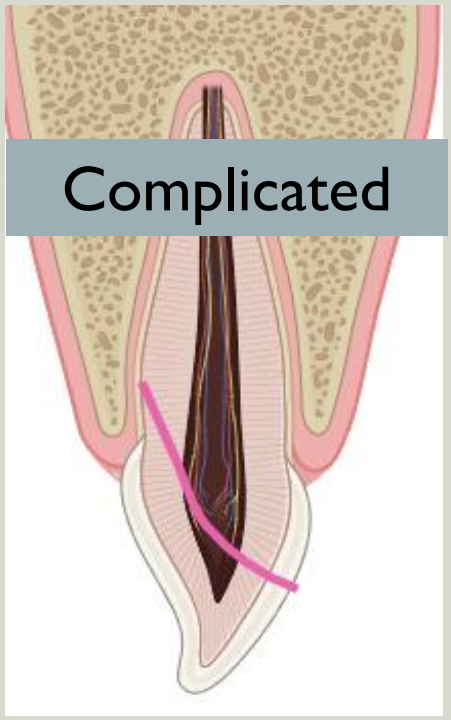
INTRODUCTION

- Crown-root fracture - A fracture involving enamel, dentin and cementum, with or without pulp exposure (N502.54)
- Prevalence – 5% in permanent teeth; 2% in primary teeth
- Etiology –



Andreasen, J.O., Andreasen, F.M. and Andersson, L. (2019a) *Textbook and color atlas of traumatic injuries to the teeth*. Hoboken, NJ: Wiley-Blackwell





INTRODUCTION

- Mechanism - Primarily horizontal impact on the labial portion

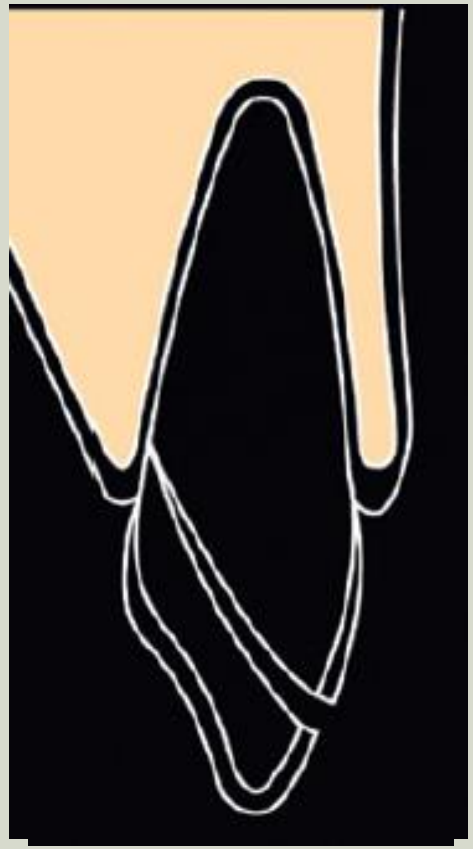
↓ **compressive stress zones develop**

Point of contact (labial) and the cervical portion (palatal)

↓

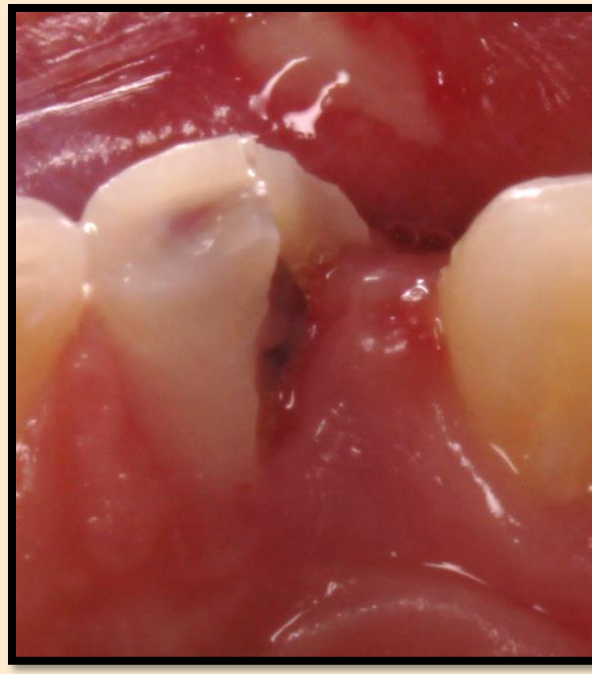
Fracture due to shearing stress between the two zones

- Fracture line that originates labially in the crown portion, extending apically and palatally in an oblique direction
- Coronal fragment may be partially attached or detached



Andreasen JO. Etiology and pathogenesis of traumatic dental injuries. A clinical study of 1,298 cases. Scand J Dent Res. 1970;78:329–42.

DIAGNOSIS - CLINICAL

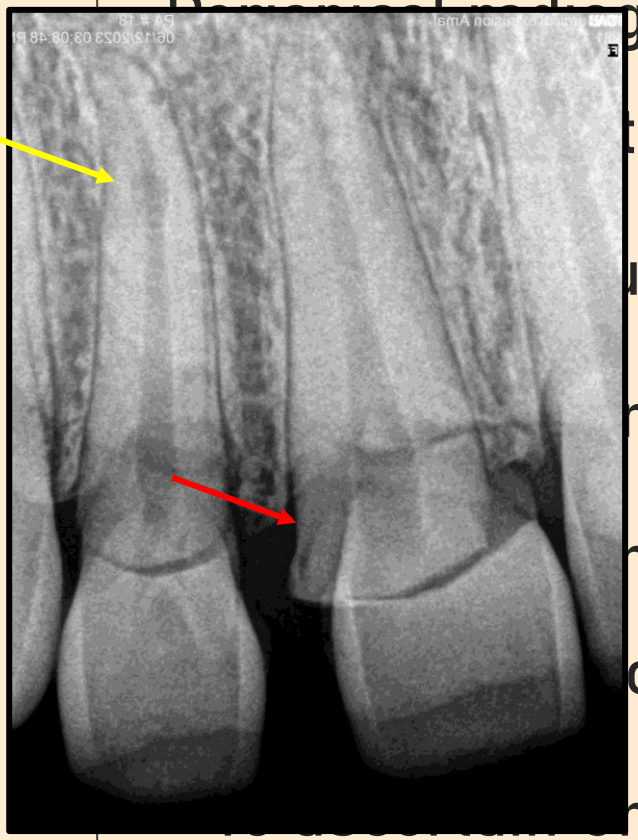


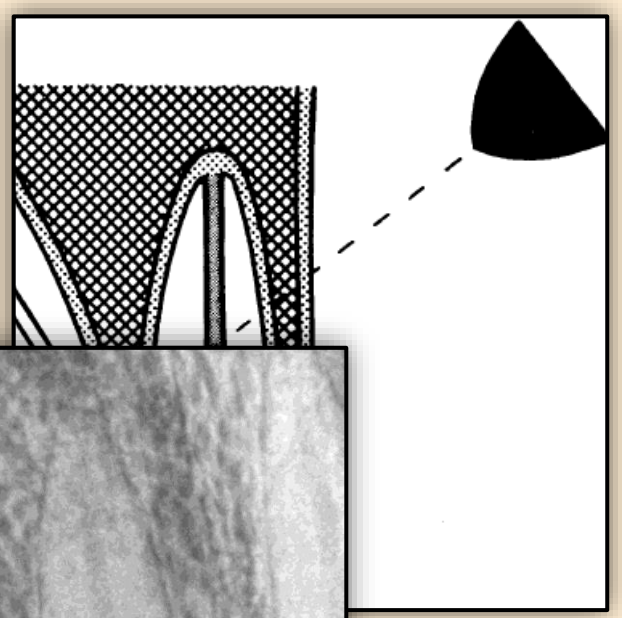
- Fracture line may not be visible in cervical region
- Palpation - Mobility of the coronal or proximal fragment
- Percussion – Tenderness present
- Sensibility – Usually positive for the coronal fragment
- Communication between pulpo-periodontal complex and oral cavity ➡ Microbial infiltration ➡ Inflammation

Dental Trauma Guide. Available at: https://dentaltraumaguide.org/dental-guides/permanent-crown-root-fracture-with-pulp-involvement/permanent-crown-root-fracture-with-pulp-involvement-diagnosis/

DIAGNOSIS - RADIOGRAPHIC

- Periapical radiograph – One parallel and two additional at
- tions
- ualize palatal fracture line due to ove
- racture line visible
- res in mesiodistal direction difficult t
- o superimposition
- rown-root ratio

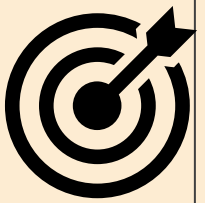




May JJ, Cohenca N, Peters OA. Contemporary management of horizontal root fractures to the permanent dentition: diagnosis—radiologic assessment to include cone-beam computed tomography. J Endod. 2013;39:S20–5.

DIAGNOSIS - RADIOGRAPHIC

- To accurately ascertain crestal relationship, visualize # line and Crown-root ratio for effective planning ➡ CBCT

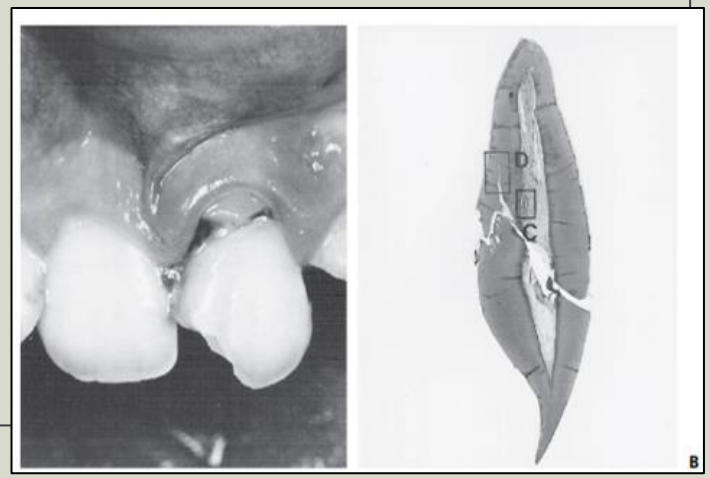


- Fracture line involving the root undetected in 58% teeth with angulated Periapicals, by detected on CBCT

Sha X, Jin L, Han J, Li Y, Zhang L, Qi S. Comparison between periapical radiography and cone beam computed tomography for the diagnosis of anterior maxillary trauma in children and adolescents. Dental Traumatology. 2022 Feb;38(1):62–70.

HEALING

- Communication with the oral cavity to the pulp and periodontal ligament in these fractures permits bacterial invasion and subsequent inflammation.
- For this reason fracture healing cannot be expected in crown-root fractures.
- Early histologic changes consist of acute pulpal inflammation located close to the fracture caused by invasion of bacteria.
- Later, proliferation of marginal gingival epithelium into the pulpal chamber can be seen



Andreasen, J.O., Andreasen, F.M. and Andersson, L. (2019a) *Textbook and color atlas of traumatic injuries to the teeth*. Hoboken, NJ: Wiley-Blackwell

MANAGEMENT

- Level of cooperation to be assessed
- Consider need for sedation
- Need for aesthetic management in adolescents

- Immature tooth – Consider pulp preservation (partial/complete pulpotomy)
- Mature tooth – To initiate RCT, followed by further evaluation
- In case of significant loss of coronal tooth structure – RET not recommended (Intracanal reinforcement required)

MANAGEMENT

Age and

Level and

- Supra-crestal fractures more amenable to restoration – Better prognosis
- Atleast 2-3 mm of sound tooth structure required between crest and restoration (Preserve biologic width and limit microbial ingress)

- Apically-extending, vertically oriented fractures/ Multiple fractures – Prognosis is poor

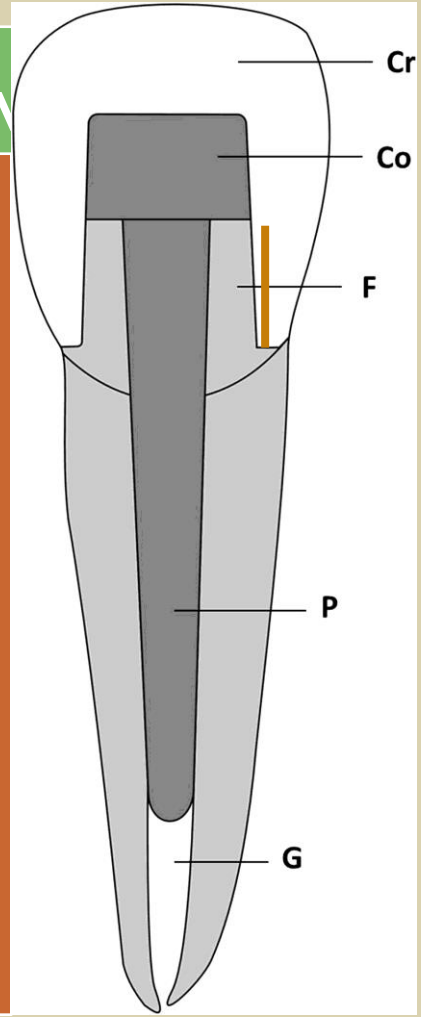
MANAGEMENT

Age and behavi
the pa

Root

Lev

- Determines the tooth preparation and intracanal reinforcement
- A crown-root ratio of 2:3 is ideal;
  1:1 is acceptable
- Adequate ferrule of atleast 2 mm is advisable



IADT 2020 GUIDELINE – FRACTURES AND LUXATION

Uncomplicated crown-root fracture (crown-root fracture without pulp exposure)	Treatment
 A fracture involving enamel, dentin and cementum (Note: Crown-root fractures typically extend below the gingival margin)	• Until a treatment plan is finalized, temporary stabilization of the loose fragment to the adjacent tooth/teeth or to the non-mobile fragment should be attempted • If the pulp is not exposed, removal of the coronal or mobile fragment and subsequent restoration should be considered • Cover the exposed dentin with glass-ionomer or use a bonding agent and composite resin Future Treatment Options: • *The treatment plan is dependent, in part, on the patient's age and anticipated co-operation. Options include:* • Orthodontic extrusion of the apical or non-mobile fragment, followed by restoration (may also need periodontal re-contouring surgery after extrusion) • Surgical extrusion • Root canal treatment and restoration if the pulp becomes necrotic and infected • Root submergence • Intentional replantation with or without rotation of the root • Extraction • Autotransplantation

Complicated crown-root fracture (crown-root fracture with pulp exposure)	Treatment
 A fracture involving enamel, dentin, cementum and the pulp (Note: Crown-root fractures typically extend below the gingival margin)	• Until a treatment plan is finalized, temporary stabilization of the loose fragment to the adjacent tooth/teeth or to the non-mobile fragment should be attempted • *In immature teeth with incomplete root formation*, it is advantageous to preserve the pulp by performing a partial pulpotomy. Rubber dam isolation is challenging but should be tried. - Non-setting calcium hydroxide or non-staining calcium silicate cements are suitable materials to be placed on the pulp wound • *In mature teeth with complete root formation*, removal of the pulp is usually indicated - Cover the exposed dentin with glass-ionomer or use a bonding agent and composite resin Future Treatment Options: • *The treatment plan is dependent, in part, on the patient's age and anticipated co-operation. Options include:* • Completion of root canal treatment and restoration • Orthodontic extrusion of the apical segment (may also need periodontal re-contouring surgery after extrusion) • Surgical extrusion • Root submergence • Intentional replantation with or without rotation of the root • Extraction • Autotransplantation

MANAGEMENT

- Splinting of fragment(s) as an emergency procedure for up to 3 days
- Uncomplicated # ➡ Fragment can be removed and re-attached after placing a pulp capping material
- Definitive management –

Coronal fragment removal and supragingival restoration

Fragment reattachment

Surgical exposure – Gingivectomy ± Osteotomy

Orthodontic extrusion

Surgical extrusion

Intentional replantation

Auto-transplantation

Decoronation

MANAGEMENT

Fragment Reattachment

- Performed in case of supra-crestal and superficial fractures
- A reinforcing post used as an intermediate material for adhesion
- Preparation done inside coronal fragment – Groove/notch/box
- Adverse events – Dislodgement/Discoloration, Bone loss(subgingival)

Advantages	Disadvantages
• Immediate procedure	• Long term reports limited
• Simple and minimally invasive	• Discoloration due to dehydration

EVIDENCE

Fragment reattachment after complicated crown-root fractures of anterior teeth: A systematic review

Dental Traumatology

2020

Priyal Khandelwal | Siddharth Srinivasan | Buvaneshwari Arul | Velmurugan Natanasabapathy

- 12 Case re
- Mucoperi
- Endodont
- Tooth pre
- Rehydrati
- Transient
procedure

n most

r

Conclusion

- Fragment Reattachment useful as an interim option for complicated CR # of permanent anterior teeth
- Level of evidence – Observation studies

MANAGEMENT

Orthodontic Extrusion

- Performed to facilitate movement of the fracture line to a supragingival position
- Mainly indicated in cases of uncomplicated CR #; can be performed in complicated CR # as well
- Both slow (10-20g) and rapid extrusion(40-60g) modalities can be performed.

MANAGEMENT

Orthodontic Extrusion

- Slow extrusion with weak force (20-30g) induces gingival migration with mild alveolar bone migration incisally, predisposing to relapse
- To prevent relapse, supracrestal fibrotomy advised during the retention period
- Strong forces (>60g) cause minimal gingival and alveolar migration
- Extrusion accomplished in 4 to 6 weeks; may require up to 8 weeks in certain cases

Advantages	Disadvantages
• Stable position of tooth achieved	• Longer treatment duration
• Gingival health and alveolar bone level maintained	• Patient compliance required
• Pulp vitality maintained	• Technique sensitive

EVIDENCE

Systematic Review

Orthodontic Forced Eruption of Permanent Anterior Teeth with Subgingival Fractures: A Systematic Review

Elisabeth Reichardt [1,*], Ralf Krug [2], Michael M. Bornstein [3], Jürgen Tomasch [4], Carlalberta Verna [1] and Gabriel Krastl [2]

International Journal of Environmental Research and Public Health

2021

- Identified 1 Prospective clinical tria
- To prevent of ortho extrusion)
- Extrusion
- Use of Bra
- Retention

Conclusion

- Time required for orthodontic extrusion less in adolescents than adults
- Level of evidence for both benefits and adverse effects (Resorption and Pulp necrosis) is low
- Orthodontic extrusion seen to be feasible and predictable, with low level of evidence

MANAGEMENT

Surgical Extrusion

- Performed when coronal fragment in less than half of the root length
- Not performed in uncomplicated crown-root fractures, to maintain tooth vitality
- Two techniques have been advised (Kahnberg and colleagues) –

  1 – Raising a flap ➡ manually extruding exposed root apex ➡ secured with bone graft

  2 – Minimal sectioning of cervical gingival fibres with elevator ➡ Luxation and extrusion with forceps

Advantages	Disadvantages
• Minimal treatment duration	• Risk of marginal bone loss
• Stable position of tooth achieved	• Reduced Crown/Root ratio
• Permits inspection of radicular area	• Risk of external root resorption
• No special skill required	

EVIDENCE

Surgical extrusion as a treatment option for crown–root fracture in permanent anterior teeth: a syste

Bhaskar Das, Muruga

- Identified 2
- Periodontiu
- incidenc (Serum/blo
- Minor loss
- Periapical h
- Mobility reduced over 3-4 weeks of splinting
- No incidence of Ankylosis

Conclusion

- Surgical Extrusion viable option for CR # management for permanent anterior teeth
- Less technique sensitive, simple, swift, acceptable aesthetics and reduced reports of failure

MANAGEMENT

Intentional Replantation

- Surgical procedure involving extra-oral examination and repair, followed by re-insertion into the socket
- Differs from Surgical extrusion in that the tooth is repositioned at the original pre-operative coronal level, with or without rotation
- Permits viewing the in-accessible root areas
- When performed using Emdogain, 82.8% survival at 4 years F/U reported

Plotino G, Abella Sans F, Bastos JV, Nagendrababu V. Effectiveness of intentional replantation in managing teeth with apical periodontitis: A systematic review. Int Endod J. 2023 Oct;56(S3):499–509.

Advantages	Disadvantages
• Permits inspection of root surface	• Risk of root resorption and ankylosis
• Cost effective	• Risk of damage to socket

MANAGEMENT

Autotransplantation

- Alternative option to implants in children and adolescents
- Involves atraumatic extraction of a donor tooth and transplanting in the prepared socket of recipient site
- Indicated in a growing patient with # line extending vertically in sub-crestal region/ Multiple sub-crestal # lines/ Un-restorable tooth indicated for extraction
- PDL cells are preserved on the donor tooth enables maintain bone and induce new alveolar bone formation

Plotino G, Abella Sans F, Duggal MS, Grande NM, Krastl G, Nagendrababu V, et al. Present status and future directions: Surgical extrusion, intentional replantation and tooth autotransplantation. Int Endod J. 2022 May;55(S3):827–42.

MANAGEMENT

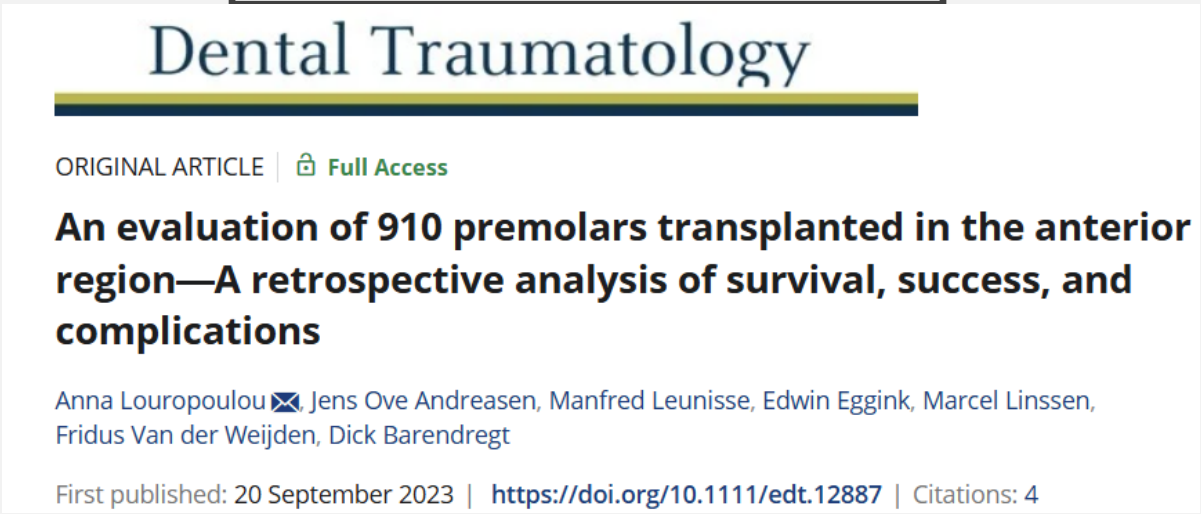
Autotransplantation

- Higher success rate in transplantation of an immature donor tooth
- To replace Central incisor – Mandibular 2nd Premolar, Canine/ Mandibular 1st Premolar
- To replace Lateral incisor – Mandibular 1st Premolar, Canine/ Mandibular 2nd Premolar
- Maxillary 1st premolar not advised (Bifid roots)
- Survival rate of >95% over 5 year follow-up (Tsukiboshi, 2019)

Advantages	Disadvantages
• Gingival aesthetics maintained	• Technique sensitive
• Pulp vitality may be maintained	• Donor tooth and recipient site incompatability

Dhillon, I.K. *et al.* (2023) 'Tooth autotransplantation with 3d-printed replicas as part of interdisciplinary management of children and adolescents: Two case reports', *Dental Traumatology*, 39(S1), pp. 81–89. doi:10.1111/edt.12837.

EVIDENCE



Dental Traumatology

ORIGINAL ARTICLE | Full Access

An evaluation of 910 premolars transplanted in the anterior region—A retrospective analysis of survival, success, and complications

Anna Louropoulou, Jens Ove Andreasen, Manfred Leunisse, Edwin Eggink, Marcel Linssen, Fridus Van der Weijden, Dick Barendregt

First published: 20 September 2023 | https://doi.org/10.1111/edt.12887 | Citations: 4

- Total of 910 premolars were transplanted in 707 patients in the anterior region
- Average age at surgery was 16 years
- Overall survival – 10 years:

  Immature premolars = 99.8%

  Mature premolars in adolescents = 100%

  Mature premolars in adults = 87.5%
- Root resorption in 2.4% and ankylosis in 1.2% of transplanted teeth

MANAGEMENT

Decoronation

- Performed to achieve root submergence and preserve the alveolar bone for future rehabilitation
- Primarily indicated for cases of dentoalveolar ankylosis
- Involves coronectomy beneath the level of the CEJ and instrumentation of the pulp canal to stimulate bleeding at the peri-apical area
- Good prognosis when performed before root completion; favourable results when performed between 10 to 12 years
- Provisic

Advantages	Disadvantages
• Alveolar bone width and height preserved	• Technique sensitive
• Minimal reported complications	• Patient acceptance minimal
	• May require additional grafting

C-R# - POINTERS

- Whenever feasible, to prescribe a Cone Beam CT in cases suspected of CR # involving sub-crestal region
- Although the surgical options appear invasive, they are relatively conservative and the long term outcomes can be favourable*
- To complete endodontic treatment within 2 weeks following surgical intervention
- To always consider the use of an intra-coronal reinforcement prior to restoration

Uncomplicated crown-root fracture (crown-root fracture without pulp exposure)	Clinical findings	Imaging, radiographic assessment, and findings	Treatment	Follow up	Favorable outcomes	Unfavorable outcomes
 A fracture involving enamel, dentin and cementum (Note: Crown-root fractures typically extend below the gingival margin)	• Pulp sensibility tests usually positive • Tender to percussion. • Coronal, or mesial or distal, fragment is usually present and mobile • The extent of the fracture (sub- or supra-alveolar) should be evaluated	• Apical extension of fracture usually not visible • Missing fragments should be accounted for: - If fragment is missing and there are soft tissue injuries, radiographs of the lip and/or cheek are indicated to search for tooth fragments or foreign debris • Recommended radiographs: - One parallel periapical radiograph - Two additional radiographs of the tooth taken with different vertical and/or horizontal angulations - Occlusal radiograph • CBCT can be considered for better visualization of the fracture path, its extent, and its relationship to the marginal bone; also, useful to evaluate the crown-root ratio and to help determine treatment options	• Until a treatment plan is finalized, temporary stabilization of the loose fragment to the adjacent tooth/teeth or to the non-mobile fragment should be attempted • If the pulp is not exposed, removal of the coronal or mobile fragment and subsequent restoration should be considered • Cover the exposed dentin with glass-ionomer or use a bonding agent and composite resin Future Treatment Options: • *The treatment plan is dependent, in part, on the patient's age and anticipated co-operation. Options include:* • Orthodontic extrusion of the apical or non-mobile fragment, followed by restoration (may also need periodontal re-contouring surgery after extrusion) • Surgical extrusion • Root canal treatment and restoration if the pulp becomes necrotic and infected • Root submergence • Intentional replantation with or without rotation of the root • Extraction • Autotransplantation	Clinical and radiographic evaluations are necessary: • after 1 wk • after 6-8 wk • after 3 mo • after 6 mo • after 1 y • then yearly for at least 5 ys	• Asymptomatic • Positive response to pulp sensibility testing • Continued root development in immature teeth • Good quality restoration	• Symptomatic • Discoloration • Pulp necrosis and infection • Apical periodontitis • Lack of further root development in immature teeth • Loss of restoration • Breakdown of the restoration • Marginal bone loss and periodontal inflammation

Complicated crown-root fracture (crown-root fracture with pulp exposure)	Clinical findings	Imaging, radiographic assessment, and findings	Treatment	Follow up	Favorable outcomes	Unfavorable outcomes
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THANK YOU!

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