

Assessing the Outcomes of Cracked Teeth

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ABSTRACT:

Pressure from teeth grinding. Fillings as large as these undermine the tooth 's integrity. Chewing and biting hard foods, like ice, or hard candies, blows to the mouth might happen with a car accident, sporting injury, fall, or even a first fight Leads to fractured teeth. A thorough literature search was performed using the database like Pubmed, Google scholar, BioRxiv, MESH, Cochran database using the keywords 'Assessment; Fracture; Teeth/Tooth; Treatment planning; Outcomes ' with no date and year restrictions. The language is restricted to English. 16 articles with similar data have been found which were analysed and have been included in this study. The recent articles discussed in this study help us in gaining further knowledge about assessment

of the outcomes of cracked teeth and also to gain knowledge about the various types of tooth fracture and treatment plannings. In conclusion, cracked teeth are an underlying symptom of poor facial and growth development. Whilst it is often assumed that facial development and cracked teeth are purely genetically determined, modern environmental influences have a role to play.

Keywords: Assessment; Fracture; Teeth/Tooth; Treatment planning; Outcomes Development.

INTRODUCTION:

Pressure given during teeth grinding, large fillings as these undermine the tooth 's integrity can cause cracks in tooth (Kim *et al.*, 2013). Chewing and biting hard food items like ice and hard candies also cause fractures. blows to the mouth might happen with a car accident, sporting injury, fall, or even a first fight Leads to fractured teeth. Dentists see tooth fractures day to day in their daily routine(Abbott and Leow, 2009). The severity and outcomes of a fracture ranges from minor which does not need any treatment to severe, resulting in root canal therapy (RCT), or even tooth loss. Cracked tooth syndrome (CTS), most common and often presents a diagnostic difficulties to the dentist and a painful, frustrating event to the patient. Cracked tooth syndrome is a term applied to a presumptive diagnosis of incomplete tooth fracture that typically presents with consistent symptoms of pain to biting and temperature stimuli, especially frozen or cold food items (Marquis *et al.*, 2006). Unfortunately, the tooth may already be destined for RCT or extraction by the time the incomplete tooth fracture becomes symptomatic. Since the results for teeth with an incomplete tooth fracture may be so severe, resulting in the need for significant reconstruction, RCT, or extraction, the creation of a crack presents a major problem for patients and dentists (Kang, Kim and Kim, 2016). There is a current need for a set of recommendations on how to avoid, diagnose and treat cracks in teeth based on evidence. The main purpose of this paper was to analyse the literature to assess the evidence of risk factors for broken teeth and their prevention, diagnosis and treatment (Jose, P. and Subbaiyan, 2020). A thorough literature search was performed using the database like Pubmed, Google scholar, BioRxiv, MESH, Cochran database using the keywords ‘Assessment; Fracture; Teeth/Tooth; Treatment planning; Outcomes ’ with no date and year restrictions. The language is restricted to English. 16 articles with similar data have been found which were analysed and have been included in this study.

Our team has rich experience in research and we have collaborated with numerous authors over various topics in the past decade (Ariga *et al.*, 2018; Basha, Ganapathy and Venugopalan, 2018; Hannah *et al.*, 2018; Hussain *et al.*, 2018; Jeevanandan and Govindaraju, 2018; Kannan and Venugopalan, 2018; Kumar and Antony, 2018; Menon *et al.*, 2018; M. P. Manohar and Sharma, 2018; Nandakumar and Nasim, 2018; Nandhini, Babu and Mohanraj, 2018; Ravinthar and Jayalakshmi, 2018a; Seppan *et al.*, 2018; Teja, Ramesh and Priya, 2018; Duraisamy *et al.*, 2019; Gheena and Ezhilarasan, 2019; Hema Shree *et al.*, 2019; Rajakeerthi and Ms, 2019; Rajendran *et al.*, 2019a; Sekar *et al.*, 2019; Sharma *et al.*, 2019; Siddique *et al.*, 2019a; Janani, Palanivelu and Sandhya, 2020a; Johnson *et al.*, 2020; Jose, Ajitha and Subbaiyan, 2020).

Cracked teeth/tooth:

In 1964, Cameron coined the word "cracked tooth syndrome" and identified it as an incomplete fracture of a critical posterior tooth that may or may not involve pulp. While a crack is often repaired, a cracked tooth will never be one hundred pc healed, unlike a broken bone (Olivieriet al., 2020). However, timely care provides the easiest chance of saving your tooth and avoiding infection and further damage, and even after treatment your mouth might also be sore, the pain may subside within a few days (Janani, Palanivelu and Sandhya, 2020b).

Etiology of teeth fracture:

Many different factors can cause changes in the structural strength of the teeth, including the structural design of cavity preparations (Kansalet al., 2014). Large mesio occlusal-distal (MOD) preparations are often an example of this which can jeopardise the integrity of the tooth by reducing the amount of remaining sound tooth structure, particularly when the tooth is exposed to excessive occlusal stress (Kumar and Delphine Priscilla Antony, 2018). The excessive depth of a MOD cavity preparation, together with lateral masticatory forces, produces internal shear and tensile stresses that invite complete or incomplete vertical root fracture (Ramesh, Teja and Priya, 2018). The risk of fracturing increases when a tooth is handled with reconstruction because of the reduced support strength of the tooth (Ravinthar and Jayalakshmi, 2018b). The further repaired surfaces, and/or the larger the isthmus, the greater the possibility of cuspal fracture. With current restorations, Bader and colleagues (2004) researched risk factors for tooth fracture and demonstrated increased RVP as a strong risk factor for full cusp fracture (relative volume proportion-size of restoration, i.e. a measure that accounts for restoration depth and area relative to tooth size). Coronal fractures have all been associated with parafunctional force trauma, excursive intervention, injury to the face or jaw, procedures such as regeneration, thermal expansion, and contraction of repair tissue. The chance of a crack being present is also increased by combinations of factors such as interference combined with reconstruction. Medical observation indicates that among bruxers, broken cusps and fractured teeth occur more often than among non-bruxers (Krell and Caplan, 2018). The role of occlusion is often cited in developing CTS and coronary fracture (Noor, S Syed Shihaab and Pradeep, 2016). The wedging effect of the cusp-fossa relationship has been due to a key variable in cuspal fractures. Recent research with current social implications have shown that oral piercings can cause tooth fractures (Teja and Ramesh, 2019).

Diagnosis of cracked teeth:

In the literature, CTS has been described as a difficult diagnostic and treatment issue (Nasim et al., 2018). In the past, the diagnosis of CTS was based solely on the symptoms of the tooth: localised chewing or biting pain, unexplained cold aversion, and pressure-releasing pain (Rajendran et al., 2019b). The diagnosis of CTS can be confirmed, in addition to the symptomatology identified by the patient, through a succession of procedures or tests conducted by the clinician. Vision enhancers, symptom reproducers, and radiographs are the most widely

used devices for diagnosing CTS (Moore *et al.*, 2016). Fiber optic light transillumination and the use of magnification can help in the visualisation of a crack. The tooth must be clean, because the light is put directly on the tooth. Under these conditions, a crack that penetrates the dentin of the tooth will cause a disturbance of light transmission. To further assist in the crack depiction, several writers recommend removing current restorations and stains until the tooth is found. Pulp percussion, biting, and thermal testing are used to replicate the patient's symptoms (R, Rajakeerthi and Ms, 2019).

A small rubber disc, burlaw wheel, or plastic wedge is positioned over each occlusal cusp to perform the bite test. The pain of the patient is measured at closure and opening, with pain at release normally suggesting a broken tooth (Yang *et al.*, 2017). Radiographs can help to determine the pulpal and periodontal health of the tooth, but a crack on a radiograph is seldom seen. In the simulated tooth structure, ultrasound is also capable of imaging cracks and may be an important diagnostic aid in the future. The literature explains all of these diagnostic procedures, but none of them are examined during a standardised clinical examination. Thus, CTS remains difficult to diagnose and a source of irritation for both the dentist and the patient.

Hairline cracks:

A tooth fracture in the hairline can be a slight crack within the tooth (Nasim and Nandakumar, 2018). It's currently a common disorder in developed nations and one of the leading causes of tooth loss. Some of the various types of cracks that can occur on your teeth are as follows. Chewing will cause movement of the bits as the outer hard tissues of the tooth are cracked, and the pulp can then become irritated. To the degree that it will not repair itself the pulp will gradually weaken. The tooth can not only hurt while chewing, it can also become vulnerable to high temperatures(Wu, Lew and Chen, 2019).

Enamel rebuilding:

If the enamel is damaged, it cannot be returned (Nasim and Nandakumar, 2018). Weakened enamel, however, is often restored by improving its mineral content to a degree. While toothpastes and mouthwashes can never "reconstruct" teeth, they contribute to the current phase of remineralization (Han, Lee and Choi, 2018).

Types of tooth fracture:

Five forms of cracks in teeth were identified by the American Association of Endodontics (Ramanathan and Solete, 2015). While it is important as a clinician to be familiar with all forms of crack as a diagnostic aid, it is also difficult to distinguish clinically between the various types of cracks. That of a craze line is the first and most benign fracture. Craze lines are fractures that are visible and contain only enamel. However it is not always possible to guarantee that a visible fracture is restricted to enamel (Olivieriet *al.*, 2020).

The broken cusp originates in the crown of the tooth, spreads into dentin, and ends in the cervical area of the fracture. Typically, they are associated with extensive restorations that cause

unsupported cusp enamel. The AAE describes a cracked tooth as a crack that without separating the two segments, apically spreads from the occlusal tooth surface (Siddique *et al.*, 2019b). A split tooth is a crack that usually extends along both marginal ridges in a mesiodistal direction, separating the tooth into two distinct sections. Vertical root fractures occur in the root and are usually complete, but they may be incomplete (Hilton *et al.*, 2013). For all classification schemes, a common issue is that they do not relate the descriptions to the clinical effects or treatment recommendations.

The fracture of the tooth was characterised by Silvestri and Singh (1978) into two main categories: fully fractured teeth and partial broken teeth. The full fracture was then subdivided into complete fractures that were obliquely directed and vertically directed. The authors proposed that as a result of extensive reconstruction that undermines a cusp, the full oblique fracture occurs more often. Under the powers of mastication or parafunctional action, the weakened cusp is then entirely sheared off. A vertically induced complete fracture is clinically characterised as two separate mobile segments of the tooth and root with regard to each other (M. Manohar and Sharma, 2018). Incomplete tooth fractures were also partitioned into two categories: oblique and vertical. An oblique crack originates in enamel on the occlusal surface, contains one or more cusps, moves in an oblique direction under cusps to dentin, and ends in enamel or cement gingivally. There is no full tooth shaving section. Incomplete vertical fractures begin in the enamel and spread to dentin, and spread to the heart in some cases (Gheret *al.*, 1987). Without complete segment separation, the crack may run in a mesiodistal direction over one or both of the marginal ridges or buccolingually among the cusps.

A more detailed system for the category was developed by Talim and Gohil (1974):

Class I. Enamel fracture: Horizontal or oblique, Vertical, Full, Incomplete.

Class II. Enamel and dentin fracture not involving pulp: Horizontal or oblique, Vertical, Complete, Incomplete.

Class III. Enamel and dentine fractures involving pulp: Horizontal, Vertical, Complete, Incomplete.

Class IV. Roots fracture: Vertical or oblique, presence of pulp, exclusion of pulp, lateral, third cervical, third middle and third apical (Bader, Shugars and Roberson, 1996).

Table 1. Crack types

CRACK TYPES	DIAGNOSIS	TREATMENT PLANNING
Craze Lines	Can be differentiated from other fractures by transillumination	No treatment is needed

Fractured Cusp	Dental dye	Removal of fractured cusp and restored with direct or cuspal reinforced restoration
Cracked tooth	Probing gums looking for inflammation	Rinse with warm water, Anti inflammatory medicines to subside the pain.
Split tooth	Pain felt biting and release of biting pressure given	Replacement of the split part of the tooth
Vertical Root fracture	CBCT or Periapical radiograph	Extraction of tooth or Endodontics surgery

Incompletely cracked teeth:

CTS is when, tooth has cracked incompletely but no part of the tooth has broken off yet. It is sometimes referred to as a greenstick fracture. The signs are very complex which makes diagnosis a notoriously difficult condition (Gutmann, 1992).

Treatment planning:

Our institution is passionate about high quality evidence based research and has excelled in various fields ((Pc, Marimuthu and Devadoss, 2018; Ramesh *et al.*, 2018; VijayashreePriyadharsini, SmilineGirija and Paramasivam, 2018; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Ramadurai *et al.*, 2019; Sridharan *et al.*, 2019; VijayashreePriyadharsini, 2019; Chandrasekar *et al.*, 2020; Mathew *et al.*, 2020; R *et al.*, 2020; Samuel, 2021)

Any type of restoration of protective cuspal coverage is included in traditional CTS treatments mentioned in the literature. The basic treatment technique proposed is to remove any previous restoration, evaluate the health of the pulp and the residual structure of the coronal tooth, and restore it with a full crown if indicated (Cameron, 1964). Until placement with the crown, any tooth with permanent pulpitis or necrotic pulp should have an RCT. Along with the Endo activator for canal irrigation, the endodontic needle was used to relieve pain (Ramamoorthi, Nivedhitha and Divyanand, 2015). Cast gold partial or complete tooth covering, fused porcelain to full metal coverage, and full porcelain coverage were used. Some authors suggest removing the existing restoration, adding a sedative filling (e.g. IRM, restorative material for zinc oxide eugenol), and cementing a stabilising orthodontic band. A repair and complete restoration of the coverage will be applied once symptoms have been healed and the tooth has been found restorable. In comparison to a full restoration of the crown, more conventional bonded

restorations have also been suggested to treat symptomatic damaged teeth (Silvestri and Singh, 1978). In-vitro load checks cover most of the tooth fracture studies. Teeth are prepared and repaired with different materials, or are not repaired, and are subject to mechanical loading prior to tooth fractures. There are also situations where extraction is the only option for treatment (Talim and Gohil, 1974). In such instances, the crack splits the tooth into two. Usually, extraction is the only solution that involves furcation when the crack is complete, deep to the bone, and when the pieces move (Eakle *et al.*, 1986).

CONCLUSION:

This review reports that cracks in teeth are standard clinical findings. Incidence studies found that mandibular molars were the most likely to have a fracture, and this occurrence was almost twice as high as that in maxillary molars, the next most commonly fractured teeth. Cracked tooth risk factors are multifactorial and can be separated into two general categories: natural causes (i.e. tooth form, age, wear patterns) (i.e. tooth preparation).

REFERENCES:

1. Abbott, P. and Leow, N. (2009) 'Predictable management of cracked teeth with reversible pulpitis', *Australian Dental Journal*, pp. 306–315. doi: 10.1111/j.1834-7819.2009.01155.x.
2. Ariga, P. *et al.* (2018) 'Determination of correlation of width of Maxillary Anterior Teeth using Extraoral and Intraoral Factors in Indian Population: A systematic review', *World journal of dentistry*, 9(1), pp. 68–75.
3. Bader, J. D., Shugars, D. A. and Roberson, T. M. (1996) 'Using crowns to prevent tooth fracture', *Community Dentistry and Oral Epidemiology*, pp. 47–51. doi: 10.1111/j.1600-0528.1996.tb00812.x.
4. Basha, F. Y. S., Ganapathy, D. and Venugopalan, S. (2018) 'Oral hygiene status among pregnant women', *Journal of advanced pharmaceutical technology & research*, 11(7), p. 3099.
5. Chandrasekar, R. *et al.* (2020) 'Development and validation of a formula for objective assessment of cervical vertebral bone age', *Progress in orthodontics*, 21(1), p. 38.
6. Duraisamy, R. *et al.* (2019) 'Compatibility of Nonoriginal Abutments With Implants: Evaluation of Microgap at the Implant-Abutment Interface, With Original and Nonoriginal Abutments', *Implant dentistry*, 28(3), pp. 289–295.
7. Eakle, W. S. *et al.* (1986) 'Fractures of posterior teeth in adults', *The Journal of the American Dental Association*, pp. 215–218. doi: 10.14219/jada.archive.1986.0344.
8. Ezhilarasan, D., Apoorva, V. S. and Ashok Vardhan, N. (2019) 'Syzygiumcumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells', *Journal of oral pathology & medicine: official publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology*, 48(2), pp. 115–121.

9. Gheena, S. and Ezhilarasan, D. (2019) 'Syringic acid triggers reactive oxygen species-mediated cytotoxicity in HepG2 cells', *Human & experimental toxicology*, 38(6), pp. 694–702.
10. Gher, M. E. *et al.* (1987) 'Clinical survey of fractured teeth', *The Journal of the American Dental Association*, pp. 174–177. doi: 10.14219/jada.archive.1987.0006.
11. Gutmann, J. L. (1992) *Problem Solving in Endodontics: Prevention, Identification, and Management*. Mosby Elsevier Health Science.
12. Hannah, R. *et al.* (2018) 'Awareness about the use, ethics and scope of dental photography among undergraduate dental students dentist behind the lens', *Journal of advanced pharmaceutical technology & research*, 11(3), p. 1012.
13. Han, S. Y., Lee, J. and Choi, S. Y. (2018) 'Anterior esthetic restoration accompanied by gingivectomy of patient with unesthetic tooth proportion of maxillary anterior teeth: a case report', *Journal of Dental Rehabilitation and Applied Science*, pp. 208–217. doi: 10.14368/jdras.2018.34.3.208.
14. Hema Shree, K. *et al.* (2019) 'Saliva as a Diagnostic Tool in Oral Squamous Cell Carcinoma - a Systematic Review with Meta Analysis', *Pathology oncology research: POR*, 25(2), pp. 447–453.
15. Hilton, T. J. *et al.* (2013) 'Comparison of CaOH with MTA for Direct Pulp Capping', *Journal of Dental Research*, pp. S16–S22. doi: 10.1177/0022034513484336.
16. Hussainy, S. N. *et al.* (2018) 'Clinical performance of resin-modified glass ionomer cement, flowable composite, and polyacid-modified resin composite in noncarious cervical lesions: One-year follow-up', *Journal of conservative dentistry: JCD*, 21(5), pp. 510–515.
17. Janani, K., Palanivelu, A. and Sandhya, R. (2020a) 'Diagnostic accuracy of dental pulse oximeter with customized sensor holder, thermal test and electric pulp test for the evaluation of pulp vitality: an in vivo study', *Brazilian dental science*, 23(1). doi: 10.14295/bds.2020.v23i1.1805.
18. Janani, K., Palanivelu, A. and Sandhya, R. (2020b) 'Diagnostic accuracy of dental pulse oximeter with customized sensor holder, thermal test and electric pulp test for the evaluation of pulp vitality - An in vivo study', *Brazilian Dental Science*. doi: 10.14295/bds.2020.v23i1.1805.
19. Jeevanandan, G. and Govindaraju, L. (2018) 'Clinical comparison of Kedo-S paediatric rotary files vs manual instrumentation for root canal preparation in primary molars: a double blinded randomised clinical trial', *European archives of paediatric dentistry: official journal of the European Academy of Paediatric Dentistry*, 19(4), pp. 273–278.
20. Johnson, J. *et al.* (2020) 'Computational identification of MiRNA-7110 from pulmonary arterial hypertension (PAH) ESTs: a new microRNA that links diabetes and PAH', *Hypertension research: official journal of the Japanese Society of Hypertension*, 43(4), pp. 360–362.
21. Jose, J., Ajitha and Subbaiyan, H. (2020) 'Different treatment modalities followed by

- dental practitioners for Ellis class 2 fracture – A questionnaire-based survey’, *The open dentistry journal*, 14(1), pp. 59–65.
22. Jose, J., P., A. and Subbaiyan, H. (2020) ‘Different Treatment Modalities followed by Dental Practitioners for Ellis Class 2 Fracture – A Questionnaire-based Survey’, *The Open Dentistry Journal*, pp. 59–65. doi: 10.2174/1874210602014010059.
 23. Kang, S. H., Kim, B. S. and Kim, Y. (2016) ‘Cracked Teeth: Distribution, Characteristics, and Survival after Root Canal Treatment’, *Journal of Endodontics*, pp. 557–562. doi: 10.1016/j.joen.2016.01.014.
 24. Kannan, A. and Venugopalan, S. (2018) ‘A systematic review on the effect of use of impregnated retraction cords on gingiva’, *Journal of advanced pharmaceutical technology & research*, 11(5), p. 2121.
 25. Kansal, R. *et al.* (2014) ‘Assessment of Dentinal Damage during Canal Preparation Using Reciprocating and Rotary Files’, *Journal of Endodontics*, pp. 1443–1446. doi: 10.1016/j.joen.2014.02.015.
 26. Kim, S.-Y. *et al.* (2013) ‘Different Treatment Protocols for Different Pulpal and Periapical Diagnoses of 72 Cracked Teeth’, *Journal of Endodontics*, pp. 449–452. doi: 10.1016/j.joen.2012.11.052.
 27. Krell, K. V. and Caplan, D. J. (2018) ‘12-month Success of Cracked Teeth Treated with Orthograde Root Canal Treatment’, *Journal of endodontia*, 44(4), pp. 543–548.
 28. Kumar, D. and Antony, S. D. P. (2018) ‘Calcified canal and negotiation-A review’, *Journal of advanced pharmaceutical technology & research*, 11(8), p. 3727.
 29. Kumar, D. and Delphine Priscilla Antony, S. (2018) ‘Calcified Canal and Negotiation-A Review’, *Research Journal of Pharmacy and Technology*, p. 3727. doi: 10.5958/0974-360x.2018.00683.2.
 30. Manohar, M. P. and Sharma, S. (2018) ‘A survey of the knowledge, attitude, and awareness about the principal choice of intracanal medicaments among the general dental practitioners and nonendodontic specialists’, *Indian journal of dental research: official publication of Indian Society for Dental Research*, 29(6), pp. 716–720.
 31. Manohar, M. and Sharma, S. (2018) ‘A survey of the knowledge, attitude, and awareness about the principal choice of intracanal medicaments among the general dental practitioners and nonendodontic specialists’, *Indian Journal of Dental Research*, p. 716. doi: 10.4103/ijdr.ijdr_716_16.
 32. Marquis, V. L. *et al.* (2006) ‘Treatment outcome in endodontics: the Toronto Study. Phase III: initial treatment’, *Journal of endodontia*, 32(4), pp. 299–306.
 33. Mathew, M. G. *et al.* (2020) ‘Evaluation of adhesion of Streptococcus mutans, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: Randomized controlled trial’, *Clinical oral investigations*, pp. 1–6.
 34. Menon, S. *et al.* (2018) ‘Selenium nanoparticles: A potent chemotherapeutic agent and an elucidation of its mechanism’, *Colloids and surfaces. B, Biointerfaces*, 170, pp. 280–292.

35. Moore, B. *et al.* (2016) 'Impacts of Contracted Endodontic Cavities on Instrumentation Efficacy and Biomechanical Responses in Maxillary Molars', *Journal of endodontia*, 42(12), pp. 1779–1783.
36. Nandakumar, M. and Nasim, I. (2018) 'Comparative evaluation of grape seed and cranberry extracts in preventing enamel erosion: An optical emission spectrometric analysis', *Journal of conservative dentistry: JCD*, 21(5), pp. 516–520.
37. Nandhini, J. S. T., Babu, K. Y. and Mohanraj, K. G. (2018) 'Size, shape, prominence and localization of gerdy's tubercle in dry human tibial bones', *Journal of advanced pharmaceutical technology & research*, 11(8), p. 3604.
38. Nasim, I. *et al.* (2018) 'Clinical performance of resin-modified glass ionomer cement, flowable composite, and polyacid-modified resin composite in noncarious cervical lesions: One-year follow-up', *Journal of Conservative Dentistry*, p. 510. doi: 10.4103/jcd.jcd_51_18.
39. Nasim, I. and Nandakumar, M. (2018) 'Comparative evaluation of grape seed and cranberry extracts in preventing enamel erosion: An optical emission spectrometric analysis', *Journal of Conservative Dentistry*, p. 516. doi: 10.4103/jcd.jcd_110_18.
40. Noor, S. S. S. E., S Syed Shihaab and Pradeep (2016) 'Chlorhexidine: Its properties and effects', *Research Journal of Pharmacy and Technology*, p. 1755. doi: 10.5958/0974-360x.2016.00353.x.
41. Olivieri, J. G. *et al.* (2020) 'Outcome and Survival of Endodontically Treated Cracked Posterior Permanent Teeth: A Systematic Review and Meta-analysis', *Journal of endodontia*, 46(4), pp. 455–463.
42. Pc, J., Marimuthu, T. and Devadoss, P. (2018) 'Prevalence and measurement of anterior loop of the mandibular canal using CBCT: A cross sectional study', *Clinical implant dentistry and related research*. Available at: <https://europepmc.org/article/med/29624863>.
43. Rajakeerthi and Ms, N. (2019) 'Natural Product as the Storage medium for an avulsed tooth – A Systematic Review', *Cumhuriyet Üniversitesi Diş Hekimliği Fakültesi Dergisi*, 22(2), pp. 249–256.
44. Rajendran, R. *et al.* (2019a) 'Comparative evaluation of remineralizing potential of a paste containing bioactive glass and a topical cream containing casein phosphopeptide-amorphous calcium phosphate: An in vitro study', *Pesquisabrasileira em Odontopediatria e Clínica Integrada*, 19(1), pp. 1–10.
45. Rajendran, R. *et al.* (2019b) 'Comparative Evaluation of Remineralizing Potential of a Paste Containing Bioactive Glass and a Topical Cream Containing Casein Phosphopeptide-Amorphous Calcium Phosphate: An in Vitro Study', *Pesquisa Brasileira em Odontopediatria e Clínica Integrada*, pp. 1–10. doi: 10.4034/pboci.2019.191.61.
46. Ramadurai, N. *et al.* (2019) 'Effectiveness of 2% Articaine as an anesthetic agent in children: randomized controlled trial', *Clinical oral investigations*, 23(9), pp. 3543–3550.

47. Ramamoorthi, S., Nivedhitha, M. S. and Divyanand, M. J. (2015) 'Comparative evaluation of postoperative pain after using endodontic needle and EndoActivator during root canal irrigation: A randomised controlled trial', *Australian endodontic journal: the journal of the Australian Society of Endodontology Inc*, 41(2), pp. 78–87.
48. Ramanathan, S. and Solete, P. (2015) 'Cone-beam Computed Tomography Evaluation of Root Canal Preparation using Various Rotary Instruments: An in vitro Study', *The Journal of Contemporary Dental Practice*, pp. 869–872. doi: 10.5005/jp-journals-10024-1773.
49. Ramesh, A. *et al.* (2018) 'Comparative estimation of sulfiredoxin levels between chronic periodontitis and healthy patients - A case-control study', *Journal of periodontology*, 89(10), pp. 1241–1248.
50. Ramesh, S., Teja, K. and Priya, V. (2018) 'Regulation of matrix metalloproteinase-3 gene expression in inflammation: A molecular study', *Journal of Conservative Dentistry*, p. 592. doi: 10.4103/jcd.jcd_154_18.
51. Ravinthar, K. and Jayalakshmi (2018a) 'Recent advancements in laminates and veneers in dentistry', *Journal of advanced pharmaceutical technology & research*, 11(2), p. 785.
52. Ravinthar, K. and Jayalakshmi (2018b) 'Recent Advancements in Laminates and Veneers in Dentistry', *Research Journal of Pharmacy and Technology*, p. 785. doi: 10.5958/0974-360x.2018.00148.8.
53. R, H. *et al.* (2020) 'CYP2 C9 polymorphism among patients with oral squamous cell carcinoma and its role in altering the metabolism of benzo[a]pyrene', *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*, pp. 306–312. doi: 10.1016/j.oooo.2020.06.021.
54. R, R., Rajakeerthi, R. and Ms, N. (2019) 'Natural Product as the Storage medium for an avulsed tooth – A Systematic Review', *Cumhuriyet Dental Journal*, pp. 249–256. doi: 10.7126/cumudj.525182.
55. Samuel, S. R. (2021) 'Can 5-year-olds sensibly self-report the impact of developmental enamel defects on their quality of life?', *International journal of paediatric dentistry / the British Paedodontic Society [and] the International Association of Dentistry for Children*, 31(2), pp. 285–286.
56. El Ghoch, M., Valerio, A. *Let food be the medicine, but not for coronavirus: Nutrition and food science, telling myths from facts* 2020) *Journal of Population Therapeutics and Clinical Pharmacology*, 27 (SP1), pp. e1-e4.
57. Seppan, P. *et al.* (2018) 'Therapeutic potential of *Mucuna pruriens* (Linn.) on ageing induced damage in dorsal nerve of the penis and its implication on erectile function: an experimental study using albino rats', *The aging male: the official journal of the International Society for the Study of the Aging Male*, pp. 1–14.
58. Sharma, P. *et al.* (2019) 'Emerging trends in the novel drug delivery approaches for the treatment of lung cancer', *Chemico-biological interactions*, 309, p. 108720.
59. Siddique, R. *et al.* (2019a) 'Qualitative and quantitative analysis of precipitate formation

- following interaction of chlorhexidine with sodium hypochlorite, neem, and tulsi', *Journal of conservative dentistry: JCD*, 22(1), pp. 40–47.
60. Siddique, R. *et al.* (2019b) 'Qualitative and quantitative analysis of precipitate formation following interaction of chlorhexidine with sodium hypochlorite, neem, and tulsi', *Journal of conservative dentistry: JCD*, 22(1), pp. 40–47.
61. Sridharan, G. *et al.* (2019) 'Evaluation of salivary metabolomics in oral leukoplakia and oral squamous cell carcinoma', *Journal of oral pathology & medicine: official publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology*, 48(4), pp. 299–306.
62. Teja, K. V. and Ramesh, S. (2019) 'Shape optimal and clean more', *Saudi Endodontic Journal*. Available at: <http://www.saudiendodj.com/article.asp?issn=1658-5984;year=2019;volume=9;issue=3;spage=235;epage=236;aulast=Teja>.
63. Teja, K. V., Ramesh, S. and Priya, V. (2018) 'Regulation of matrix metalloproteinase-3 gene expression in inflammation: A molecular study', *Journal of conservative dentistry: JCD*, 21(6), pp. 592–596.
64. VijayashreePriyadharsini, J. (2019) 'In silico validation of the non-antibiotic drugs acetaminophen and ibuprofen as antibacterial agents against red complex pathogens', *Journal of periodontology*, 90(12), pp. 1441–1448.
65. VijayashreePriyadharsini, J., SmilineGirija, A. S. and Paramasivam, A. (2018) 'In silico analysis of virulence genes in an emerging dental pathogen *A. baumannii* and related species', *Archives of oral biology*, 94, pp. 93–98.
66. Wu, S., Lew, H. P. and Chen, N. N. (2019) 'Incidence of Pulpal Complications after Diagnosis of Vital Cracked Teeth', *Journal of endodontia*, 45(5), pp. 521–525.
67. Yang, S.-E. *et al.* (2017) 'Analysis of the characteristics of cracked teeth and evaluation of pulp status according to periodontal probing depth', *BMC oral health*, 17(1), p. 135.