

A 22-year-old male with pain and tooth surface loss on multiple teeth

Sageer Ahmed, Shegufta Tabassum, Mozammal Hossain, Md. Mujibur Rahman Howlader, Md. Joynal Abdin and Md. Shamsul Alam

Article Info

Department of Conservative Dentistry and Endodontics, Faculty of Dentistry, Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka, Bangladesh

For Correspondence:

Mozammal Hossain
mozammalresearch@gmail.com

Received: 8 February 2019
Accepted: 28 February 2019
Available Online: 15 March 2019

ISSN: 2224-7750 (Online)
2074-2908 (Print)

DOI: 10.3329/bsmmuj.v12i1.40165

Keywords: Caries; Molar tooth; Pain; Periodontitis; Resorption

Cite this article:

Ahmed S, Tabassum S, Hossain M, Howlader MMR, Abdin MJ, Alam MS. A 22-year-old male with pain and tooth surface loss on multiple teeth. Bangabandhu Sheikh Mujib Med Univ J. 2019; 12: 39-44.

Copyright:

The copyright of this article is retained by the author(s) [Attribution CC-BY 4.0]

Available at:

www.banglajol.info

A Journal of Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

Presentation of Case

Dr. Sageer Ahmed (MS Resident): A 22-year-old male reported to the outpatient department with the complaints of occasional pain and tingling sensation on his maxillary left posterior teeth and mandibular anterior teeth for 3 to 4 months with slight mobility of mandibular anterior teeth. He had no significant medical history as well as no history of trauma and familial history of similar disease. He also stated that he went to Dhaka Dental College where he received clinical and radiological investigations and diagnosed as a case of external tooth resorption. In the Dhaka Dental College, upper left 1st and 2nd premolar, mandibular right central and lateral incisor teeth were extracted. Root canal treatment was started on the maxillary left central and lateral incisor, canine and 1st molar teeth and in the lower jaw, right canine and left central incisor teeth were subjected to root canal treatment. As the patient's chief complain did not subside, he was referred to our outpatient department. On clinical observation, the periodontal condition was found fairly well with control of the dental plaque and the teeth looked normal in appearance. There was no sinus tract but the affected teeth were slightly tender to percussion and vital to pulp vitality test.

Dr. Kashfia Ahmed Keya (Medical Officer): Different medical test such as complete blood count, fasting blood glucose, serum inorganic phosphate, calcium, parathyroid hormone, HBsAg, AntiHCB, serum total bilirubin, serum alanine transaminase, serum alkaline phosphatase, serum acid phosphatase, serum creatinine, serum urea, T₃, T₄ and vitamin D were performed (Table I). It was found that all the findings were within the normal physiological range. However, parathyroid hormone was in the border line of upper limit (65.1 pg/mL) and vitamin D level was 17.8 ng/mL, which was slightly below the normal range and the patient was advised to receive vitamin D supplement.

Radiological Findings

Dr. Mozammal Hossain (Associate Professor): The intraoral periapical and orthopantogram radio-

graph revealed that the cervical radiolucency was seen on the cervical areas of upper left central and lateral incisor, canine, and 1st molar tooth. In the lower jaw, the affected teeth were right canine and left central incisor teeth. The lamina dura was intact and the width of periodontal ligament was also intact (Figure 1).

Histological Findings

Dr. Asaduzzaman Misha (Dental Pathologist): Histological examination was performed on the extracted upper left third molar tooth as it was also affected later on and it disclosed the presence of multinucleated giant osteoclast-like cells and infiltration of chronic inflammatory cells in the resorptive tissue.

Treatment Procedure

Dr. Shegufta Tabassum (FCPS Trainee): Following discussion with the patient, surgical exposure, debridement and restoration of defects by mineral trioxide aggregate along with endodontic treatment were planned. After preparation of the access cavity, a temporary barrier was made at the resorption sites by glass ionomer cement for the purpose of isolation. Root canal treatment was performed on the upper left central and lateral incisors, canine, first molar and lower right canine and left central incisor tooth according to the conventional method. As the tooth become symptomless, the labial flap was then reflected to expose the lesion. The lesion was then dry and leathery in texture with no bleeding present. It had a honeycomb-like appearance. The lesion was debrided first with spoon excavator and then slow speed hand piece with carbide round bur. The bleeding in the operative field was controlled by the pressure of moisten cotton pack and irrigated with normal saline. The cavities were then restored with mineral trioxide aggregate (Pro-root, Dentsply, USA). Mineral trioxide aggregate was mixed according to the manufacturer's instruction and it was then placed at the resorption site using a carrier and condensed with a moistened cotton pellet. A radiograph was taken to check proper place-



Table I

Laboratory findings

Test	Result	Reference value
Vitamin D (ng/mL)	17.8	20-25
Fasting blood glucose (mmol/L)	5.3	3.5-6.0
Serum inorganic phosphate (mg/dL)	3.1	2.3-4.7
Calcium (mg/dL)	9.7	8.5-10.5
Parathyroid hormone (pg/mL)	65.1	10-65
Serum total bilirubin (mg/dL)	0.7	0.2-1.2
Alanine transaminase (IU/L)	53	30-65
Serum creatinine (mg/dL)	0.7	0.6-1.3
Blood urea (mg/dL)	14.6	15-45
TSH (μ IU/mL)	2.5	0.4-6.1
T ₃ (ng/mL)	1.7	0.7-2.2
T ₄ (ng/mL)	1.0	0.8-1.8
Serum alkaline phosphatase (IU/L)	78	40-129
Serum acid phosphatase (IU/L)	4.9	<5.4
HBsAg	Negative	---
Anti-HCV	Negative	---

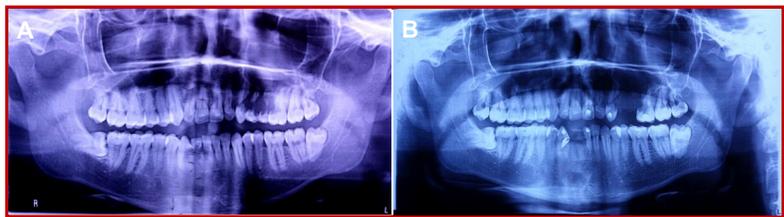


Figure 1: A) The orthopantomograph revealed cervical radiolucent lesion on upper left central and lateral incisors, canine, 1st and 2nd premolar, 1st molar tooth. In the lower jaw, the affected teeth are right central, lateral incisors and left central incisor, The lamina dura was intact and width of PDL was intact; B) The orthopantomograph following extraction of affected tooth i.e. upper left 1st and 2nd premolar and lower right central and lateral incisor



Figure 2: Photograph showing the intact external surfaces of teeth with fairly healthy gingival tissue

ment. After 10 min when the initial setting of mineral trioxide aggregate was completed, the flap was sutured back with 3-0 black silk suture. The patient was called for the removal of stitch and evaluation after 1 week. Finally, the patient was advised to come for follow-up visit at 3, 6, 9, 12 months, yearly and throughout the life.

Provisional Diagnosis

External tooth resorption

Differential Diagnosis

Aggressive periodontitis

Dr. Md. Joynal Abdin (Assistant Professor): In case of

aggressive periodontitis, there is rapid destruction of the clinical periodontal attachment and the bone as well as surrounding tissues of the affected teeth.¹⁻² Furthermore, it can occur localized or generalized based on patient health condition especially due to selective immune dysfunction.³⁻⁴ Patient with aggressive periodontitis usually presents with chronic inflammation of gingival tissue and deep periodontal pockets with or without bacterial plaques and complaints of deep dull pain during mastication. In the radiograph, vertical loss of alveolar bone in multiple teeth is evident.⁵ Microbial activities and systemic disease may also associate with aggressive periodontitis.⁶⁻⁸

External inflammatory root resorption

Dr. Md. Mujibur Rahman Howlader (Associate Professor): In the histological examination, external inflammatory root resorption is characterized by resorption gaps in the cementum and dentin.⁹⁻¹⁰ It usually occurs due to infection, occlusal trauma or systemic factors as well as a sequel of orthodontic tooth movement.¹¹⁻¹² Multinucleated osteoclast-like giant cell activity can also be the source of root and cervical resorption of the tooth which is evident in histopathological examination of this case.

Cervical caries

Dr. Abdin: Cervical carious lesions are smooth surface lesions which morphology and extent are similar to carious smooth surface lesions of the tooth. The lesions may present with variable morphology and therefore not detected in the routine clinical examination but could be detected in routine radiograph. Among the etiological factors, high sugar diet, poor oral hygiene, xerostomia and orthodontic brackets are common. On clinical examinations, gingival recession and exposed root surfaces may be found.¹³⁻¹⁴ A saucer-like appearance on the roots of the affected teeth that involves cementum could be recognized by radiological examination. It is also common among the elderly patient.¹⁵

Osteoporosis

Dr. Howlader: Osteoporosis is a complex and multifactorial chronic disease. It can progress silently until fracture of tooth and bone appears late in life.¹⁵⁻¹⁶ It is associated with demineralization of bones as well as deformities and bone fracture. The patient usually complains of pain. Previous studies have indicated that the rate of loss of bone minerals is twice higher in women than in men due to lack of estrogen in women in post-menopausal period.¹⁷⁻¹⁹ A significant correlation between periodontitis and osteoporosis have been reported in female.²⁰ A possible correlation between systemic osteoporosis and alveolar bone loss in periodontal disease is also reported by some of the previous studies.²¹⁻²²

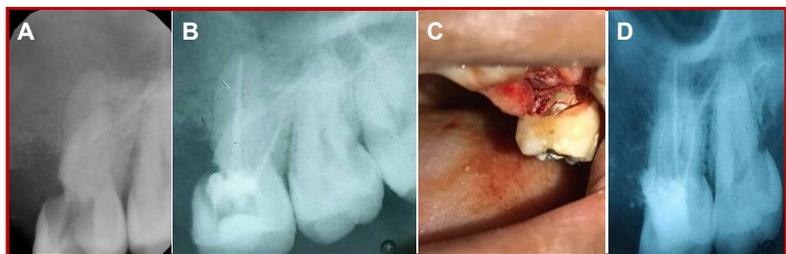


Figure 3: Pre-operative radiograph showing external cervical resorption on the mesial side of maxillary first molar tooth (A), obturation after completion of root canal treatment (B), exposure of resorption defect after reflection of flap (C), radiograph showing repair of resorption defect with mineral trioxide aggregate (D)

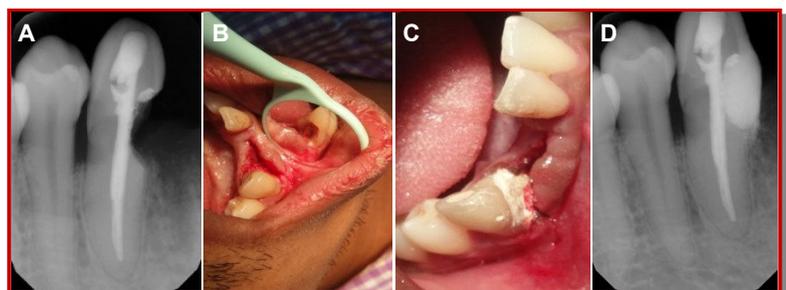


Figure 4: Pre-operative radiograph showing external cervical resorption on the mesial side mandibular right canine (A), exposure of resorption defect after reflection of flap (B), repair of resorption defect with mineral trioxide aggregate (C), radiograph after repair of resorption defect (D)

Clinical Diagnosis

Cervical tooth resorption

Dr. Ahmed's Diagnosis

External tooth resorption

Discussion

Dr. Ahmed: Multiple external resorption of permanent teeth is not common. A study indicated that maxillary teeth were more commonly involved than the mandibular teeth.²³ This is also similar to the present case.

Radiographic discussion

Dr. Hossain: Investigation of cervical external resorption is difficult by conventional radiography. In the present case, intraoral radiograph, Orthopantomogram and histological examinations were performed for diagnosis. It is possible to use other techniques such as X-ray microfocus computed tomography for further analysis.²⁴⁻²⁵

Discussion on treatment options

Dr. Tabassum: There are several options prescribed

by some of the previous studies that include:

a) The resorptive defects could be restored with an "open sandwich" technique where the dentin is conditioned with 10% polyacrylic acid for 15 sec and then a resin-modified glass ionomer cement is used to restore the majority of the preparation. The remaining of tooth structure (above the crest of alveolar bone) is restored with a bonded com-posite resin.²⁶⁻²⁷ The problem in this procedure is the difficulty to achieve isolation i.e. moisture control.

b) Debridement of the resorptive lesion.²⁸ In this technique, the lesion is accessed, whether internally or externally, and debrided with a carbide round bur in a slow-speed handpiece. The dentin is then scrubbed for 1 min with 90% aqueous trichloroacetic acid on a cotton ball.²⁸ However, trichloroacetic acid cauterizes the residual resorptive tissue. If any of the invading resorptive tissue remains viable, the resorptive process is likely to continue. The trichloroacetic acid is also harmful to the gingival tissue if it comes in contact with the tissues. Furthermore, dentin that has been treated with trichloroacetic acid is severely demineralized and is not suitable for bonding with either dentin-bonding agents or glass ionomer materials.

c) Dental implants following the extraction of symptomatic teeth with idiopathic resorption.²⁹ However, placing implants in alveolar bone require adequate bony supports. In such patient, there may be involvement of alveolar bone which will finally lead to the loss of bony supports and failure of the implant.

d) Repair with biodentin.³⁰⁻³¹ It has been proposed as a favorable repair material as it can be placed in permanent and close contact with periodontal tissue due to its bioactivity and biocompatibility.

e) Periodontal flap reflection, curettage, restoration of the defect either with mineral trioxide aggregate, amalgam, composite resin, or glass ionomer cement, and repositioning the flap to its original position is also another treatment option for treatment of cervical resorption.³² However, periodontal reattachment cannot be expected with amalgam or composite resin and is unlikely with glass ionomer cement but there is experimental evidence to suggest that this might be possible if mineral trioxide aggregate is used in this situation. Therefore, in the present study, mineral trioxide aggregate was used to repair the resorption area.

Repair with mineral trioxide aggregate

Dr. Ahmed: Mineral trioxide aggregate was chosen as the filling material for its biocompatibility and for its sealing ability even in presence of moisture. In previous studies, mineral trioxide aggregate was successfully used to repair communication between the pulp canal space and the periodontal tissue that occurs in cases of root perforation in dogs and

humans.³³⁻³⁵ Mineral trioxide aggregate is extensively used to seal the resorption and perforation defects in these studies.

Discussion on the location of defects

Dr. Ahmed: The use of chemical agents, such as trichloroacetic acid also eliminates resorbing cells, which penetrate into the deeper parts of the defect and enhance the visualization of the defect.²⁸ CBCT has a good role in three-dimensional evaluation of resorption defects.³⁶ Inflammatory cervical resorption occurs immediately below the epithelial attachment of the tooth. As a result, it must be noticed that the location is not always cervical but related to the level of the marginal tissues and the pocket depth.

Role of vitamin D on tooth resorption

Dr. Abdin: During development of enamel, vitamin D plays an important role by increasing the absorption of the calcium and phosphate from foods.³⁷⁻³⁸ Therefore, in the case of vitamin D deficiency, enamel hypoplasia and dental caries is a prominent feature of tooth loss because it does not mineralize sufficiently and there is an increase of cavities of the tooth.³⁹⁻⁴⁰ Furthermore, in the absence of sufficient vitamin D, the bone that forms in the jaw or skull isn't sufficiently mineralized so there is also the rapid progression of periodontal disease.⁴¹⁻⁴²

Comparison with previous studies

Dr. Hossain: A previous study indicated that localized invasive cervical lesions (class 1 or 2) could be successfully treated with mechanical and chemical debridement of the resorptive lesion followed by restoration. For the moderate-size lesions (class 3), the success rate was 77.8%. However, in the case of the extensive class 4 lesions, 12.5% success rate was found.²⁸ This condition is explained as extracanal invasive resorption or external cervical resorption. It could be assumed that at least one to two year follow up is necessary for the case.

Follow-up

Dr. Ahmed: After 3 months follow-up, it was found three more teeth were affected and after 6 month follow-up, it was found no further involvement of other teeth was seen. The patient is still on observation. So, the prognosis is doubtful.

Dr. Govind Kumar Chaudhary (MS Resident): Why do you choose the mineral trioxide aggregate for this case?

Dr. Ahmed: In this case, control of moisture was the main hindrance for the placement of restorative material, mineral trioxide aggregate is, however, not affected by moisture or blood contamination as it is hydrophilic in nature. Other advantages of this

material include high biocompatibility, radio-opacity, highly alkaline pH, bacteriostatic, excellent sealing ability, regeneration of hard tissue structures and low solubility.³³⁻³⁵

Dr. Md. Asaduzzaman (MS Resident): What is the prognosis of this case?

Dr. Ahmed: Teeth with inflammatory cervical resorption are often structurally compromised and may eventually fail even though the endodontic treatment is successful. The endodontic treatment is irrelevant if the resorption is not eliminated, and the restorative aspects are not managed properly. Long-term follow-up is needed to evaluate this case. After 3 months follow-up, it was found three more teeth were affected and after 6 month follow-up, it was found no further involvement of other teeth was seen. The patient is still on observation. So, prognosis is doubtful.

Dr. Tahmida Haque (MS Resident): What may be the other causes of such resorption?

Dr. Howlader: Orthodontic tooth movement, trauma, periapical or periodontal inflammation in post-endodontic complications, tumors, cysts, occlusal stress, impacted and supernumerary teeth, transplantation and re-implantation of the tooth are among the local causes that could lead to pathological root resorption.⁴³⁻⁴⁴ Postendodontic tooth resorption (internal) may be associated with the uses of calcium hydroxide-based root canal sealers. Endocrine imbalances, Paget's disease of the bone, renal and hepatic disease have been reported as systemic causes of pathological root resorption.⁴⁵⁻⁴⁶ In addition, enlarged prostate prostatic hyperplasia and prostatic carcinoma have also been reported as one of the systemic reason of tooth resorption.⁴⁷⁻⁴⁸

Final Diagnosis

Idiopathic invasive cervical resorption

References

1. Mass E, Hershkovitz F, Zilberman U. Localised aggressive periodontitis in a 3-year-old-boy. Eur Arch Paediatr Dent. 2018; 19: 61-63.
2. Miller K, Treloar T, Guelmann M, Rody WJ Jr, Shaddox LM. Clinical characteristics of localized aggressive periodontitis in primary dentition. J Clin Pediatr Dent. 2018; 42: 95-102.
3. Petit C, Huck O, Amar S, Tenenbaum H. Management of localized aggressive periodontitis: A 30-year follow-up. Quintessence Int. 2018; 49: 615-24.
4. Hamad C, Haller B, Hoffmann T, Lorenz K. Five-year results of nonsurgical treatment to manage

- severe generalized aggressive periodontitis. *Quintessence Int.* 2018; 20: 2-11.
5. Nibali L, Tomlins P, Akcalı A. Radiographic morphology of intrabony defects in the first molars of patients with localized aggressive periodontitis: Comparison with health and chronic periodontitis. *J Periodontol Res.* 2018; 53: 582-88.
 6. Rafiei M, Kiani F, Sayehmiri F, Sayehmiri K, Sheikhi A, Zamanian Azodi M. Study of *Porphyromonas gingivalis* in periodontal diseases: A systematic review and meta-analysis. *Med J Islam Repub Iran.* 2017; 31: 62.
 7. Chen HW, Zhou W, Liao Y, Hu SC, Chen TL, Song ZC. Analysis of metabolic profiles of generalized aggressive periodontitis. *J Periodontol Res.* 2018; 53: 894-901.
 8. Khocht A, Albandar JM. Aggressive forms of periodontitis secondary to systemic disorders. *Periodontol 2000.* 2014; 65: 134-48.
 9. Machado R, Leoni GB, Yarid P, Cruz-Filho AM, Sousa-Neto MD. Idiopathic external apical root resorption: Clinical report of 2 cases. *Gen Dent.* 2017; 65: 62-65.
 10. Vilela RG, Gjerde K, Frigo L, Leal Junior EC, Lopes-Martins RA, Kleine BM, Prokopowitsch I. Histomorphometric analysis of inflammatory response and necrosis in re-implanted central incisor of rats treated with low-level laser therapy. *Lasers Med Sci.* 2012; 27: pp 551-57.
 11. Diouf JS, Benoist FL, Benoist HM. External inflammatory root resorption associated with a traumatic occlusion. *J Clin Orthod.* 2015; 49: 195-200.
 12. Abbott PV. Prevention and management of external inflammatory resorption following trauma to teeth. *Aust Dent J.* 2016; 61: 82-94.
 13. Renvert S, Persson GR. Treatment of periodontal disease in older adult. *Periodontol 2000.* 2016; 72: 108-19.
 14. Chan DC, Adkins J. Technique on restoring subgingival cervical lesion. *Oper Dent.* 2004; 29: 350-53.
 15. Lu Y, Zhao F, Ren X, Li Z, Yang X, Han J. A rare case of osteogenesis imperfecta combined with complete tooth loss. *J Pediatr Endocrinol Metab.* 2014; 27: 143-47.
 16. Anil S, Preethanath RS, AlMoharib HS, Kamath KP, Anand PS. Impact of osteoporosis and its treatment on oral health. *Am J Med Sci.* 2013; 346: 396-401.
 17. Martínez-Maestre MA, Machuca G, González-Cejudo C, Flores JR, Cardoso RT, Castelo-Branco C. Osteoporosis, fragility fracture, and periodontal disease: A cross-sectional study in Spanish postmenopausal women. *Menopause* 2013; 20: 79-84.
 18. Compston J, Cooper A, Cooper C, Francis R, Kanis JA, Marsh D, McCloskey EV, Reid DM, Selby P, Wilkins M. Guidelines for the diagnosis and management of osteoporosis in postmenopausal women and men from the age of 50 years in the UK. *Maturitas* 2009; 62: 105-08.
 19. Goyal L, Goyal T, Gupta ND. Osteoporosis and periodontitis in postmenopausal women: A systematic review *J Midlife Health.* 2017; 8: 151-58.
 20. Choi JK, Kim YT, Kweon HI, Park EC, Choi SH, Lee JH. Effect of periodontitis on the development of osteoporosis: Results from a nationwide population-based cohort study (2003-2013). *BMC Womens Health.* 2017; 17: 77.
 21. de Souza JG, Neto AR, Filho GS, Dalago HR, de Souza Júnior JM, Bianchini MA. Impact of local and systemic factors on additional peri-implant bone loss. *Quintessence Int.* 2013; 44: 415-24.
 22. Jeffcoat M. The association between osteoporosis and oral bone loss. *J Periodontol.* 2005; 76: 2125-32.
 23. Soni NN, La Velle WE. Idiopathic root resorption: Report of a case. *Oral Surg Oral Med Oral Pathol.* 1970; 29: 387-89.
 24. Liu Z, Yan C, Kang C, Zhang B, Li Y. Distributional variations in trabecular architecture of the mandibular bone: An *in vivo* micro-CT analysis in rats. *PLoS One.* 2015; 10: e0116194.
 25. Mashyakhy M, Chourasia HR, Halboub E, Roges RA, Gambarini G. Nonsurgical management and 2-year follow-up by means of cone beam computed tomography of an invasive cervical resorption in a molar. *J Contemp Dent Pract.* 2018; 19: 1152-56.
 26. Tavares WL, Lopes RC, Oliveira RR, Souza RG, Henriques LC, Ribeiro-Sobrinho AP. Surgical management of invasive cervical resorption using resin-modified glass ionomer cement. *Gen Dent.* 2013; 61: e16-18.
 27. Gijón, Martín CL, Encinas RMP, Navajas JM. Aetiological, histopathological, clinical, diagnostic and therapeutical features of idiopathic cervical resorption. *Dent Update.* 2016; 43: 964-66.
 28. Heithersay GS. Treatment of invasive cervical resorption: An analysis of results using topical application of trichloroacetic acid, curettage, and restoration. *Quintessence Int.* 1999; 30: 96-110.
 29. Blaszczyzyn A, Heinemann F, Gedrange T, Kawala B, Gerber H, Dominiak M. Immediate loading of an implant with fine threaded neck-bone resorption and clinical outcome of single tooth restorations in the maxilla. *Biomed Tech (Berl).* 2012; 57: 3-9
 30. Eftekhari L, Ashraf H, Jabbari S. Management of invasive cervical root resorption in a mandibular canine using biodentine as a restorative material: A case report. *Iran Endod J.* 2017; 12: 386-89.
 31. Rahman MMA, Hossain M, Fatema S, Alam MS. Comparative efficacy of mineral trioxide aggregate and biodentine for the repair of pulpal floor perforation. *Bangabandhu Sheikh Mujib Med Univ J.* 2018; 11: 295-99.

32. Kim Y, Lee CY, Kim E, Roh BD. Invasive cervical resorption: Treatment challenges. *Restor Dent Endod.* 2012; 37: 228-31.
 33. Noetzel J, Ozer K, Reissshauer BH, Anil A, Rössler R, Neumann K, Kielbassa AM. Tissue responses to an experimental calcium phosphate cement and mineral trioxide aggregate as materials for furcation perforation repair: A histological study in dogs. *Clin Oral Investig.* 2006; 10: 77-83.
 34. Main C, Mirzayan N, Shabahang S, Torabinejad M. Repair of root perforations using mineral trioxide aggregate: A long-term study. *J Endod.* 2004; 30: 80-83.
 35. Shomi KN, Hossain M, Alam MS. Clinical and radiological evaluation of furcal perforation repaired by mineral trioxide aggregate and intermediate restorative material. *Bangabandhu Sheikh Mujib Med Univ J.* 2017; 10: 70-75.
 36. Shokri A, Eskandarloo A, Noruzi-Gangachin M, Khajeh S. Detection of root perforations using conventional and digital intraoral radiography, multi-detector computed tomography and cone beam computed tomography. *Restor Dent Endod.* 2015; 40: 58-67.
 37. van der Tas JT, Elfrink MEC, Heijboer AC, Rivadeneira F, Jaddoe VWV, Tiemeier H, Schoufour JD, Moll HA, Ongkosuwito EM, Wolvius EB, Voortman T. Foetal, neonatal and child vitamin D status and enamel hypomineralization. *Community Dent Oral Epidemiol.* 2018; 46: 343-51.
 38. Large DM, Mawer EB, Davies M. Dystrophic calcification, cataracts, and enamel hypoplasia due to long-standing, privational vitamin D deficiency. *Metab Bone Dis Relat Res.* 1984; 5: 215-18.
 39. Gyll J, Ridell K, Öhlund I, Åkeson PK, Johansson I, Holgerson PL. Vitamin D status and dental caries in healthy Swedish children. *Nutr J.* 2018; 17: 11.
 40. Schroth RJ, Lavelle C, Tate R, Bruce S, Billings RJ, Moffatt ME. Prenatal vitamin D and dental caries in infants. *Pediatrics* 2014; 133: 1277-84.
 41. Pinto JPNS, Goergen J, Muniz FWMG, Haas AN. Vitamin D levels and risk for periodontal disease: A systematic review. *J Periodontal Res.* 2018; 53: 298-305.
 42. Uwitonze AM, Murererehe J, Ineza MC, Harelimana EL, Nsabimana U, Uwambaye P, Gatarayiha A, Haq A, Razzaque MS. Effects of vitamin D status on oral health. *J Steroid Biochem Mol Biol.* 2018; 175: 190-94.
 43. Dudic A, Giannopoulou C, Meda P, Montet X, Kiliaridis S. Orthodontically induced cervical root resorption in humans is associated with the amount of tooth movement. *Eur J Orthod.* 2017; 39: 534-40.
 44. Ionta FQ, de Oliveira GC, de Alencar CR, Gonçalves PS, Alcalde MP, Minotti PG, Machado MA, Rios D. Conservative management of external root resorption after tooth reimplantation: A 3-year follow-up. *Gen Dent.* 2016; 64: 42-46.
 45. Kuperstein AS, Berardi TR, Mupparapu M. Systemic diseases and conditions affecting jaws. *Dent Clin North Am.* 2016; 60: 235-64.
 46. Lima SM, Grisi DC, Kogawa EM, Franco OL, Peixoto VC, Gonçalves-Júnior JF, Arruda MP, Rezende TM. Diabetes mellitus and inflammatory pulpal and periapical disease: A review. *Int Endod J.* 2013; 46: 700-09.
 47. Coleman RE. Clinical features of metastatic bone disease and risk of skeletal morbidity. *Clin Cancer Res.* 2006; 12: 6243-49.
 48. Marx RE, Sawatari Y, Fortin M, Broumand V. Bisphosphonate-induced exposed bone (osteonecrosis/osteopetrosis) of the jaws: Risk factors, recognition, prevention, and treatment. *J Oral Maxillofac Surg.* 2005; 63: 1567-75.
-