

Cone-Beam Computed Tomographic Study of Root Resorption in Maxillary Anterior Teeth Following Rhinoplasty

Hussein Haleem Jasim^{1,*}

¹Department of Oral Diagnosis, College of Dentistry, University of Wasit, Iraq

*Correspondence should be addressed to Hussein Haleem Jasim, halmhanawi@uowasit.edu.iq

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Abstract

Introduction: Rhinoplasty, frequently ranked among the most performed cosmetic surgeries around the world, is usually done to adjust the nose's shape for appearance (aesthetic) or breathing (functional) purposes, or both. Because the procedure deals directly with nasal and facial anatomy, it doesn't just stop there. It can, and often does, affect nearby structures. The dental region, in particular, tends to be more vulnerable than often anticipated. Risks extend beyond what's immediately visible. One complication that might arise is root resorption. This involves a slow breakdown of dentin and cementum, set off by odontoclast cells, and can lead, over time, to tooth movement or even loss.

Aim of the study: To investigate whether root resorption could emerge as a post-op complication in the maxillary anterior teeth after rhinoplasty.

Materials and methods: A total of 195 individuals, aged 18 to 45, underwent either open or closed rhinoplasty procedures, without gender preference, addressing both aesthetic and functional concerns. CBCT scans were obtained at intervals of 3, 6, 9, and 12 months following surgery to check for root resorption evidence.

Results: The statistical analysis found no significant relationship between rhinoplasty and root resorption development in maxillary anterior teeth. It found that root resorption occurrence was likely independent of the type of rhinoplasty (chi-square was 3.16, p-value was 0.07, not significant at $p > 0.05$).

Conclusion: The study found a non-significant shift toward increased root resorption in the maxillary anterior teeth with rhinoplasty, and it did not suggest decisive evidence of a higher risk. The study also found that external root resorption was more common than internal resorption, and among the teeth observed, it found that the maxillary central incisors ended up being the ones most frequently involved.

Keywords: Tooth root, Resorption, Rhinoplasty, CBCT, Maxilla, Anterior teeth

Introduction

Rhinoplasty, often seen as one of the hardest operations in plastic surgery. The nose is not just a structure, it's shape, space, and movement. It breathes, senses, and reacts, all tangled. Emotions rise, breaths shift, Immune signals respond. Even subtle habits may shift. The anatomy curves and folds in ways that challenge the hands that try to reshape it. Nothing about it stays simple. The nose sits right at the center of the face. Even a small change can catch the eye fast. That alone

pulls many people toward the idea of reshaping it. But there's more underneath. Function, emotion, breath, and immune response all fold into the mix. Planning the operation. That part does not happen in isolation. Every layer—function, emotion, biology—adds its twist. After surgery, those same layers still speak. Not always loud, but present. Some complications show up early, the big ones especially. Catching them matters. Helps guide the surgeon's next step. Helps shape what gets said to patients, what can be expected, and where the edge of possibility sits [1].

Modern rhinoplasty is generally carried out through either the open or closed technique, though which one stands as superior remains unsettled [2]. Open technique allows for direct view of the nasal framework, making it easier to catch and handle internal irregularities. This way, corrections can be more precise. Still, the external incision across the columella sometimes leaves a visible scar afterwards [3]. In contrast, the closed method avoids external cuts and usually wraps up faster than the open version. Healing time tends to be shorter as well. But there's a trade-off. Access through the nostrils narrows the view, limits control over internal structures. That makes precise shaping tougher and might raise the likelihood of errors or unwanted outcomes [4].

Tooth root resorption

Root resorption tends to occur when mineralized cementum or dentine breaks down, not from bacteria, but through the activity of clastic cells working in contact with both the soft and hard parts of the tooth [5,6]. In fully developed dentitions, the process often comes from cells resembling osteoclasts, known as odontoclasts, sometimes multinucleated, sometimes not. Under usual conditions, roots stay intact, shielded by a layer of unmineralized cementoid on the outside and pre-dentin on the inside. These layers act as barriers. Clastic cells, simply put, cannot latch onto surfaces that remain unmineralized [6,7].

Tooth root resorption classification

Internal root resorption: It tends to start around the canal wall, slowly eating into the nearby radicular dentine over time. Found within the canal system itself [8], this condition carries a somewhat uncertain background—the precise causes and mechanisms still lack full explanation. Often seen in cases involving reimplanted or injured teeth, or those treated with pulpotomy, cavity preps, partial pulp removal, or even capping with calcium hydroxide. Sometimes linked with carious lesions, cracks, or heat exposure. These triggers appear to provoke the pulp tissue, setting off inflammation. In such a state, certain primitive pulp cells may shift into resorptive roles—osteoclasts, sometimes macrophages—gradually leading to internal breakdown of dentine [9,10].

External root resorption

External inflammatory root resorption: A resorptive process sometimes follows trauma, advanced periodontal issues, or certain orthodontic interventions, sparking an inflammatory shift deep within the periodontal ligament. The damage from this form of resorption tends not to settle on its own, often progressing with considerable tissue loss [11]. What precisely drives it, both causes and mechanisms, remains unclear. Internal resorption seems often associated with previously injured or replanted teeth, pulpotomized cases, teeth shaped for crowns, or those exposed to caries or partial pulp removal. Calcium hydroxide pulp capping, high thermal exposure, or fracture lines may also play a role. These irritants stir the pulp tissue into a state of activation,

where inflammation sets off a chain that may convert certain undifferentiated pulp cells into macrophage-like or osteoclast-like cells, setting the stage for dentin breakdown [9,10].

External replacement resorption: Over time, leads to loss of the original root material as bone begins to take its place, ending up with bone and root tissue directly joined. Typically, such change follows a strong traumatic event; cases like avulsion, deep intrusion, or heavy lateral displacement often led to this outcome [12].

Cervical root resorption: It remains not entirely explained. A mix of cementum disturbance and periodontal ligament damage is frequently linked to its onset, though other unknown contributors might be involved. Among the leading triggers reported: prior injuries and orthodontic forces. Teeth most frequently seen with this condition include upper incisors, canines, and both first molars, especially maxillary and mandibular ones [13].

Etiopathogenesis of tooth root resorption

Even though the cause of tooth root resorption remains poorly understood, several risk and predisposing factors have been observed that can stimulate resorption. Two factors reported are endogenous and exogenous, related to the host. Body traits such as race, age, gender, genetic effect, occlusion characteristics, etc., are endogenous variables [5,14–21]. Exogenous factors include orthodontic treatment, pulp infection, trauma, tooth bleaching, etc. [14,22–27].

Raised pressure within the root canal space, along with involvement of prostaglandins and certain cytokines, appears linked to how internal root resorption develops [15,16,28]. With external inflammatory resorption, things tend to shift here; damage in periodontal tissues alongside necrotic changes in the pulp canal seem to matter more. The open dentinal tubules often attract bacterial buildup and decaying tissue fragments [5,6]. Meanwhile, in external replacement resorption, the situation turns somewhat different. It reflects a faulty repair process, where missing cementum and dentin slowly get replaced by growing alveolar bone [5,29].

Materials and Methods

A total of 195 individuals, aged 18 to 45, underwent either open or closed rhinoplasty procedures, without gender preference, addressing aesthetic and functional concerns at the radiology departments of several plastic surgery hospitals in Baghdad, Iraq, between May 2021 and June 2023. Cone Beam Computed Tomography (CBCT) scans were obtained at intervals of 3, 6, 9, and 12 months to investigate whether root resorption could emerge as a post-op complication in the maxillary anterior teeth after rhinoplasty. The tooth root resorptions included in the current study were classified into mild, moderate and severe root resorption based on their radiographic appearance, location and root structure (**Table 1**). The CBCT imaging software generated 3D reconstructions

Table 1. Internal and external root resorption severity.

Resorption Type	Stage	Radiographic Appearance	Location	Root Structure
Internal Root Resorption (IRR)	Mild (Incipient)	Small, well-defined round or oval radiolucency continuous with the pulp chamber or canal within the pulp space.	Within the pulp space	No visible perforation of root walls.
	Moderate	Enlarged radiolucent area with irregular shape extending further into dentin.	Confined within the root canal system	Dentin walls appear thinner, but no external perforation.
	Severe (Advanced)	Large radiolucency distorting normal pulp anatomy.	May extend into the periodontal ligament (PDL) space	Severe thinning or discontinuity of dentin, risking root fracture or external communication.
External Root Resorption (ERR)	Mild (Surface Resorption)	Small, irregular, and shallow radiolucent defects on the surface of the root.	Cervical, middle, or apical third portion of the root	No observed root shortening or loss of function.
	Moderate (Inflammatory Resorption)	Deeper radiolucent areas invade dentin with irregular, ragged edges.	It may appear at multiple sites along the root	Progressive loss of root length, sometimes with widened PDL space due to inflammation.
	Severe (Extensive or Replacement Resorption)	Large, irregular resorptive defects leading to root shortening.	Can involve extensive portions of the root	Root may appear 'moth-eaten' or partially replaced by bone in cases of replacement resorption.

for optimal root evaluation to detect the presence of root resorption, with additional multi-planar views (axial, sagittal, and coronal) for comprehensive analysis. All parameters of the CBCT system were adjusted to be similar to all CBCT images: Voxel size ranged from 0.1 to 0.2 mm to ensure high-resolution imaging of the maxillary anterior teeth, and the field of view (FOV) was set between 5×5 cm and 10×10 cm.

Exclusion criteria

Exclusion criteria included patients with prior history of root resorption, previous rhinoplasty, periodontal disease, dental pathology, teeth mobility, sensitivity, discoloration, symptoms or tenderness, malocclusion, non-vital anterior teeth, parafunctional habits like bruxism and clenching, systemic diseases affect bone structure (like osteoporosis or hyperparathyroidism), any medication affecting bone metabolism, pre-existing dental or facial trauma, congenital deformities, orthodontic or dental prosthesis appliances, dental implant, missing maxillary anterior teeth were excluded from the study.

Statistical analysis

Chi-square statistic was applied to find the potential relationship between the root resorption formation in maxillary anterior teeth after open and closed rhinoplasty.

Results

(A) Analysis of findings in patients who underwent open rhinoplasty surgery revealed a total root resorption rate of 5.64%, distributed as follows (**Table 2** and **Figure 1**):

- At 3-month follow-up, no root resorption was identified (n=0).
- 6 months later, it was found that four patients showing signs of external root resorption (n=4). In three instances, the resorption was mild in severity. Two instances involved the upper central incisors (n=2), and one affected a lateral incisor (n=1). The fourth case was moderate in severity and also involved a maxillary central incisor (n=1). No internal resorptions were identified (n=0).
- 9 months later, it was found that seven patients showing signs of external root resorption (n=7). In four instances, the resorption was mild in severity. Two maxillary central incisors were affected (n=2), one affected instance for each of the maxillary lateral incisor (n=1) and maxillary canine (n=1). Internal resorption was identified in a mild case of the maxillary lateral incisor (n=1). No progression or recovery was observed in previous root resorption cases. 1-year follow-up: No additional root resorptions were identified (n=0). No progression or recovery was observed in previous root resorption cases.

- (B) Analysis of findings in patients who underwent closed rhinoplasty surgery revealed a total root resorption rate of 2.05%, distributed as follows:

 - 6 months later, it was found that two patients showing signs of external root resorption (n=2) of mild severity involved the maxillary central incisors.
 - 9 months later, it was found that two patients showing signs of external root resorption of mild severity (n=2). Two teeth were affected, one affected instance for the maxillary central incisors was affected (n=1), and one affected instance for the maxillary lateral incisor (n=1), with no progression or recovery was observed in previous root resorption cases.
- 1-year follow-up: No additional root resorptions were identified (n=0). No progression or recovery was observed in previous root resorption cases.

The statistical analysis found no statistically significant relationship between rhinoplasty type (open vs. closed) and root resorption formation in maxillary anterior teeth. The chi-square statistic was 3.16, with a p-value of 0.07, which is not significant at $p>0.05$ (**Table 3**). The findings showed that the rate of root resorptions after open and closed rhinoplasty was 7.7%, and the most prominent resorbed roots of the maxillary anterior teeth were in the maxillary central incisor teeth (4.62%), followed by maxillary lateral incisor teeth (2.56%), and maxillary canine teeth (0.52%), respectively (**Figure 2**).

Table 2. Distribution of root resorption in patients after open versus closed rhinoplasty.					
Tooth Type	Open Rhinoplasty (n = 100)	Percentage (%)	Closed Rhinoplasty (n=95)	Percentage (%)	Total n (%)
External Root Resorption					
Maxillary Central Incisors	6 cases (4 mild, 2 moderate)	3.08%	3 mild cases	1.54%	9 (4.62%)
Maxillary Lateral Incisors	3 cases (2 mild, 1 moderate)	1.54%	1 mild case	0.51%	4 (2.05%)
Maxillary Canines	1 mild case	0.51%	0 cases	0.0%	1 (0.51%)
					14 (7.18%)
Internal Root Resorption					
Maxillary Lateral Incisors	1 mild case	0.51%	0 cases	0.0%	1 (0.51%)
Total Cases	11 cases	5.64%	4 cases	2.05%	15 (7.7%)

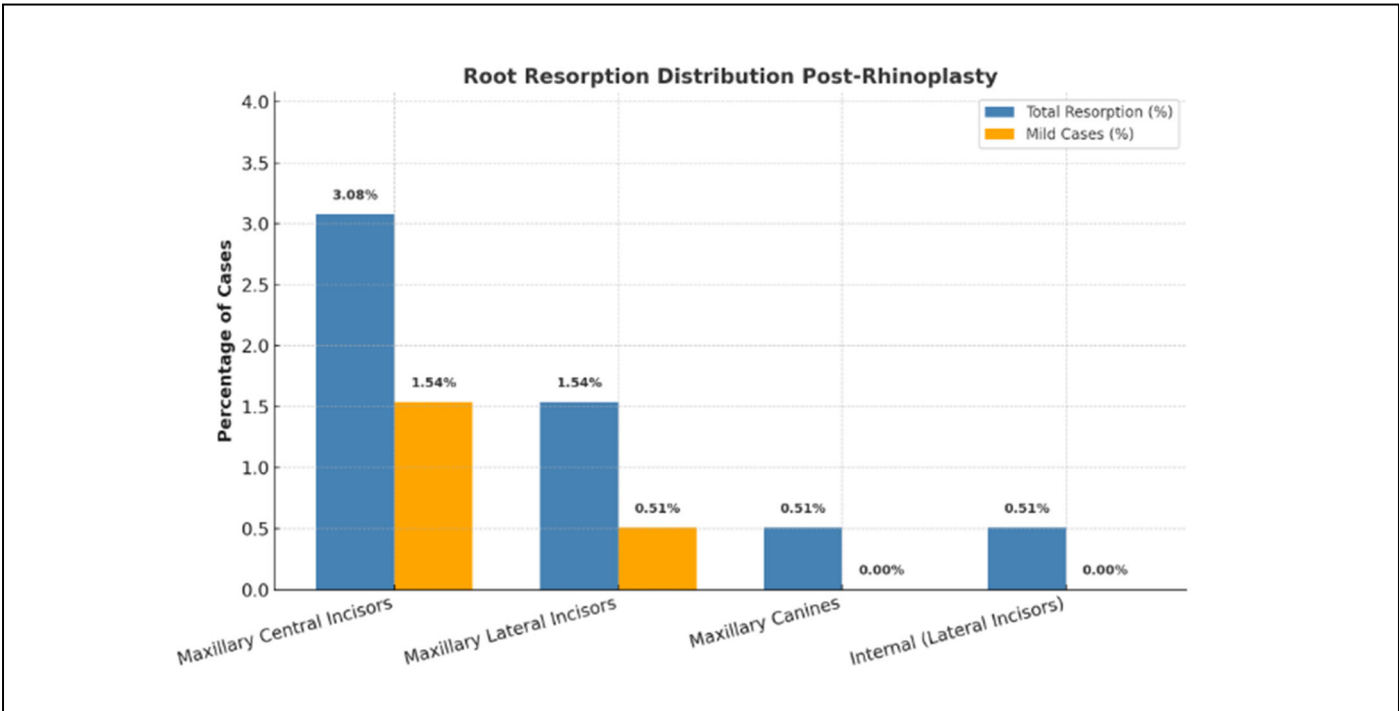


Figure 1. A bar graph showing the rates of root resorption in anterior maxillary teeth after rhinoplasty surgery.

Table 3. The relationship between the type of rhinoplasty (open vs. closed) and root resorption in maxillary anterior teeth.

Surgery	Root Resorption (Yes)	Root Resorption (No)	Total
Open Rhinoplasty	11	89	100
Closed Rhinoplasty	4	91	95
Total	15	180	195

The chi-square statistic = 3.16. The p-value = 0.07. Not significant at $p > 0.05$.

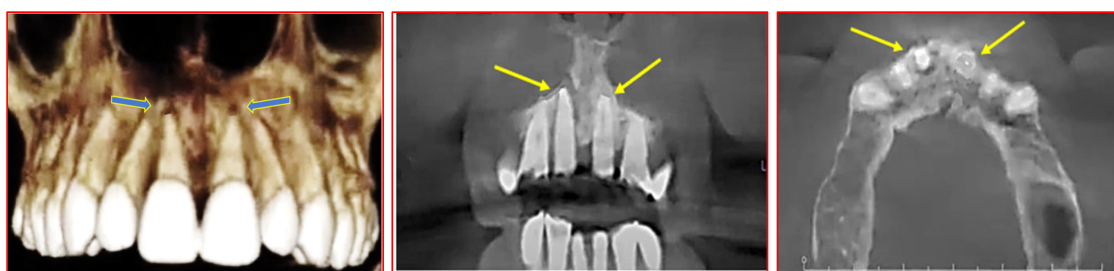


Figure 2. CBCT images showing mild external root resorption in the maxillary central incisors.

Discussion

Rhinoplasty typically involves manual intervention close to the nasal cavity. It may apply pressure on neighboring tooth roots. The closeness of maxillary anterior teeth to the nasal cavity, particularly the root tips of these teeth, may cause unintended pressure or damage during surgery and can lead to inflammatory and vascular alterations that can contribute to negative consequences on the root of these teeth. The current study investigated the potential relationship between the effects of post-operative rhinoplasty and root resorption development in maxillary anterior teeth.

Facial traumas primarily affecting the anterior teeth have been reported in conjunction with the development of some complications [25]. Like traumatic injuries, internal bleaching increases root resorption during orthodontic treatment [30–32]. Other researchers reported that the inflammation of the dental pulp and bacterial agents may also play a role in the pathogenesis of root resorption [27].

The current study found that the effects of open and closed rhinoplasty surgery are insufficient to cause significant effects on the roots of maxillary anterior teeth. The absence of significance suggests that bone manipulation likely remains within a safe level of stress tolerance near dental structures. This could be because the biomechanical forces involved during the rhinoplasty approach may not exceed threshold levels enough to get significant root resorption in maxillary anterior teeth. The study showed that the rate of root resorption in open rhinoplasty (5.64%) was higher than in closed rhinoplasty (2.05%). This may be due to an extensive surgical manipulation in the maxilla near the nasal and the adjacent structures

through open rhinoplasty. In addition, trauma to supporting structures, including septal adjustments and osteotomies, may exert pressure on the cementum and periodontal ligament, leading to root resorption. This pressure may also cause microfractures of the bone, disrupting the adjacent teeth and their roots. In addition, mechanical vibration of instruments utilized through bone manipulation may transfer stress to the apical areas of the roots. The inflammatory response initiated by surgical trauma is another underlying trigger of root resorption. Following rhinoplasty, localized inflammation is elevated around the surgical site. Inflammatory mediators like prostaglandin, cytokines and enzymes can stimulate the osteoclastic activity, causing resorption of roots and bone due to prolonged inflammatory response. The blood supply near maxillary anterior teeth may be compromised due to surgical manipulation or the use of nasal packing and splints, this can lead to ischemia, which negatively affects the normal healing process and promotes resorptive changes in adjacent teeth. A lower frequency of root resorption in closed rhinoplasty (2.05%) is likely associated with the reduced invasiveness of the technique due to limited external incisions and minimal manipulation of maxillary structures, minimizing the risk of mechanical and inflammatory effects and reducing potential complications involving tooth roots. The study showed that the rate of root resorptions after open and closed rhinoplasty was 7.7%, and the most prominent resorbed roots of the maxillary anterior teeth were in the maxillary central incisors (4.62%).

Many researchers have highlighted several risk factors that lead to root resorption. For example, orthodontic forces are considered one of the primary etiologic contributors to root resorption [23,26]. Root resorption can result from pressure

exerted by an adjacent unerupted tooth. Unerupted canines frequently contribute to root resorption in adjacent lateral incisors or premolars [33].

Genetic variations in the interleukin-1 β gene have been linked to the inflammatory response triggered by orthodontic treatment, which may help explain the development of specific external apical resorptions. External root resorption estimation using qualitative and quantitative measures was 24.7% and 28.3% for dizygotic twins and 44.9% and 42.9% for monozygotic twins, respectively. The heritability estimate was found to be 0.34. [15,16,18,19]. Certain studies pointed out that chronic asthma, along with allergies, may raise the risk for inflammatory root resorption throughout orthodontic therapy [34,35]. Systemic conditions or hormonal insufficiencies have been flagged in some reports as possible contributors, though findings remain somewhat mixed and not firmly settled [36–38].

Several other complications of rhinoplasty were also stated that warrant real attention. Reduction-type rhinoplasty, for instance, has been associated with breathing issues, which appear in approximately 70% of cases where revision becomes necessary. Literature points as well to rarer but serious outcomes—brain injuries, rhinoliquorrhea, fistulas linking the carotid artery and cavernous sinus, even aneurysms or cavernous sinus thrombosis. Discoloration may appear on the incisors, sometimes the result of vessel or nerve trauma. With time and accumulated experience, the odds of facing rhinoplasty-related complications tend to go down. Still, that alone is not enough. What matters just as much is a habit of ongoing study, along with a careful effort to tell apart what is truly a complication from what stems from error [39].

Every day habits appear to carry weight, too. Individuals who bite their nails, for instance, often show more pronounced root resorption. This may be a result of the increased pressure exerted on the periodontal tissues [34]. Further research with expanded participant groups, follow-up assessments over a long time and incorporation of control samples for further variables may aid in identifying any underlying relationship between rhinoplasty and root resorption in maxillary anterior teeth. However, the possibility of rare or delayed development of root resorptions necessitates continued observation in long-term studies, especially in high-risk patients with pre-existing dental challenges.

Conclusion

Rhinoplasty is a non-significant factor for the development of root resorption in the maxillary anterior teeth. The difference between closed and open rhinoplasty regarding root resorption development was insignificant. External root resorptions are most commonly observed in open rhinoplasty. External root resorption was observed more often than internal root resorption. In addition, the roots of maxillary central incisors were commonly resorbed.

Ethical Approval

The study was conducted in accordance with the ethical standards of the Ethics Committee for Scientific Research at the College of Dentistry, University of Wasit., Ref. No. 152021 in 2/5/2021.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

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Nil.

Conflicts of Interest

No conflict of interest.

References

1. Thomson C, Mendelsohn M. Reducing the incidence of revision rhinoplasty. J Otolaryngol. 2007 Apr;36(2):130–4.
2. Azzawi SA, Kidd T, Shoaib T. Closed Rhinoplasty: A Single Surgeon Experience of 238 Cases over 2 Years. Indian J Otolaryngol Head Neck Surg. 2022 Sep;74(3):255–9.
3. Jayarajan R, Natarajan A, Nagamuttu R. Outcomes of Closed Versus Open Technique of Rhinoplasty During Primary Repair of Unilateral Cleft Lip: A Systematic Review. Cleft Palate Craniofac J. 2019 Jan;56(1):74–83.
4. Cafferty A, Becker DG. Open and Closed Rhinoplasty. Clin Plast Surg. 2016 Jan;43(1):17–27.
5. Tronstad L. Root resorption—etiology, terminology and clinical manifestations. Endod Dent Traumatol. 1988 Dec;4(6):241–52. doi:
6. Trope M. Root resorption due to dental trauma. Endodontic topics. 2002 Mar;1(1):79–100.
7. Wedenberg C, Lindskog S. Evidence for a resorption inhibitor in dentin. Scand J Dent Res. 1987 Jun;95(3):205–11.
8. Patel S, Saberi N, Pimental T, Teng PH. Present status and future directions: Root resorption. Int Endod J. 2022 Oct;55 Suppl 4(Suppl 4):892–921.
9. Darcey J, Qualtrough A. Resorption: part 1. Pathology, classification and aetiology. Br Dent J. 2013 May;214(9):439–51.
10. Umashetty G, Hoshing U, Patil S, Ajgaonkar N. Management of Inflammatory Internal Root Resorption with Biodentine and Thermoplasticised Gutta-Percha. Case Rep Dent. 2015;2015:452609.
11. Nagne M, Ikhar A. A Review on Internal Resorption. J Pharm Res Int. 2021;33:3458–65.
12. Soares AJ, Souza GA, Pereira AC, Vargas-Neto J, Zaia AA, Silva EJ.

- Frequency of root resorption following trauma to permanent teeth. J Oral Sci. 2015 Jun;57(2):73–8.
13. Patel S, Mavridou AM, Lambrechts P, Saberi N. External cervical resorption-part 1: histopathology, distribution and presentation. Int Endod J. 2018 Nov;51(11):1205–23.
14. Heboyian AG, Avetisyan AA, Margaryan MM. CLINICAL CASE OF A RARELY DIAGNOSED TOOTH ROOT INTERNAL RESORPTION. New Armenian Medical Journal. 2018 Dec 1;12(4):87–92.
15. Bastos JV, Silva TA, Colosimo EA, Côrtes MI, Ferreira DA, Goulart EM, Gomez RS, Dutra WO. Expression of inflammatory cytokines and chemokines in replanted permanent teeth with external root resorption. Journal of endodontics. 2017 Feb 1;43(2):203–9.
16. Ahuja R, Almuzian M, Khan A, Pascovici D, Dalci O, Darendeliler MA. A preliminary investigation of short-term cytokine expression in gingival crevicular fluid secondary to high-level orthodontic forces and the associated root resorption: case series analytical study. Progress in Orthodontics. 2017 Dec;18:23.
17. Sameshima GT, Sinclair PM. Predicting and preventing root resorption: Part I. Diagnostic factors. American Journal of Orthodontics and Dentofacial Orthopedics. 2001 May 1;119(5):505–10.
18. Heboyian A, Syed AU, Rokaya D, Cooper PR, Manrikyan M, Markaryan M. Cytomorphometric analysis of inflammation dynamics in the periodontium following the use of fixed dental prostheses. Molecules. 2020 Oct 12;25(20):4650.
19. Avetisyan A, Markaryan M, Rokaya D, Tovani-Palane MR, Zafar MS, Khurshid Z, et al. Characteristics of Periodontal Tissues in Prosthetic Treatment with Fixed Dental Prostheses. Molecules. 2021 Mar 2;26(5):1331.
20. Proffit WR, Fields H, Sarver D. Contemporary orthodontics. Mosby. Elsevier; 2007. P. 331–58.
21. Estevez R, Aranguren J, Escorial A, de Gregorio C, De La Torre F, Vera J, et al. Invasive cervical resorption Class III in a maxillary central incisor: diagnosis and follow-up by means of cone-beam computed tomography. J Endod. 2010 Dec;36(12):2012–4.
22. Makedonas D, Lund H, Gröndahl K, Hansen K. Root resorption diagnosed with cone beam computed tomography after 6 months of orthodontic treatment with fixed appliance and the relation to risk factors. Angle Orthod. 2012 Mar;82(2):196–201.
23. Consolaro A. Extreme root resorption in orthodontic practice: teeth do not have to be replaced with implants. Dental Press J Orthod. 2019 Nov 11;24(5):20–8.
24. Al-Badri S, Kinirons M, Cole B, Welbury R. Factors affecting resorption in traumatically intruded permanent incisors in children. Dent Traumatol. 2002 Apr;18(2):73–6.
25. Şermet Elbay Ü, Elbay M, Kaya E, Sinanoglu A. Management of an intruded tooth and adjacent tooth showing external resorption as a late complication of dental injury: three-year follow-up. Case Rep Dent. 2015;2015:741687.
26. Topkara A, Karaman AI, Kau CH. Apical root resorption caused by orthodontic forces: A brief review and a long-term observation. Eur J Dent. 2012 Oct;6(4):445–53.
27. Gabor C, Tam E, Shen Y, Haapasalo M. Prevalence of internal inflammatory root resorption. J Endod. 2012 Jan;38(1):24–7.
28. Iglesias-Linares A, Hartsfield JK Jr. Cellular and Molecular Pathways Leading to External Root Resorption. J Dent Res. 2017 Feb;96(2):145–52.
29. Patel S, Ford TP. Is the resorption external or internal? Dent Update. 2007 May;34(4):218–29.
30. Newton R, Hayes J. The association of external cervical resorption with modern internal bleaching protocols: what is the current evidence? Br Dent J. 2020 Mar;228(5):333–37.
31. Abbott P, Heah SY. Internal bleaching of teeth: an analysis of 255 teeth. Aust Dent J. 2009 Dec;54(4):326–33.
32. Dahl JE, Pallesen U. Tooth bleaching—a critical review of the biological aspects. Crit Rev Oral Biol Med. 2003;14(4):292–304.
33. Yan B, Sun Z, Fields H, Wang L. Maxillary canine impaction increases root resorption risk of adjacent teeth: a problem of physical proximity. Am J Orthod Dentofacial Orthop. 2012 Dec;142(6):750–7.
34. Owman-Moll P, Kurol J. Root resorption after orthodontic treatment in high- and low-risk patients: analysis of allergy as a possible predisposing factor. Eur J Orthod. 2000 Dec;22(6):657–63.
35. Ioi H, Kido MA, Murata N, Nishioka M, Asakawa M, Muroya R, et al. Effect of allergy on root resorption induced by orthodontic tooth movement. In: Bourzgui F, Editor. Issues in Contemporary Orthodontics. London: IntechOpen Limited; 2015. P. 113–32.
36. Haugland L, Kristensen KD, Lie SA, Vandevska-Radunovic V. The effect of biologic factors and adjunctive therapies on orthodontically induced inflammatory root resorption: a systematic review and meta-analysis. Eur J Orthod. 2018 May 25;40(3):326–36.
37. Consolaro A, Franschichone TR, Furquim LZ. Multiple or severe root resorptions are not associated with systemic factors, individual susceptibility, family tendency or individual predisposition. Dental Press Journal of Orthodontics. 2011;16:17–21.
38. Oberoi S, Kneuppel S. Three-dimensional assessment of impacted canines and root resorption using cone beam computed tomography. Oral Surg Oral Med Oral Pathol Oral Radiol. 2012 Feb;113(2):260–7.
39. Rettinger G. Risks and complications in rhinoplasty. GMS Curr Top Otorhinolaryngol Head Neck Surg. 2007;6:Doc08.