

Bölüm 4

ORTODONTİK TEDAVİDEKİ KOMPLİKASYONLARA GÜNCEL BİR BAKIŞ

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1. GİRİŞ

Her medikal tedavinin avantajları, dezavantajları, riskleri ve komplikasyonları vardır. Bunlar prognozu, tedavi planını ve tedavinin genel kalitesini etkilemektedir. Ortodontik tedavi için de bu durum geçerlidir. Her ne kadar cerrahi branşlardaki kadar yüksek olmasa da ortodonti branşında da geniş bir komplikasyon yelpazesi mevcuttur. Bunun sebebi, aparey ve materyal çeşitliliğinden, aktif tedavi süresinden, tedavi alternatifçi çeşitliliğinden ve hasta grubunun geniş yaş aralığından kaynaklanmaktadır. Hastanın tedavisine başlamadan önce risk faktörleri ve olası komplikasyonlar, hastaya özel olarak değerlendirilmeli ve zarar-yarar dengesi önüne alınarak tedaviye başlamaya karar verilmelidir.

Komplikasyonların yaşanmasının önüne geçmek için ilgili konuya hakim olmak, detaylı bir tedavi planı hazırlamak, tedavi planını dikkatlice uygulamak ve hastayı sorumlulukları hakkında iyi bilgilendirmek gerekmektedir. Yine de komplikasyonlar, bütün branşlardan hekimlerin başına gelebilmektedir. Hekimin gerekli tedbirleri tedavi öncesinde almasından bağımsız olarak, meydana gelmiş komplikasyona da doğru müdahale edebilmelidir.

Kökeni Fransızcadan gelen ve karmaşıklık anlamında olan komplikasyonlar, ortodontide; lokal, sistemik ve diğer olmak üzere üç ana başlık altında sınıflandırılabilir.

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4.3 Hastanın Tedaviye Uyum Göstermemesi

Ortodontik tedavinin süresi ve başarısı mekanik faktörlerin yanı sıra hastanın uyumuna, motivasyonuna ve kooperasyonuna bağlıdır (157). Qabool ve ark. (157), ortodontik tedavi süreci boyunca farklı aşamalarda kooperasyonun ve uyumun değiştiğini belirtmektedir. Kooperasyonun seviyeleme aşamalarında yüksek iken boşluk kapama aşamasında düşmeye başladığını ve tedavi bitene kadar da düşmeye devam ettiğini belirtmişlerdir.

5. SONUÇ

Göründüğü gibi ortodontik tedavilerde çeşitli komplikasyonlar mevcuttur. Ortodonti de diş hekimliğinin tüm alanlarında olduğu gibi sürekli değişmekte ve gelişmektedir. Her yeni metot, malzeme ve teknolojinin entegre olmasıyla yeni tedavi opsiyonları ve bununla birlikte daha farklı komplikasyonlar da oluşmaktadır. Her branşa olduğu gibi aktif çalışan her hekim komplikasyonlarla karşılaşacaktır. Hekim bu komplikasyonlarla karşılaşmadan önce gerekli önlemleri almalı ve karşılaşmaktan sonra da durumun yönetimini en doğru şekilde yapacak şekilde bilgi sahibi olmalıdır.

6. KAYNAKÇA

1. Richter AE, Arruda AO, Peters MC, Sohn W. Incidence of caries lesions among patients treated with comprehensive orthodontics. Am J Orthod Dentofacial Orthop. 2011 May;139(5):657–64.
2. Chapman JA, Roberts WE, Eckert GJ, Kula KS, González-Cabezas C. Risk factors for incidence and severity of white spot lesions during treatment with fixed orthodontic appliances. Am J Orthod Dentofacial Orthop. 2010 Aug; 138(2):188–94.
3. Khoroushi M, Kachui M. Prevention and Treatment of White Spot Lesions in Orthodontic Patients. Contemp Clin Dent. 2017 Jan 1; 8(1):11–9.
4. Boersma JG, Van Der Veen MH, Lagerweij MD, Bokhout B, Prahl-Andersen B. Caries prevalence measured with QLF after treatment with fixed orthodontic appliances: influencing factors. Caries Res. 2005; 39(1):41–7.
5. Gorelick L, Geiger AM, Gwinnett AJ. Incidence of white spot formation after bonding and banding. Am J Orthod. 1982; 81(2):93–8.
6. Heymann GC, Grauer D. A contemporary review of white spot lesions in orthodontics. J Esthet Restor Dent. 2013 Apr; 25(2):85–95.
7. Chang HS, Walsh LJ, Freer TJ. Enamel demineralization during orthodontic treatment. Aetiology and prevention. Aust Dent J. 1997 Oct; 42(5):322–7.
8. Rossini G, Parrini S, Castroflorio T, Deregbus A, Debernardi CL. Efficacy of clear aligners in controlling orthodontic tooth movement: a systematic review. Angle Orthod. 2015 Sep 1; 85(5):881–9.
9. Albhaiji Z, Al-Khateeb SN, Abu Alhaija ES. Enamel demineralization during clear aligner orthodontic treatment compared with fixed appliance therapy, evaluated with

- quantitative light-induced fluorescence: A randomized clinical trial. Am J Orthod Dentofacial Orthop. 2020 May 1; 157(5):594–601.
- 10. Moshiri M, Eckhart JE, McShane P, German DS. Consequences of poor oral hygiene during aligner therapy. J Clin Orthod. 2013; 47(8):494–8
 - 11. Buschang PH, Chastain D, Keylor CL, Crosby D, Julien KC. Incidence of white spot lesions among patients treated with clear aligners and traditional braces. Angle Orthod. 2019; 89(3):359–64.
 - 12. Zahradník RT, Magnusson I, Walker C, McDonell E, Hillman CH, Hillman JD. Preliminary assessment of safety and effectiveness in humans of ProBiora3, a probiotic mouthwash. J Appl Microbiol. 2009 Aug; 107(2):682–90.
 - 13. Denis M, Atlan A, Vennat E, Tirlet G, Attal JP. White defects on enamel: diagnosis and anatomopathology: two essential factors for proper treatment (part 1). Int Orthod. 2013 Jun; 11(2):139–65.
 - 14. Perdigão J. Resin infiltration of enamel white spot lesions: An ultramorphological analysis. Journal of esthetic and restorative dentistry. 2020 Apr 1;32(3):317–24.
 - 15. Kidd EAM, Fejerskov O. What constitutes dental caries? Histopathology of carious enamel and dentin related to the action of cariogenic biofilms. J Dent Res. 2004 Jan
 - 16. Meyer-Lueckel H, Paris S, Kielbassa AM. Surface layer erosion of natural caries lesions with phosphoric and hydrochloric acid gels in preparation for resin infiltration. Caries Res. 2007 Apr; 41(3):223–30.
 - 17. Yuan H, Li J, Chen L, Cheng L, Cannon RD, Mei L. Esthetic comparison of white-spot lesion treatment modalities using spectrometry and fluorescence. Angle Orthod. 2014 Mar; 84(2):343–9.
 - 18. Hodges SJ, Spencer RJ, Watkins SJ. Unusual indelible enamel staining following fixed appliance treatment. J Orthod. 2000 Dec; 27(4):303–6.
 - 19. Kamber R, Papageorgiou SN, Eliades T. Does orthodontic treatment have a permanent effect on tooth color? : A systematic review and meta-analysis. Journal of Orofacial Orthopedics. 2018 Mar 1; 79(2):73–82.
 - 20. Pinzan-Vercelino CRM, Souza Costa AC, Gurgel JA, Salvatore Freitas KM. Comparison of enamel surface roughness and color alteration after bracket debonding and polishing with 2 systems: A split-mouth clinical trial. Am J Orthod Dentofacial Orthop. 2021 Nov 1; 160(5):686–94.
 - 21. Eliades T, Kakaboura A, Eliades G, Bradley TG. Comparison of enamel colour changes associated with orthodontic bonding using two different adhesives. Eur J Orthod. 2001; 23(1):85–90.
 - 22. Inokoshi S, Burrow M, Kataumi M, Yamada T, Takatsu T. Opacity and color changes of tooth-colored restorative materials. Oper Dent. 1996;
 - 23. Karamouzos A, Athanasiou AE, Papadopoulos MA, Kolokithas G. Tooth-color assessment after orthodontic treatment: a prospective clinical trial. Am J Orthod Dentofacial Orthop. 2010; 138(5):537.e1-537.e8.
 - 24. Barwick PJ, Ramsay DS. Effect of brief intrusive force on human pulpal blood flow. Am J Orthod Dentofacial Orthop. 1996; 110(3):273–9.
 - 25. McDonald F, Pitt Ford TR. Blood flow changes in permanent maxillary canines during retraction. Eur J Orthod. 1994 Feb; 16(1):1–9.
 - 26. Baik UB, Kim H, Chae HS, Myung JY, Chun YS. Teeth discoloration during orthodontic treatment. The Korean Journal of Orthodontics. 2017 Jul 27; 47(5):334–9.

27. Boncuk Y, Çehreli ZC, Polat-Özsoy Ö. Effects of different orthodontic adhesives and resin removal techniques on enamel color alteration. *Angle Orthod.* 2014; 84(4):634–41.
28. Dumbryte I, Linkeviciene L, Linkevicius T, Malinauskas M. Does orthodontic debonding lead to tooth sensitivity? Comparison of teeth with and without visible enamel microcracks. *Am J Orthod Dentofacial Orthop.* 2017 Feb 1; 151(2):284–91.
29. Arhun N, Arman A. Effects of Orthodontic Mechanics on Tooth Enamel: A Review. *Semin Orthod.* 2007 Dec 1;13(4):281–91.
30. Dumbryte I, Veblene J, Linkeviciene L, Malinauskas M. Enamel microcracks in the form of tooth damage during orthodontic debonding: a systematic review and meta-analysis of in vitro studies. *Eur J Orthod.* 2018 Nov 30; 40(6):636–48.
31. Yassaei S, Soleimanian A, Nik ZE. Effects of Diode Laser Debonding of Ceramic Brackets on Enamel Surface and Pulpal Temperature. *J Contemp Dent Pract.* 2015 Apr 1; 16(4):270–4.
32. Bishara SE, Trulove TS. Comparisons of different debonding techniques for ceramic brackets: an in vitro study. Part II. Findings and clinical implications. *American journal of orthodontics and dentofacial orthopedics.* 1990; 98(3):263–73.
33. Han G, Hu M, Zhang Y, Jiang H. Pulp vitality and histologic changes in human dental pulp after the application of moderate and severe intrusive orthodontic forces. *Am J Orthod Dentofacial Orthop.* 2013 Oct; 144(4):518–22.
34. Javed F, Al-Kheraif AA, Romanos EB, Romanos GE. Influence of orthodontic forces on human dental pulp: a systematic review. *Arch Oral Biol.* 2015; 60(2):347–56.
35. Ramazanzadeh BA, Sahhafian AA, Mohtasham N, Hassanzadeh N, Jahanbin A, Shakeri MT. Histological changes in human dental pulp following application of intrusive and extrusive orthodontic forces. *J Oral Sci.* 2009 Mar 3; 51(1):109–15.
36. Holst AI, Karl M, Karolczak M, Goellner M, Holst S. Quantitative assessment of orthodontic mini-implant displacement: the effect of initial force application. *Quintessence Int.* 2010 Jan; 41(1):59–66.
37. Derringer KA, Linden RWA. Angiogenic growth factors released in human dental pulp following orthodontic force. *Arch Oral Biol.* 2003 Apr 1; 48(4):285–91.
38. Derringer K, Linden R. Epidermal growth factor released in human dental pulp following orthodontic force. *Eur J Orthod.* 2007 Feb; 29(1):67–71
39. Derringer KA, Jaggers DC, Linden RWA. Angiogenesis in human dental pulp following orthodontic tooth movement. *J Dent Res.* 1996; 75(10):1761–6.
40. Lund H, Gröndahl K, Hansen K, Gröndahl HG. Apical root resorption during orthodontic treatment: A prospective study using cone beam CT. *Angle Orthod.* 2012 May 1; 82(3):480–7.
41. Nieto-Nieto N, Solano JE, Yañez-Vico R. External apical root resorption concurrent with orthodontic forces: the genetic influence. *Acta Odontol Scand.* 2017 May 19; 75(4):280–7
42. Samandara A, Papageorgiou SN, Ioannidou-Marathiotou I, Kavvadia-Tsatala S, Papadopoulos MA. Evaluation of orthodontically induced external root resorption following orthodontic treatment using cone beam computed tomography (CBCT): a systematic review and meta-analysis. *Eur J Orthod.* 2019 Jan 23; 41(1):67–79.
43. Al-Qawasmi RA, Hartsfield JK, Everett ET, Flury L, Liu L, Foroud TM, et al. Genetic predisposition to external apical root resorption. *American Journal of Orthodontics and Dentofacial Orthopedics.* 2003 Mar 1;123(3):242–52.

44. Guo Y, He S, Gu T, Liu Y, Chen S. Genetic and clinical risk factors of root resorption associated with orthodontic treatment. American Journal of Orthodontics and Dentofacial Orthopedics. 2016 Aug 1;150(2):283–9.
45. Brezniak N, Wasserstein A. Orthodontically induced inflammatory root resorption. Part II: The clinical aspects. Angle Orthod. 2002 Apr; 72(2):180–4
46. Hartsfield JK, Everett ET, Al-Qawasmi RA. Genetic factors in external apical root resorption and orthodontic treatment. Critical Reviews in Oral Biology and Medicine. 2004 Mar 1; 15(2):115–22.
47. Aman C, Azevedo B, Bednar E, Chandiramami S, German D, Nicholson E, et al. Apical root resorption during orthodontic treatment with clear aligners: A retrospective study using cone-beam computed tomography. Am J Orthod Dentofacial Orthop. 2018 Jun 1; 153(6):842–51
48. Baumrind S, Korn EL, Boyd RL. Apical root resorption in orthodontically treated adults. American Journal of Orthodontics and Dentofacial Orthopedics. 1996 Sep 1;110(3):311–20.
49. Vlaskalic V, Boyd RL, Baumrind S. Etiology and sequelae of root resorption. Semin Orthod. 1998 Jun 1;4(2):124–31.
50. Robert W. DeShields. A Study of Root Resorption in Treated Class II, Division I Malocclusions. Angle Orthod. 1969 Oct 1; 39(4)
51. 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.
52. Brezniak N, Wasserstein A. Root resorption after orthodontic treatment: Part 2. Literature review. American journal of orthodontics and dentofacial orthopedics 1993; 103(2):138–46.
53. Apajalahti S, Peltola JS. Apical root resorption after orthodontic treatment -- a retrospective study. Eur J Orthod. 2007 Aug; 29(4):408–12.
54. Arita K, Hotokezaka H, Hashimoto M, Nakano-Tajima T, Kurohama T, Kondo T, et al. Effects of diabetes on tooth movement and root resorption after orthodontic force application in rats. Orthod Craniofac Res. 2016 May 1; 19(2):83–92.
55. Oyama K, Motoyoshi M, Hirabayashi M, Hosoi K, Shimizu N. Effects of root morphology on stress distribution at the root apex. Eur J Orthod. 2007 Apr; 29(2):113–7.
56. Malmgren O, Goldson L, Hill C, Orwin A, Petrini L, Lundberg M. Root resorption after orthodontic treatment of traumatized teeth. Am J Orthod. 1982; 82(6):487–91.
57. Brin I, Ben-Bassat Y, Heling I, Engelberg A. The influence of orthodontic treatment on previously traumatized permanent incisors. Eur J Orthod. 1991 Oct; 13(5):372–7.
58. Casa MA, Faltin RM, Faltin K, Sander FG, Arana-Chavez VE. Root resorptions in upper first premolars after application of continuous torque moment. Intra-individual study. Journal of orofacial orthopedics = Fortschritte der Kieferorthopädie. 200; 62(4):285–95.
59. Taithongchai R, Sookkorn K, Killiany DM. Facial and dentoalveolar structure and the prediction of apical root shortening. Am J Orthod Dentofacial Orthop. 1996; 110(3):296–302.
60. Sameshima GT, Sinclair PM. Predicting and preventing root resorption: Part II. Treatment factors. American journal of orthodontics and dentofacial orthopedics. 2001; 119(5):511–5.

61. Pamukçu H, Polat-Özsoy Ö, Gülsahi A, Özdemre MÖ. External apical root resorption after nonextraction orthodontic treatment with labial vs. lingual fixed appliances. *J Orofac Orthop.* 2020 Jan 1; 81(1):41–51.
62. Blake M, Woodside DG, Pharoah MJ. A radiographic comparison of apical root resorption after orthodontic treatment with the edgewise and Speed appliances. *American journal of orthodontics and dentofacial orthopedics.* 1995; 108(1):76–84.
63. Chen W, Haq AAA, Zhou Y. Root resorption of self-ligating and conventional preadjusted brackets in severe anterior crowding Class I patients: a longitudinal retrospective study. *BMC Oral Health.* 2015 Oct 1; 15(1).
64. Jacobs C, Gebhardt PF, Jacobs V, Hechtner M, Meila D, Wehrbein H. Root resorption, treatment time and extraction rate during orthodontic treatment with self-ligating and conventional brackets. *Head Face Med.* 2014 Jan 23; 10(1).
65. Kawashima-Ichinomiya R, Yamaguchi M, Tanimoto Y, Asano M, Yamada K, Nakajima R, et al. External apical root resorption and the release of interleukin-6 in the gingival crevicular fluid induced by a self-ligating system. *Open J Stomatol.* 2012 Jun 12; 2(2):116–21.
66. Brezniak N, Wasserstein A. Root Resorption Following Treatment with Aligners. *Angle Orthod.* 2008 Nov 1; 78(6):1119–24.
67. Fang X, Qi R, Liu C. Root resorption in orthodontic treatment with clear aligners: A systematic review and meta-analysis. *Orthod Craniofac Res.* 2019 Nov 1; 22(4):259–69.
68. Gandhi V, Mehta S, Gauthier M, Mu J, Kuo CL, Nanda R, et al. Comparison of external apical root resorption with clear aligners and pre-adjusted edgewise appliances in non-extraction cases: a systematic review and meta-analysis. *Eur J Orthod.* 2021 Feb 1; 43(1):15–24.
69. Guangli Han; Shengfu Huang; Johannes W. Von den Hoff; Xianglong Zeng; Anne Marie Kuijpers-Jagtman. Root resorption after orthodontic intrusion and extrusion: An intraindividual study. *Angle Orthod.* 2005 Dec; 75(6).
70. Yamaguchi M, Fukasawa S. Is Inflammation a Friend or Foe for Orthodontic Treatment?: Inflammation in Orthodontically Induced Inflammatory Root Resorption and Accelerating Tooth Movement. *Int J Mol Sci.* 2021 Mar 1; 22(5):1–21.
71. Jiménez Montenegro VC, Jones A, Petocz P, Gonzales C, Darendeliler MA. Physical properties of root cementum: Part 22. Root resorption after the application of light and heavy extrusive orthodontic forces: a microcomputed tomography study. *Am J Orthod Dentofacial Orthop.* 2012; 141(1):e1.
72. Ballard DJ, Jones AS, Petocz P, Darendeliler MA. Physical properties of root cementum: part 11. Continuous vs intermittent controlled orthodontic forces on root resorption. A microcomputed-tomography study. *Am J Orthod Dentofacial Orthop.* 2009; 136(1):8.e1-8.e8.
73. Lombardo L, Bragazzi R, Perissinotto C, Mirabella D, Siciliani G. Cone-beam computed tomography evaluation of periodontal and bone support loss in extraction cases. *Prog Orthod.* 2013; 14(1).
74. Proffit, W.R., Fields, H.W., Larson, B. and Sarver DM. Contemporary Orthodontic (proffit, 2019). Contemporary orthodontics-e-book Elsevier Health Sciences. 2019;5–24.

75. Antoszewska-Smith J, Sarul M, Łyczek J, Konopka T, Kawala B. Effectiveness of orthodontic miniscrew implants in anchorage reinforcement during en-masse retraction: A systematic review and meta-analysis. *Am J Orthod Dentofacial Orthop.* 2017 Mar 1; 151(3):440–55.
76. Lin L, Ahn HW, Kim SJ, Moon SC, Kim SH, Nelson G. Tooth-borne vs bone-borne rapid maxillary expanders in late adolescence. *Angle Orthod.* 2015 Mar 1; 85(2):253–62.
77. Papadopoulos MA, Papageorgiou SN, Zogakis IP. Clinical effectiveness of orthodontic miniscrew implants: a meta-analysis. *J Dent Res.* 2011 Aug; 90(8):969–76.
78. Jones JP, Elnagar MH, Perez DE. Temporary Skeletal Anchorage Techniques. *Oral Maxillofac Surg Clin North Am.* 2020 Feb 1; 32(1):27–37.
79. Inchingolo AM, Malcangi G, Costa S, Fatone MC, Avantario P, Campanelli M, et al. Tooth Complications after Orthodontic Miniscrews Insertion. *Int J Environ Res Public Health.* 2023 Jan 1; 20(2).
80. Kuroda S, Yamada K, Deguchi T, Hashimoto T, Kyung HM, Yamamoto TT. Root proximity is a major factor for screw failure in orthodontic anchorage. *Am J Orthod Dentofacial Orthop.* 2007 Apr; 131(4 Suppl).
81. Kuroda S, Sugawara Y, Deguchi T, Kyung HM, Takano-Yamamoto T. Clinical use of miniscrew implants as orthodontic anchorage: success rates and postoperative discomfort. *Am J Orthod Dentofacial Orthop.* 2007 Jan; 131(1):9–15.
82. Giudice A Lo, Rustico L, Longo M, Oteri G, Papadopoulos MA, Nucera R. Complications reported with the use of orthodontic miniscrews: A systematic review. *Korean J Orthod.* 2021; 51(3):199–216.
83. Kuroda S, Yamada K, Deguchi T, Hashimoto T, Kyung HM, Yamamoto TT. Root proximity is a major factor for screw failure in orthodontic anchorage. *Am J Orthod Dentofacial Orthop.* 2007 Apr; 131(4 Suppl).
84. Liou EJW, Pai BCJ, Lin JCY. Do miniscrews remain stationary under orthodontic forces? *American Journal of Orthodontics and Dentofacial Orthopedics.* 2004 Jul; 126(1):42–7.
85. Fabbroni G, Aabed S, Mizen K, Starr DG. Transalveolar screws and the incidence of dental damage: a prospective study. *Int J Oral Maxillofac Surg.* 2004 Jul; 33(5):442–6.
86. Renjen R, Maganzini AL, Rohrer MD, Prasad HS, Kraut RA. Root and pulp response after intentional injury from miniscrew placement. *Am J Orthod Dentofacial Orthop.* 2009 Nov; 136(5):708–14.
87. Hwang YC, Hwang HS. Surgical repair of root perforation caused by an orthodontic miniscrew implant. *Am J Orthod Dentofacial Orthop.* 2011 Mar 3; 139(3):407–11.
88. Tronstad L. Root resorption–etiology, terminology and clinical manifestations. *Endod Dent Traumatol.* 1988; 4(6):241–52.
89. BJORN LUDWIG, BETTINA GLASL, S. JAY BOWMAN, BENEDICT WILMES, GERO S.M. KINZINGER, JORG A. LISSON. Anatomical guidelines for miniscrew insertion: Palatal sites. *J Clin Orthod.* 2011 Aug; 45(8):433–41.
90. Smith A, Hosein YK, Dunning CE, Tassi A. Fracture resistance of commonly used self-drilling orthodontic mini-implants. *Angle Orthod.* 2015 Jan 1; 85(1):26–32.
91. Gurdan Z, Szalma J. Evaluation of the success and complication rates of self-drilling orthodontic mini-implants. *Niger J Clin Pract.* 2018 May 1; 21(5):546–52.
92. Chen Y, Kyung HM, Gao L, Yu WJ, Bae EJ, Kim SM. Mechanical properties of self-drilling orthodontic micro-implants with different diameters. *Angle Orthod.* 2010 Sep; 80(5):821–7.

93. Wilmes B, Rademacher C, Olthoff G, Drescher D. Parameters affecting primary stability of orthodontic mini-implants. *J Orofac Orthop.* 2006 May; 67(3):162–74.
94. Jia X, Chen X, Huang X. Influence of orthodontic mini-implant penetration of the maxillary sinus in the infrzygomatic crest region. *Am J Orthod Dentofacial Orthop.* 2018 May 1; 153(5):656–61.
95. Kravitz ND, Kusnoto B. Risks and complications of orthodontic miniscrews. *Am J Orthod Dentofacial Orthop.* 2007 Apr; 131
96. Li N, Sun W, Li Q, Dong W, Martin D, Guo J. Skeletal effects of monocortical and bicortical mini-implant anchorage on maxillary expansion using cone-beam computed tomography in young adults. *Am J Orthod Dentofacial Orthop.* 2020 May 1; 157(5):651–61
97. Bollen AM, Cunha-Cruz J, Bakko DW, Huang GJ, Hujuel PP. The effects of orthodontic therapy on periodontal health: a systematic review of controlled evidence. *Journal of the American Dental Association.* 2008; 139(4):413–22.
98. Papageorgiou SN, Papadelli AA, Eliades T. Effect of orthodontic treatment on periodontal clinical attachment: a systematic review and meta-analysis. *Eur J Orthod.* 2018 Apr 1; 40(2):176–84.
99. Van Gastel J, Quirynen M, Teughels W, Coucke W, Carels C. Influence of bracket design on microbial and periodontal parameters in vivo. *J Clin Periodontol.* 2007 May; 34(5):423–31.
100. Van Gastel J, Quirynen M, Teughels W, Coucke W, Carels C. Longitudinal changes in microbiology and clinical periodontal variables after placement of fixed orthodontic appliances. *J Periodontol.* 2008 Nov; 79(11):2078–86.
101. Evangelista K, Vasconcelos KDF, Bumann A, Hirsch E, Nitka M, Silva MAG. Dehiscence and fenestration in patients with Class I and Class II Division 1 malocclusion assessed with cone-beam computed tomography. *Am J Orthod Dentofacial Orthop.* 2010; 138(2):133.e1-133.e7.
102. Sheng Y, Guo HM, Bai YX, Li S. Dehiscence and fenestration in anterior teeth: Comparison before and after orthodontic treatment. *Journal of Orofacial Orthopedics.* 2020 Jan 1; 81(1):1–9.
103. Lund H, Gröndahl K, Gröndahl HG. Cone beam computed tomography evaluations of marginal alveolar bone before and after orthodontic treatment combined with premolar extractions. *Eur J Oral Sci.* 2012 Jun 1; 120(3):201–11.
104. Renkema AM, Fudalej PS, Renkema AAP, Abbas F, Bronkhorst E, Katsaros C. Gingival labial recessions in orthodontically treated and untreated individuals: a case – control study. *J Clin Periodontol.* 2013 Jun 1; 40(6):631–7.
105. Manuelli M, Marcolina M, Nardi N, Bertossi D, de Santis D, Ricciardi G, et al. Oral mucosal complications in orthodontic treatment. *Minerva Stomatol.* 2019 Feb 1; 68(2):84–8.
106. Kim H, Kim JS, Kim CS, Becker-Weimann SY, Cha JY, Choi SH. Skin irritation in children undergoing orthodontic facemask therapy. *Sci Rep.* 2023 Feb 7; 13(1):1–9.
107. Inger Egermark, Gunnar E. Carlsson, Tomas Magnusson. A Inger Egermark, Gunnar E. Carlsson, Tomas Magnusson. A prospective long-term study of signs and symptoms of temporomandibular disorders in patients who received orthodontic treatment in childhood. *Angle Orthod.* 2005 Aug; 75(4):645–50.

108. Fernández-González FJ, Cañigral A, López-Caballo JL, Brizuela A, Moreno-Hay I, del Río-Highsmith J, et al. Influence of orthodontic treatment on temporomandibular disorders. A systematic review. *J Clin Exp Dent.* 2015; 7(2):e320.
109. Simonsen AB, Deleuran M, Johansen JD, Sommerlund M. Contact allergy and allergic contact dermatitis in children - a review of current data. *Contact Dermatitis.* 2011 Nov; 65(5):254–65.
110. Krob HA, Fleischer AB, D'Agostino R, Haverstock CL, Feldman S. Prevalence and relevance of contact dermatitis allergens: a meta-analysis of 15 years of published T.R.U.E. test data. *J Am Acad Dermatol.* 2004 Sep; 51(3):349–53.
111. VAN HOOGSTRATE IMW, ANDERSEN KE, VON BLOMBERG BME, BODEN D, BRUYNZEEL DP, BURROWS D, et al. Reduced frequency of nickel allergy upon oral nickel contact at an early age. *Clin Exp Immunol.* 1991; 85(3):441–5.
112. Novak N, Gros E, Bieber T, Allam JP. Human skin and oral mucosal dendritic cells as “good guys” and “bad guys” in allergic immune responses. *Clin Exp Immunol.* 2010 Jul; 161(1):28–33.
113. Götz L, Papageorgiou SN, Jäger A. Nickel hypersensitivity and orthodontic treatment: a systematic review and meta-analysis. *Contact Dermatitis.* 2015 Jul 1; 73(1):1–14.
114. Kolokitha OE, Kaklamanos EG, Papadopoulos MA. Prevalence of nickel hypersensitivity in orthodontic patients: a meta-analysis. *Am J Orthod Dentofacial Orthop.* 2008; 134(6):722.e1–722.e12.
115. Simon J, Littlewood, Laura Mitchell. An Introduction to Orthodontics - Fifth edition. In: An Introduction to Orthodontics - Fifth edition. 5th ed. 2019. p. 52–3.
116. Rischen RJ, Breuning KH, Bronkhorst EM, Kuijpers-Jagtman AM. Records needed for orthodontic diagnosis and treatment planning: a systematic review. *PLoS One.* 2013 Nov 12; 8(11).
117. Meriç P, Kılıç DD. Anamnesis and examination forms used in orthodontic clinics: A pilot study. *American Journal of Orthodontics and Dentofacial Orthopedics.* 2022 Oct 1;162(4):e169–75.
118. Benjamin EJ, Virani SS, Callaway CW, Chamberlain AM, Chang AR, Cheng S, et al. Heart Disease and Stroke Statistics-2018 Update: A Report From the American Heart Association. *Circulation.* 2018 Mar 1; 137(12):E67–492.
119. Bensch L, Braem M, Willems G. Orthodontic considerations in the diabetic patient. *Semin Orthod.* 2004 Dec 1;10(4):252–8.
120. Shah R, Collins JM, Hodge TM, Laing ER. A national study of cross infection control: “are we clean enough?” *Br Dent J.* 2009 Sep 26; 207(6):267–74.
121. Smith DA, Nehring SM. Bacteremia. *Pediatric Emergency Medicine.* 2022 Jul 31; 530–4.
122. Senkutvan RS, Jacob S, Krishnan CS, Subbiah S. Clinical Management of Medical Disorders in Orthodontics. *International Journal of Dental Sciences and Research.* 2014; 2(2):36–41.
123. Hobson RS, Clark JD. Infective Endocarditis Associated with Orthodontic Treatment: A Case Report. *Br J Orthod.* 2016; 20(3):241–4.
124. Ziolkowska L, Olczak-Kowalczyk D, Kawalec W, Turska-Kmiec A. Fixed orthodontic appliance and infective endocarditis. *Pediatric Infectious Disease Journal.* 2010 Dec; 29(12):1155–6.
125. Dajani AS. Bacterial endocarditis after minor orthodontic procedures. *J Pediatr.* 1991 Aug 1; 119(2):339–40.

126. Biancaniello TM, Romero JR. Bacterial endocarditis after adjustment of orthodontic appliances. *J Pediatr.* 1991 Feb 1;118(2):248–9.
127. Pallasch TJ, Slots J. Antibiotic prophylaxis and the medically compromised patient. *Periodontol 2000.* 1996 Feb 1; 10(1):107–38.
128. Nejat Erverdi, Ahu Acar, Bükem İslgüden, Tanju Kadir. Investigation of Bacteremia after Orthodontic Banding and Debonding Following Chlorhexidine Mouth Wash Application. *Angle Orthod.* 2001 Jun; 71(3):190–4.
129. Vandersluis YR, Suri S. Infective endocarditis and orthodontic implications in children: A review of the literature. *Am J Orthod Dentofacial Orthop.* 2020 Jan 1; 157(1):19–28.
130. Krishnan V. Orthodontic pain: from causes to management--a review. *Eur J Orthod.* 2007; 29(2):170–9.
131. Krishnan V, Davidovitch Z. Cellular, molecular, and tissue-level reactions to orthodontic force. *Am J Orthod Dentofacial Orthop.* 2006; 129(4):469.e1-469.e32.
132. Inauen DS, Papadopoulou AK, Eliades T, Papageorgiou SN. Pain profile during orthodontic levelling and alignment with fixed appliances reported in randomized trials: a systematic review with meta-analyses. *Clin Oral Investig.* 2023
133. Stewart FN, Kerr WJS, Taylor PJS. Appliance wear: the patient's point of view. *Eur J Orthod.* 1997; 19(4):377–82.
134. Marques LS, Paiva SM, Vieira-Andrade RG, Pereira LJ, Ramos-Jorge ML. Discomfort associated with fixed orthodontic appliances: determinant factors and influence on quality of life. *Dental Press J Orthod.* 2014 May 1; 19(3):102–7.
135. Feldmanna I. Satisfaction with orthodontic treatment outcome. *Angle Orthod.* 2014; 84(4):581–7.
136. Campos LA, Santos-Pinto A, Marôco J, Campos JADB. Pain perception in orthodontic patients: A model considering psychosocial and behavioural aspects. *Orthod Craniofac Res.* 2019 Aug 1; 22(3):213–21.
137. Sandhu SS, Leckie G. Orthodontic pain trajectories in adolescents: Between-subject and within-subject variability in pain perception. *Am J Orthod Dentofacial Orthop.* 2016 Apr 1; 149(4):491-500.e4.
138. Cioffi I, Michelotti A, Perrotta S, Chiodini P, Ohrbach R. Effect of somatosensory amplification and trait anxiety on experimentally induced orthodontic pain. *Eur J Oral Sci.* 2016 Apr 1; 124(2):127–34.
139. Sandhu SS, Sandhu J. Effect of physical activity level on orthodontic pain perception and analgesic consumption in adolescents. *Am J Orthod Dentofacial Orthop.* 2015 Oct 1; 148(4):618–27.
140. Topolski F, Moro A, Correr GM, Schimim SC. Optimal management of orthodontic pain. *J Pain Res.* 2018 Mar 16; 11:589–98.
141. Sudhakar V, Vinodhini TS, Mathan Mohan A, Srinivasan B, Rajkumar BK. The efficacy of different pre- and post-operative analgesics in the management of pain after orthodontic separator placement: A randomized clinical trial. *J Pharm Bioallied Sci.* 2014; 6(Suppl 1).
142. Patel S, McGorray SP, Yezierski R, Fillingim R, Logan H, Wheeler TT. Effects of analgesics on orthodontic pain. *Am J Orthod Dentofacial Orthop.* 2011 Jan; 139(1).
143. Polat O, Karaman AI. Pain control during fixed orthodontic appliance therapy. *Angle Orthod.* 2005 Mar; 75(2):214–9.

- 144.Ghadirian H, Nik TH, Shahsavari N, Ghadirian H, Ostad SN. Acetaminophen Versus Liquefied Ibuprofen for Control of Pain During Separation in Orthodontic Patients: A Randomized Triple Blinded Clinical Trial. *Acta Med Iran.* 2016 Jul 9; 54(7):418–21
- 145.Bird SE, Williams K, Kula K. Preoperative acetaminophen vs ibuprofen for control of pain after orthodontic separator placement. *Am J Orthod Dentofacial Orthop.* 2007 Oct; 132(4):504–10.
- 146.Salmasian R, Oesterle LJ, Shellhart WC, Newman SM. Comparison of the efficacy of ibuprofen and acetaminophen in controlling pain after orthodontic tooth movement. *Am J Orthod Dentofacial Orthop.* 2009 Apr; 135(4):516–21.
- 147.Tunçer Z, Polat-Ozsoy O, Demirbilek M, Bostanoglu E. Effects of various analgesics on the level of prostaglandin E2 during orthodontic tooth movement. *Eur J Orthod.* 2014; 36(3):268–74.
- 148.Li FJ, Zhang JY, Zeng XT, Guo Y. Low-level laser therapy for orthodontic pain: a systematic review. *Lasers Med Sci.* 2015 Aug 8; 30(6):1789–803.
- 149.Pringle AM, Petrie A, Cunningham SJ, McKnight M. Prospective randomized clinical trial to compare pain levels associated with 2 orthodontic fixed bracket systems. *Am J Orthod Dentofacial Orthop.* 2009 Aug; 136(2):160–7.
- 150.Pithon MM, Santos Fonseca Figueiredo D, Oliveira DD, Coqueiro R da S. What is the best method for debonding metallic brackets from the patient's perspective? *Prog Orthod.* 2015 Dec 1; 16(1).
- 151.Lee-Knight CT, Wylie SG, Major PW, Glover KE, Grace M. Mechanical and electrotermal debonding: effect on ceramic veneers and dental pulp. *Am J Orthod Dentofacial Orthop.* 1997; 112(3):263–70.
- 152.Normando TS, Calçada FS, Ursi W, Normando D. Patients' report of discomfort and pain during debonding of orthodontic brackets: a comparative study of two methods. *World J Orthod.* 2010;
- 153.Prasad Gupta S, Rauniyar S, Prasad P, Man P, Pradhan S. A randomized controlled trial to evaluate the effectiveness of different methods on pain management during orthodontic debonding. *Prog Orthod.* 2022; 23:7.
- 154.Cardoso PC, Espinosa DG, Mecenas P, Flores-Mir C, Normando D. Pain level between clear aligners and fixed appliances: a systematic review. *Prog Orthod.* 2020 Dec 1; 21(1).
- 155.Milton TM, Hearing SD, Ireland AJ. Ingested foreign bodies associated with orthodontic treatment: report of three cases and review of ingestion/aspiration incident management. *Br Dent J.* 2001; 190(11):592–6.
- 156.Tiwana KK, Morton T, Tiwana PS. Aspiration and ingestion in dental practice: a 10-year institutional review. *J Am Dent Assoc.* 2004; 135(9):1287–91.
- 157.Qabool H, Sukhia RH, Fida M. Assessment of cooperation and compliance in adult patients at three stages of orthodontic treatment at a tertiary care hospital: A cross-sectional study. *Int Orthod.* 2020 Dec 1;18(4):794–800.