Literatur

Endodontie 2024: nicht alles neu, doch vieles anders

Dr. Ralf Schlichting, ZMK, Jg. 40, Ausgabe 4, April 2024, 184 – 194

[1] Siqueira JF Jr. Endodontic Infections: concepts, paradigms and perspectives. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2002; 94: 281-93

[2] Nair PNR, Sjögren U, Kahnberg KE, Krey G, Sundqvist G. Intraradicular bacteria and fungi in root-filled, asymptomatic human teeth with therapy-resistant periapical lesions: a long-term light and electron microscopic follow-up study. J Endod 1990; 16: 580–8

[3] Costerton JW, Veeh R, Shirtcliff M, Pasmore M, Post C: The application of biofilm science to the study and control of chronic bacteria infections. Journal of Clinical Investigations 2003; 112: 1466-77

[4] Olsen, I. Biofilm-specific antibiotic tolerance and resistance. European Journal of Clinical Microbiology and Infectious Diseases 2015 ; 34: 877–886

[5] Siqueira, J.F. Jr. & Rôças, I.N. Community as the unit of pathogenicity: an emerging concept as to the microbial pathogenesis of apical periodontitis. Oral Surgery Oral Medicine Oral Pathology Oral Radiology and Endodontology, 2009; 107: 870–878

[6] Chugal, N., Wang, J.-K., Wang, R., He, X., Kang, M.O., Li, J. et al. Molecular characterization of the microbial flora residing at the apical portion of infected root canals of human teeth. J Endod 2011; 37: 1359–1364.

[7] Siqueira, J.F. Jr. & Rôças, I.N. Diversity of endodontic microbiota revisited.J Dent Res 2009; 88,: 969–981

[8] Ricucci, D., Siqueira, J.F. Jr. Biofilms and apical periodontitis: study of prevalence and association with clinical and histopathologic findings. J Endod 2010; 36: 1277–1288.

[9] Ricucci, D. & Siqueira, J.F. Jr. Fate of the tissue in lateral canals and apical ramifications in response to pathologic conditions and treatment procedures. J Endod 2010; 36: 1–15.

[10] Pérez, A.R., Ricucci, D., Vieira, G.C.S., Provenzano, J.C., Alves, F.R.F., Marceliano-Alves, M.F. et al. Cleaning, shaping, and disinfecting abilities of 2 instrument systems as evaluated by a correlative micro-computed tomographic and histobacteriologic approach. J Endod 2020; 46: 846–857

[11] Kwang S, Abbott P. The presence and distribution of bacteria in dentinal tubules of root filled teeth. Int Endod J. 2014; 47: 600-10

[12] Dalton BC, Orstavik D, Philips C, Pettiette M, Trope M. Bacterial reduction with nickel-titanium rotary instrumentation. J Endod 1998; 24: 763-767

[13] Messing M, Souza LC, Cavalla F, Kookal KK, Rizzo G, Walji M, Silva R, Letra A. Investigating Potential Correlations between Endodontic Pathology and Cardiovascular Diseases Using Epidemiological and Genetic Approaches. J Endod. 2019;45: 104-110

[14] Garrido M, Cárdenas AM, Astorga J, Quinlan F, Valdés M, Chaparro A, Carvajal P, Pussinen P, Huamán-Chipana P, Jalil JE, Hernández M. Elevated Systemic Inflammatory Burden and Cardiovascular Risk in Young Adults with Endodontic Apical Lesions. J Endod. 2019; 45: 111-115

[15] Yip N, Liu C, Wu D, Fouad AF. The association of apical periodontitis and type 2 diabetes mellitus: A large hospital network cross-sectional case-controlled study. J Am Dent Assoc. 2021; 152: 434–443

[16] Pérez-Losada FDL, Estrugo-Devesa A, Castellanos-Cosano L, Segura-Egea JJ, López-López J, Velasco-Ortega E. Apical periodontitis and diabetes mellitus type 2: A systematic review and meta-analysis. J Clin Med. 2020; 9: 540

[17] Saleh W, Xue W, Katz J. Diabetes mellitus and periapical abscess: A cross-sectional study. J Endod. 2020; 46: 1605–1609

[18] Smadi L. Apical periodontitis and endodontic treatment in patients with type II diabetes mellitus: Comparative cross-sectional survey. J Contemp Dent Pract. 2017; 18: 358–362

[19] Jakovljevic, A.; Sljivancanin Jakovljevic, T.; Duncan, H.; Nagendrababu, V.; Jacimovic, J.; Aminoshariae, A.; Milasin, J.; Dummer, P. The association between apical periodontitis and adverse pregnancy outcomes: A systematic review. Int. Endod. J. 2021; 54: 1527–1537

[20] Ideo,F.;Niazi,S.;Mezzena,S.;Mannocci,F.;Cotti,E.PrevalenceofApicalPeriodontitisinPatientswithAutoimmuneDiseases under Immunomodulators: A Retrospective Cohort Study. J. Endod. 2022; 48: 722–729

[21] Neelakantan, P., Romero, M., Vera, J., Daood, U., Khan, A., Yan, A. et al. Biofilms in endodontics—current status and future directions. International Journal of Molecular Sciences 2017; 18: I748

[22] Johnson BR. Endodontic access. Gen Dent 2009; 57: 570-577.

[23] Ehrhardt I.C. Zuolo M.L. Cunha R.S. et al. Assessment of the separation incidence of Mtwo files used with preflaring: prospective clinical study. J Endod. 2012; 38: 1078-1081

[24] Tan B.T. Messer H.H.The effect of instrument type and preflaring on apical file size determination. Int Endod J. 2002; 35: 752-758

[25] Fogarty T.J. Montgomery S.Effect of preflaring on canal transportation. Evaluation of ultrasonic, sonic, and conventional techniques. Oral Surg Oral Med Oral Pathol. 1991; 72: 345-350.

[26] Bóveda, C. & Kishen, A. Contracted endodontic cavities: the foundation for less invasive alternatives in the management of apical periodontitis. Endodontic Topics 2015;33: 169–186.

[27] Silva, E.J.N.L., Pinto, K.P., Ferreira, C.M., Belladonna, F.G., De-Deus, G., Dummer, P.M.H.et al. Current status on minimal access cavity preparations: a critical analysis and a proposal for a universal nomenclature. Int Endod J. 2020; 53: 1618–1635.

[28] Santosh, S.S., Ballal, S. & Natanasabapathy, V. Influence of minimally invasive access cavity designs on the fracture resistance of endodontically treated mandibular molars subjected to thermocycling and dynamic loading. J Endod 2021; 47: 1496–1500

[29] Abou-Elnaga, M.Y., Alkhawas, M.A.M., Kim, H.C.& Refai, A.S. Effect of truss access and artificial truss restoration on the fracture resistance of endodontically treated mandibular first molars. J Endod 2019; 45: 813–817

[30] Augusto, C.M., Barbosa, A.F.A., Guimaraes, C.C., Lima, C.O., Ferreira, C.M., Sassone, L.M. et al. A laboratory study of the impact of ultraconservative access cavities and minimal root canal tapers on the ability to shape canals in extracted mandibular molars and their fracture resistance. Int Endod J 2020; 53: 1516–1529

[31] Lima, C.O., Barbosa, A.F.A., Ferreira, C.M., Augusto, C.M., Sassone, L.M., Lopes, R.T. et al. The impact of minimally invasive root canal preparation strategies on the shaping ability of mandibular molars. Int Endod J 2020; 53: 1680–1688

[32] Roperto, R., Sousa, Y.T., Dias, T., Machado, R., Perreira, R.D., Leoni, G.B. et al. Biomechanical behavior of maxillary premolars with conservative and traditional endodontic cavities. Quintessence International 2019; 50: 350–356

[33] Rampado ME, Tjäderhane L, Friedman S, Hamstra SJ. The benefit of the operating microscope for access cavity preparation by undergraduate students. J Endod. 2004; 30: 863-867.

[34] Aung NM, Myint KK. Diagnostic Accuracy of CBCT for Detection of Second Canal of Permanent Teeth: A Systematic Review and Meta-Analysis. Int J Dent. 2021; 20: 1107471

[35] García-Font M, Duran-Sindreu F, Calvo C, Basilio J, Abella F, Ali A, Roig M, Olivieri JG. Comparison of postoperative pain after root canal treatment using reciprocating instruments based on operator's experience: A prospective clinical study. J Clin Exp Dent. 2017; 9: e869-e874

[36] Bird DC, Chambers D, Peters OA. Usage parameters of nickel-titanium rotary instruments: a survey of endodontists in the United States. J Endod. 2009; 35: 1193-1197

[37] Anderson M, Price JW, Parashos P Fracture resistance of electropolished rotary nickel-titanium endodontic instrumentsJ. Endod 2007; 33: 1212-1216

[38] Alapati S. B., Brantley W. A., Iijima M., et al. Metallurgical characterization of a new nickel-titanium wire for rotary endodontic instruments. J Endod 2009; 35: 1589–1593

[39] Nakatsukasa T, Ebihara A, Kimura S, Maki K, Nishijo M, Tokita T, Okiji T: Comparative evaluation of mechanical properties and shaping performance of heat-treated nickel titanium rotary instruments used in single lengt technique.Dent Mat J 2021; 40: 743-749

[40] Brantley WA, Alapati SB. Heat treatment of dental alloys:a review. In Metallurgy-advances in materials and processes. 2012 Intech

[41] Donnermeyer D, Viedenz A, Schäfer E, Bürklein S. Impact of new cross-sectional designs on the shaping ability of rotary NiTi instruments in S-shaped canals. Odontology. 2020; 108: :174-179

[42] Turpin YL, Chagneau F, Vulcain JM (2000) Impact of two theoretical cross-sections on torsional and bending stresses of nickel-titanium root canal instrument models. J Endod 26, 414-417

[43] Logsdon J, Dunlap C, Arias A, Scott R, Peters OA. Current Trends in Use and Reuse of Nickel-Titanium Engine-driven Instruments: A Survey of Endodontists in the United States. J Endod. 2020; 4: 391-396

[44] Willershausen I, Wolf TG, Schmidtmann I, Berger C, Ehlers V, Willershausen B, Briseño B. Survey of root canal irrigating solutions used in dental practices within Germany. Int Endod J. 2014:1–7.

[45] Dutner J, Mines P, Anderson A. Irrigation trends among American Association of Endodontists mem- bers: a web-based survey. J Endod. 2012; 38 (1): 37–40.

[46] Naenni, N., Thoma, K., and Zehnder, M. Soft tissue dissolution capacity of currently used and potential endodontic irrigants. J Endod. 2004; 30: 785–787

[47] Gutierrez, J.H., Jofre, A., and Villena, F. Scanning electron microscope study on the action of endodontic irrigants on bacteria invading the dentinal tubules. Oral Surg Oral Med Oral Pathol. 1990; 69: 491–501

[48] Clegg MS, Vertucci FJ, Walker C, Belanger M, Britto LR. The effect of exposure to irrigant solutions on apical dentin biofilms in vitro. J Endod. 2006;32: 434–7.

[49] Cvek, M., Nord, C.E., and Hollender, L. Antimicrobial effect of root canal debridement in teeth with immature root. A clinical and microbiologic study. Odontol Revy. 1976; 27: 1–10

[50] Retamozo B, Shabahang S, Johnson N, Aprecio RM, Torabinejad M. Minimum contact time and concentration of sodium hypochlorite required to eliminate Enterococcus faecalis. J Endod. 2010; 36: 520-3.

[51] Yamada R, Armas A, Goldman M, Pin P: A scanning electron microscopic comparison of a high-volume final flush with several irrigating solutions. Part 3. J Endod 1983; 9: 137-42

[52] Abou-Rass, M. and Oglesby, S.W. The effects of temperature, concentration, and tissue type on the solvent ability of sodium hypochlorite. J Endod. 1981; 7: 376–377

[53] Dychdala, G.R. Chlorine and chlorine compounds. in: S.S. Block (Ed.) Disinfection, sterilization and preservation. Lea & Febiger, Philadelphia; 1991: 131–151

[54] Hemptinne F, Slaus G, Vandendael M, Jaquet W, DeMoore R, Bottenberg B. In vivo intracanal temperature evolution after the injection of room temperature or pre heated sodium hypochlorite. J Endod. 2015;41: 1112-1115

[55] Kuruvilla JR, Kamath MP. Antimicrobial activity of 2.5% sodium hypochlorite and 0.2% chlorhexidine gluconate separately and combined, as endodontic irrigants. J Endod. 1998; 24: 472.

[56] Rocha AW, de Andrade CD, Leitune VC, Collares FM, Samuel SM, Grecca FS, de Figueiredo JA, dos Santos RB. Influence of endodontic irrigants on resin sealer bond strength to radicular dentin. Bull Tokyo Dent Coll. 2012; 53 (1): 1–7.

[57] Lester, K.S. and Boyde, A. Scanning electron microscopy of instrumented, irrigated and filled root canals. Br Dent J. 1977; 143: 359–367

[58] Nygaard Östby, B. Chelation in root canal therapy. Odontol Tidskr. 1957; 65: 3–11

[59] Loel, D.A. Use of acid cleanser in endodontic therapy. J Am DeAssoc. 1975; 90: 148–151

[60] Mayer BE, Peters OA, Barbakow F: Effects of rotary instruments and ultrasonic irrigation on debris and „Smear layer“ scores: a scanning electon microscopic studa. Int Endod J 2002; 35: 582-89

[61] Zehnder, M., Schmidlin, P., Sener, B., and Waltimo, T. Chelation in root canal therapy reconsidered. *J Endod*. 2005; 31: 817–820

[62] Gulabivala K, Patel B, Evans G, et al. Effects of mechanical and chemical procedures on root canal surfaces. Endod Top. 2005; 10: 103–22

[63] Calt S, Serper A: Time-dependent effects of EDTA on dentin structures. J Endod 2002; 28: 17-19

[64] Fidalgo TK, Barcelos R, Portela MB, Soares RM, Gleiser R, Silva-Filho FC.: Inhibitory activity of root canal irrigants against Candida albicans,

Enterococcus faecalis and Staphylococcus aureus. Braz Oral Res. 2010 Oct-Dec;24(4):406-12.

[65] Zehnder M, Schmidlin P, Sener B, Waltimo T. Chelation in root canal therapy reconsidered. J Endod. 2005; 31: 817–20.

[66] Tartari BM, Guimarães LS, Amoras MA, Duarte PA, Silva e Souza CM. Bramante Etidronate causes minimal changes in the sodium hypochlorite ability to dis- solve organic matter. Int Endod J. 2015; 48: 399–404.

[67] Lottanti S, Gautschi H, Sener B, Zehnder M. Effects of ethylenediaminetetraacetic, etidronic and peracetic acid irrigation on human root dentine and the smear layer. Int Endod J. 2009; 42: 335–43.

[68] Campello AF, Rodrigues RCV, Alves FRF, Miranda KR, Brum SC, Mdala I, Siqueira JF Jr, Rôças IN. Enhancing the Intracanal Antibacterial Effects of Sodium Hypochlorite with Etidronic Acid or Citric Acid. J Endod. 2022; 48: 1161-1168

[69] Morago A, Ruiz-Linares M, Ferrer-Luque CM, Baca P, Rodríguez Archilla A, Arias-Moliz MT. Dentine tubule disinfection by different irrigation protocols. Microsc Res Tech. 2019; 82: 558-563.

[70] Tartari T, Duarte Junior AP, Silva Júnior JOC, Klautau EB, Mario Honorato Silva E Souza Junior; Patrícia de Almeida Rodrigues Silva E Souza. Etidronate from medicine to endodontics: effects of different irrigation regimes on root dentin roughness. J Appl Oral Sci. 2013; 21: 409–15

[71] N. V. Ballal , S.Das, B.S.S Rao, M. Zehnder, D.Mohn. Chemical, cytotoxic and genotoxic analysis of etidronate in sodium hypochlorite solution. Int Endod J. First published 08 March 2019

[72] Torabinejad M, Johnson WB, Inventors; US patent and trademark office, assignee. Irrigation solution and methods for use. USA. 2003

[73] Torabinejad M, Shabahang S, Aprecio RM, Kettering JD. The antimicrobial effect of mtad: an in vitro investigation. J Endod. 2003; 29: 400–3.

[74] Tay FR, Hosoya Y, Loushine RJ, Pashley DH, Weller RN, Low DC. Ultrastructure of intraradicular dentin after irrigation with BioPure MTAD. II. The consequence of obturation with an epoxy resin-based sealer. J Endod. 2006; 32: 473.

[75] Krause TA, Liewehr FR, Hahn CL. The antimicrobial effect of mtad, sodium hypochlorite, doxycycline, and citric acid on enterococcus faecalis. J Endod. 2007; 33:28–30.

[76] Tay FR, Pashley DH, Loushine RJ, Doyle MD, Gillespie WT, Weller RN, et al. Ultrastructure of smear layer-covered intraradicular dentin after irrigation with BioPure MTAD. J Endod. 2006; 32 :218.

[77] Castagnola R, Martini C, Colangeli M, Pellicciotta I, Marigo L, Grande NM, Bugli F, Plotino G. In Vitro Evaluation of Smear Layer and Debris Removal and Antimicrobial Activity of Different Irrigating Solutions. Eur Endod J. 2023 Nov 15. Doi

[78] Lee, S., Wu, M., and Wesselink, P. The effectiveness of syringe irrigation and ultrasonics to remove debris from simulated irregularities within prepared root canal walls**.** Int Endod J. 2004; 37: 672–678

[79] DiVito E, Peters OA, Olivi G (2012) Effectiveness of the erbium:YAG laser and new design radial and stripped tips in removing the smear layer after root canal instrumentation. Lasers Med Sci 27:273-280.

[80] Van Der Sluis, L.W., Versluis, M., Wu, M. et al. Passive ultrasonic irrigation of the root canal: a review of the literature. Int Endod J. 2007; 40: 415–426

[81] Gu, L.S., Kim, J.R., Ling, J. et al. Review of contemporary irrigant agitation techniques and devices. J Endod. 2009; 35: 791–804

[82] Thomas, A.R., Velmurugan, N., Smita, S., and Jothilatha, S. Comparative evaluation of canal isthmus debridement efficacy of modified Endovac technique with different irrigation systems. J Endod. 2014; 40: 1676–1680

[83] Ordinola-Zapata, R., Bramante, C.M., Aprecio, R.M. et al. Biofilm removal by 6% sodium hypochlorite activated by different irrigation techniques. Int Endod J. 2014; 47: 659–666

[84] Jiang L-M, Verhaagen B, Versluis M, van der Sluis LW (2010a) Evaluation of a sonic device designed to activate irrigant in the root canal. Journal of Endodontics 36, 143– 6

[85] Klyn SL, Kirkpatrick TC, Rutledge RE (2010) In vitro comparisons of debris removal of the EndoActivator system, the F file, ultrasonic irrigation, and NaOCl irrigation alone after hand-rotary instrumentation in human mandibular molars. Journal of Endodontics 36, 1367– 71

[86] Jensen SA, Walker TL, Hutter JW, Nicoll BK (1999) Comparison of the cleaning efficacy of passive sonic activation and passive ultrasonic activation after hand instrumentation in molar root canals. Journal of Endodontics 25, 735– 8.

[87] A. J. Conde AJ, Estevez R,Lorono G, Valencia del Pablo O, Rossi-Fedele G, Cisneros R. Effect of sonic and ultrasonic activation on organic tissue dissolution from simulated grooves in root canals using sodium hypochlorite and EDTA. Int Endod J 2016;50: 3 Nov 2016

[88] Blanken JW, Verdaasdonk R. Cavitation as a working mechanism of the Er, Cr:YSGG laser in end- odontics: a visualization study. J Oral Laser Appl. 2007; 7: 97–106

[89] Galler KM, Grubmüller V, Schlichting R, Widbiller M, Eidt A, Schuller C, Wölflick M, Hiller KA, Buchalla W. Penetration depth of irrigants into root dentine after sonic, ultrasonic and photoacoustic activation. Int Endod J. 2019 Aug;52(8):1210-1217

[90] Peters OA, Bardsley S, Fong J, Pandher G, Divito E (2011) Disinfection of root canals with photon-initiated photoacoustic streaming. J Endod 37: 1008-1012.

[91] Peeters HH, Mooduto L (2013) Radiographic examination of apical extrusion of root canal irrigants during cavitation induced by Er,Cr:YSGG laser irradiation: an in vivo study. Clin Oral Invest 17: 2105-2012.

[92] Donnermeyer D, Averkorn C, Bürklein S, Schäfer E. Cleaning Efficiency of Different Irrigation Techniques in Simulated Severely Curved Complex Root Canal Systems. J Endod. 2023 Aug 14: S0099-2399(23)00496

[93] Schuler J, Hülsmann M. PIPS (Photon Induced Photoacoustic Streaming). Eine Literaturübersicht. Endodontie 2018; 27 (4): 397-406

[94] Camilleri J, Atmeh A, Li X, Meschi N. Present status and future directions: Hydraulic materials for endodontic use. Int Endod J. 2022; 55 Suppl 3: 710-777

[95] Camilleri, J. & Aznar Portoles, C. Clinical perspective of hydraulic materials developed for root-end surgery. Special edition: Endodontics in the era of hydraulic cements. Endodontic Practice Today, 2020; 14: 205–216

[96] Atmeh AR, Hadis M, Camilleri J (2020) Real-time chemical analysis of root filling materials with heating: guidelines for safe temperature levels. Int Endod J 2020; 53: 698–708

[97] Al-Haddad A, Che Ab Aziz ZA (2021) Bioceramic-based root canal sealers: a review. International Journal of Biomaterials 2021; 9753210: 1–10

[98] Camilleri J, Laurent P, About I.: Hydration of biodentine,Theracal LC, and a prototype tricalcium silicate-based dentin replacement material after pulp capping in entire tooth cultures. J Endod. 2014; 40: 1846–54

[99] Koch K, Brave D, AliNasseh A.: A review of bioceramic technology in endodontics. Roots. 2013; 1: 10–3

[100] Jung S, Sielker S, Hanisch MR, Libricht V, Schäfer E, Dam- maschke T. Cytotoxic effects of four different root canal sealers on human osteoblasts. PLoS One. 2018; 13: e0194467

[101] Gomes PS, Pinheiro B, Colaço B, Fernandes MH. The Osteogenic Assessment of Mineral Trioxide Aggregate-based Endodontic Sealers in an Organotypic Ex Vivo Bone Development Model. J Endod. 2021; 47: 1461-1466.

[102] Güven EP, Taşlı PN, Yalvac ME, Sofiev N, Kayahan MB, Sahin F. In vitro comparison of induction capacity and biomineraliza- tion ability of mineral trioxide aggregate and a bioceramic root canal sealer. Int Endod J. 2013; 46: 1173–82

[103] Alsubait SA, Al Ajlan R, Mitwalli H, Aburaisi N, Mahmood A, Muthurangan M, Almadhri R, Alfayez M, Anil S. Cytotoxicity of different concentrations of three root canal sealers on human mesenchymal stem cells. Biomolecules. 2018;1: 8 E68.

[104] Colombo M, Poggio C, Dagna A, Meravini MV, Riva P, Trovati F, Pietrocola G. Biological and physico-chemical properties of new root canal sealers. J Clin Exp Dent. 2018; 10: 120-6

[105] Alsubait S, Albader S, Alajlan N, Alkhunaini N, Niazy A, Almahdy A. Comparison of the antibacterial activity of calcium silicate- and epoxy resin-based endodontic sealers against Enterococcus faecalis biofilms: a confocal laser-scanning microscopy analysis. Odontology. 2019; 107: 513-520

[106] Camilleri J, Atmeh A, Li X, Meschi N. Present status and future directions: Hydraulic materials for endodontic use. Int Endod J. 2022; 55 Suppl 3: 710-777

[107] Torabinejad M,Parirokh M, Dummer PMH.Mineraltrioxide aggregate and other bioactive endodontic cements: an updated overview—part II: other clinical applications and complications. Int Endod J. 2018; 51: 284–317

[108] G.T. Candeiro, F.C. Correia, M.A. Duarte, D.C. Ribeiro-Siqueira, G. Gavini Evaluation of radiopacity, pH, release of calcium ions, and flow of a bioceramic root canal sealer J Endod 2012; 38: 842-845

[109] Kwak SW, Koo J, Song M, Jang IH, Gambarini G, Kim HC. Physicochemical Properties and Biocompatibility of Various Bioceramic Root Canal Sealers: In Vitro Study. J Endod. 2023; 49: 871-879

[110] Jacobson HL, Xia T, Baumgartner JC: Microbial leakage evaluation of the continuous wave of condensation.J Endod. 2002; 28: 269-71

[111] Koch KA, Brave DG, Nasseh AA. Bioceramic technology: closing the endorestorative circle, Part I. Dent Today 2010; 29: 100-105

[112] Schilder H: Filling root canals in three dimensions, Dent Clin North Ampp.; 1967; Nov: 723-744

[113] Kim SR, Kwak SW, Lee JK, Goo HJ, Ha JH, Kim HC. Efficacy and retrievability of root canal filling using calcium silicate-based and epoxy resin-based root canal sealers with matched obturation techniques. Aust Endod J. 2019; 45: 337-345.

[114] Chybowski EA, Glickman GN, Patel Y, Fleury A, Solomon E, He J. Clinical Outcome of Non-Surgical Root Canal Treatment Using a Single-cone Technique with Endosequence Bioceramic Sealer: A Retrospective Analysis. J Endod. 2018; 44: 941-945

[115] Coşar M, Kandemir Demirci G, Çalışkan MK. The effect of two different root canal sealers on treatment outcome and post-obturation pain in single-visit root canal treatment: A prospective randomized clinical trial. Int Endod J. 2023 Mar; 56 (3): 318-330

[116] Siqueira J. Jr. Rochas I: Present status and future directions: Microbiology of endodontic infections. Int Endod J 2021; https://doi.org/10.1111/iej.13677

[117] Shabbir J, Zehra T, Najmi N, Hasan A, Naz M, Piasecki L, Azim AA. Access Cavity Preparations: Classification and Literature Review of Traditional and Minimally Invasive Endodontic Access Cavity Designs.
J Endod. 2021; 47: 1229-1244.

[118] Gavini G, dos Santos M,Luis C , de Lima M, Gonzales LM, Iglecias F, Peters O George, Candeiro T: Nickel–titanium instruments in endodontics: a concise review of the state of the art.Braz. oral. res. 32; 2018: suppl.1

[119] Gavini G, dos Santos M,Luis C , de Lima M, Gonzales LM, Iglecias F, Peters O George, Candeiro T: Nickel–titanium instruments in endodontics: a concise review of the state of the art.Braz. oral. res. 32; 2018: suppl.1

[120] M Losertová et al IOP Conf. Ser.: Mater. Sci. Eng. 2017; 266: 012008

[121] M Losertová et al IOP Conf. Ser.: Mater. Sci. Eng. 2017; 266: 012008

[122] Galler KM, Grubmüller V, Schlichting R, Widbiller M, Eidt A, Schuller C, Wölflick M, Hiller KA, Buchalla W. Penetration depth of irrigants into root dentine after sonic, ultrasonic and photoacoustic activation.
Int Endod J. 2019; 52: 1210-1217

[123] Sfeir, Germain et al. “Calcium Silicate-Based Root Canal Sealers: A Narrative Review and Clinical Perspectives.”Materials 2021;14 : n. pag.