sciendo

Serbian Dental Journal, vol. 66, N° 4, 2019 | 189

ORIGINAL ARTICLE
ORIGINALNI RAD

DOI: 10.2478/sdj-2019-0020
UDC: 615.46:616.314-7; 616.314-089.843-06

Biological complications of the cement-retained implant-supported restorations

Minja Miličić Lazić[1], Milica Jakšic[2], Ana Todorović[1], Igor Đorđević[1], Vojkan Lazić[1]

[1]University of Belgrade, School of Dental Medicine, Clinic of Prosthodontics, Belgrade, Serbia;
[2]University of Belgrade, School of Dental Medicine, Department of Biology and Human Genetics, Belgrade, Serbia

SUMMARY

Dental cements have been established in practice since 1878, and technological advances in the field of implant prosthetics have directly influenced the development of materials in this area. Although the retention type of implant-supported restorations can be dual, it is nowadays known that the overall rate of technical complications is higher for cement-retained restorations by 2% over screw-retained restorations. Biological complications, including peri-implant mucositis, periimplantitis, bone loss around implants, soft-tissue recession and fistula suppuration, are also more frequent with cement-retained restorations. The most common of these, periimplantitis is often related to factors depending on a clinician.

Keywords: cement-retained implant crown; cement volume; dental cement; luting cement application; periimplantitis

INTRODUCTION

Prosthetic components of implant restorations represent transmucosal part of the implant and replace the missing crown of the tooth. An important decision in implant prosthetics is the choice of retention of definitive prosthetic restoration on implant abutment. The crown may be retained by screw or cement. The main advantage of screw retention is retrievability in the case of complications, and the possibility to return it to function after repair of the problem. The disadvantages of this type of retention are: technically demanding procedure, more expensive, inability to compensate extreme divergence of the implant and abutment axis, and requirement that the screw hole should be on the occlusal surface of posterior teeth and lingual surface of anterior teeth [1, 2].

On the other hand, cementation of permanent implant crown is widespread primarily because due to the simple process of fixing dental restorations on implants and the fact that cement materials have been present in dental practice for over a hundred years.

Wismeijer and Wittneben indicated that high rate of clinical success in working with cement-retained crowns correlates with proper adherence to indications (single crowns or small bridges, situations where the interarch space is higher than 7mm, when a screw-retained crown would decrease the aesthetics and in case of narrow-diameter implant crowns on which the screw opening would compromise the occlusal contact pattern) [3, 4]. Data from the literature indicate that the occurrence of biological complications, such as periimplantitis with the presence of fistula, resulting from residual cement, is 2.2% higher in cement-retained crowns compared to screw retention [5]. Some authors suggest the benefits of cement retention [6-8]. Primarily, a more passive fit of casting (given the fact that cement can fill micro irregularities and act as a sort of "shock absorber"). On the other hand, the ideal fit of prosthetic components of screw-retained reconstructions must exist because this ensures that the fastening screw doesn't loose or, even worse, breaks due to cyclic fatigue [9-11]. Additional advantages of cement retention are enhanced aesthetics, improved load direction, simplicity of processing and cost-effectiveness [12].

The frequency of biological complications in cement-retained restorations requires the analysis of the specificity of implants restorations in comparison to the restorations of natural teeth. At the same time, these specifics provide the answer to the question of more common complications caused by excessive cement in fixed implant prosthetics. Similarities in the anatomy of the supporting tissues of implants and teeth relate primarily to the free gingival margin, which forms keratinized epithelium that fills the area to the bottom of the gingival sulcus. The differences are related to the tissue that is apically from the bottom of the gingival sulcus. The junctional epithelium of the natural tooth is less permeable and has greater ability to regenerate unlike the junctional epithelium surrounding the implant. The fiber bundles around the natural tooth are oriented in multiple directions, while the fiber bundle surrounding the implant have horizontal-circular orientation [13]. Such structure of peri-implant tissues allows easier penetration of both microorganisms and various environmental agents [13].

The aim of this paper was to show, through literature analysis, direct connection between the occurrence of biological complications and parameters related to the

Address for correspondence: Minja MILIČIĆ LAZIĆ, University of Belgrade, School of Dental Medicine, Clinic of Prosthodontics, Rankeova 4, 11 000 Belgrade, Serbia; *minja.milicic@stomf.bg.ac.rs*

choice of cement (type, quantity and cementing technique). A literature search was performed in MEDLINE. Forty-one original scientific papers were analyzed. The fact that clinical practice has faced with higher incidence of biological complications with cement-retained crowns led to enriched electronic base related to periimplantitis and cement dependent factors in the past decade.

Cement as a risk factor for the occurrence of biological complications

The analyzed papers showed multifactorial influence of cement on the development of complications. Periimplantitis occurs as a result of biological interaction of the body with the cement material [14–17]. For easier evaluation of the results, the etiology of the problem is explained through three parameters: type and quantity of cement, as well as cementing technique.

Type of cement

Basic physical features that directly indicate the retention strength of prosthetic crown to implant abutment are compressive and tensile strength, expressed in mega-Pascal (MPa). The well-known strength values divide cements into provisional, semi-permanent and permanent [18]. The main advantage of the temporary cements is easier removal of the crown in the case of technical complications (usually fracture of porcelain veneer) [18]. However, when selecting the type of temporary cement, clinicians are facing the challenge of which cement to prioritize?

Lee JH et al. [19] found that acrylic-urethane polymer based temporary cement for implant luting cement cause a significantly higher inflammatory response in peri-implant soft tissue in comparison to conventional zinc oxide eugenol cements. Methacrylate resins represent better substrate for biofilm formation, showing greater number of oral pathogenic bacteria in the residual material of the peri-implant sulcus. In addition, the research of Korsch et al. [20, 21] demonstrated an intensive antimicrobial effect of zinc oxide and eugenol, with a dominant inhibitory effect on bacterial growth and development. Zinc oxide based cements are soluble in tissue fluids, unlike cements based on acrylic-urethane polymer (MMA), so that all extra material can be resorbed over time [22].

Limitations of the use of temporary cements are related to bridge constructions on implants. Low values of compressive strength of luting materials may cause the structure to become unfastened by loosening connection on one of the anchoring implant while the retention strength remains non changed on the other abutment. That is how Implant Bridge becomes a lever that tends to rotate around the fulcrum. In this case, it is an implant on which the crown is firmly cemented. Problems may arise if this condition lasts longer period. The compression forces, which are converted around the implant acting as a fulcrum can cause traumatic bone loss [23].

On the other hand, permanent cements have found wide application in implant prosthetics. Numerous papers indicate a detrimental effect of residual cement in peri-implant tissue [24–27]. The effect of residual cement on the soft tissues around the implant may vary. It is reflected in the inflammatory response of the body around the foreign substrate as well as the fact that residual material is good substrate for bacterial colonization [24–27].

Titanium alloys belong to the group of biocompatible materials due to their passivation potential, ie. ability to form an oxide layer on the metal surface [28]. Decomposition of the oxide layer can occur under the influence of various environmental agents. The authors especially mentioned glass ionomer and polycarboxylate cements [28, 29, 30]. Fluoride ions released from these cements tend to destabilize the oxide layer. Decomposition of the protective oxide layer increases the corrosion potential of the metal. The local corrosion effect depends on the concentration of fluoride ions and the length of time they are released from cement [31]. Resin-reinforced glass ionomer cements releases fluoride at a higher concentration than conventional glass ionomer cements. The consequence of degradation of titanium oxide and the occurrence of corrosion is most often an aesthetic problem in the form of soft tissue discoloration [31].

Quantity of luting agent

The amount of implant luting cement film required to provide good retention is defined by the space between the axial abutment walls and the interior of the implant crown. When there is a corresponding size of prosthetic components, crowns, and abutments, the average values of this space are 25–40 microns [32]. One of the advantages of cement retention over screw retention is the ability of cement to fill the micro-gap between the superstructure and the crown. However, in this case, the exposed cement can be good substrate for bacterial colonization, and the inaccurate alignment of the crown edge to the marginal edge of the suprastructure creates an anaerobic environment ideal for microorganism growth [32].

Any variations in the amount of cement required to provide adequate retention force may result in early or late complications. Excessive amount of prosthetic fixation material can lead to: inaccurate attachment of the crown due to abundant cement, supraoclusal crown position, or extrusion of excess material into the peri-implant tissue. On the contrary, insufficient cement leads to reduced retention [33].

Prevention of biological complications through cementing techniques

Cementing technique represents the clinical application of the material during the process of fixation of the crown on an abutment. A clinician should perform the procedure that will ensure optimal quantity of material inside the crown and prevent excessive extrusion. Due to the fact that cements belong to the group of low viscous fluids, Wadhwani [34] gives recommendations for working with cement materials through an experimental presentation. The specificity of cement as a fluid is that being different from water, it has different flow pressure. The viscosi-

ty coefficient of the material decreases with increasing pressure. It is important to be aware of this characteristic when working with materials. Also, the speed at which the crown is seated affects the cement flow. It is best not to seat the crown too rapidly and in vibrating manner, thus allowing the cement to penetrate perpendicularly at the length of the axial wall crowns and abutments in occlusal direction, filling in a uniform space between the prosthetic components [34].

One of the main indicators of clinical success in implant prosthetics is certainly the cementing process itself. In recent years, much attention has been paid to cementing techniques. Researchers [35–39] have made suggestions for various practical methods to achieve the most favorable amount of cement. One possibility of quantitative verification of the luting material necessary for fixing the crown to the superstructure is the method of using laboratory abutment described by Dumbrigue et al. [36]. The process is based on the controlled application of the material with a brush to the retaining walls towards the shoulder area immediately before cementing. Upon insertion of the material into the crown, the laboratory abutment is extraordinarily applied. The cement flows along the axial walls to the occlusal space and extends beyond the crown so that the excess remains on the laboratory abutment itself, and exactly enough material required for cementing is left behind in the crown margin.

An identical procedure can be performed if a copy of the abutment is made of vinylpolysiloxane material [37]. The interior of the crown is isolated with polytetrafluoroethylene tape. Then an elastic impression material is applied to the crown. While the material is still not set, a rigid post is placed in the impression material, which is intended to serve as a future abutment replica carrier. After the material is hardened, the following procedure is identical to that used in the application of fabricate laboratory abutment. To reduce the excess of material into the peri-implant tissue, some authors suggest to use a separating agent in the form of a polytetrafluoroethylene tape or to apply a layer of petroleum jelly on the transmucosal surface of the abutment before cementation and remove of the same after the procedure is finished [38].

Finally, clinical success is also influenced by the design of the abutment itself. The potential for the occurrence of biological complications in cement-retained crowns is greater if subgingival localization of the crown edge is more apically positioned [39, 40]. When the marginal edge of the abutment shoulder is positioned deeper than 2 mm below the free gingival margin, the conditions for controlling extruded material in the soft tissues and removing the excess are more difficult. It is recommended to use customized instead of fabric-designed abutment [41].

In conclusion, ideal cement could be characterized as luting material for fixing the prosthetic components strong enough to ensure balance between good retention of the crown and convenient retrievability if needed.

REFERENCES:

1. Gómez-Polo M, Ortega R, Gómez-Polo C, Celemin A, Del Rio Highsmith J. Factors Affecting the Decision to Use Cemented or Screw-Retained Fixed Implant-Supported Prostheses: A Critical Review. Int J Prosthodont. 2018; 31(1):43–54.
2. Sherif S, Susarla HK, Kapos T, Munoz D, Chang BM, Wright RF. A systematic review of screw versus cement-retained implant-supported fixed restorations. J Prosthodont. 2014; 23(1):1–9.
3. Wismeijer D, Brägger U, Evans C, Kapos T, Kelly JR, Millen C, et al. Consensus statements and recommended clinical procedures regarding restorative materials and techniques for implant dentistry. Int J Oral Maxillofac Implants. 2014; 29 Suppl:137–40.
4. Wittneben JG, Joda T, Weber HP, Brägger U. Screw retained vs. cement retained implant-supported fixed dental prosthesis. Periodontol 2000. 2017; 73(1):141–51.
5. Wittneben JG, Millen C, Brägger U. Clinical Performance of Screw-Versus Cement-Retained Fixed Implant-Supported Reconstructions: A Systematic Review. Int J Oral Maxillofac Implants. 2014; 29(Suppl):84–98.
6. Michalakis K, Hirayama H, Garefis P. Cement retained versus screw-retained implant restorations: A critical review. Int J Oral Maxillofac Implants. 2003; 18(5):719–28.
7. Lee A, Okayasu K, Wang HL. Screw- Versus Cement-Retained Implant Restorations: Current Concepts. Implant Dent. 2010; 19(1):8–15.
8. Longoni S, Sartori M, Maroni I, Baldoni M. Intraoral luting: modified prosthetic design to achieve passivity, precision of fit, and esthetics for a cement-retained, implant-supported metalresin-fixed complete denture. J Prosthodont. 2010; 19(2):166–70.
9. Bashutski JD, Wang HL. Common implant esthetic complications. Implant Dent. 2007; 16(4):340–8.
10. Tosches NA, Brägger U, Lang NP. Marginal fit of cemented and screw-retained crowns incorporated on the Straumann (ITI) Dental Implant System: an in vitro study. Clin Oral Implants Res. 2009; 20(1):79–86.
11. Keith SE, Miller BH, Woody RD, Higginbottom FL. Marginal discrepancy of screw-retained and cemented metal-ceramic crowns on implants abutments. Int J Oral Maxillofac Implants. 1999; 14(3):369–78.
12. Hebel KS, Gajjar RC. Cement-retained versus screw-retained implant restorations: achieving optimal occlusion and esthetics in implant dentistry. J Prosthet Dent. 1997; 77(1):28–35.
13. Michael N, Takei H, Klokkevold P, Carranza FA. Carranza's Clinical Periodontology, 10th ed., Elsevier Health Sciences, 2006.
14. Burbano M, Wilson TG Jr, Valderrama P, Blansett J, Wadhwani CP, Choudhary PK, et al. Characterization of Cement Particles Found in Peri-implantitis-Affected Human Biopsy Specimens. Int J Oral Maxillofac Implants. 2015; 30(5):1168–73.
15. Staubli N, Walter C, Schmidt JC, Weiger R, Zitzmann NU. Excess cement and the risk of periimplant disease - a systematic review. Clin Oral Implants Res. 2017; 28(10):1278–90.
16. Kotsakis GA, Zhang L, Gaillard P, Raedel M, Walter MH, Konstantinidis IK. Investigation of the Association Between Cement Retention and Prevalent Peri-Implant Diseases: A Cross-Sectional Study. J Periodontol. 2016; 87(3):212–20.
17. Garzon H, Camilo A, Camilo T, Johana C, Javier C, Jefferson C, et al. Relationship Between Dental Cement Materials of Implant-Supported Crowns with Periimplantitis Development in Humans: A Systematic Review of Literature. J Long Term Eff Med Implants. 2018; 28(3):223–32.
18. Wolfart S. Implant Prosthodontics: A Patient-Oriented Strategy. 1st ed. St. Louis, 2016.
19. Lee JH, Yang SE, Lee J, Lee SY. Influence of Luting Materials and Methods and the Restoration Surface on the Amount of Cement Remnants in Implant Restorations. J Oral Implantol. 2019; 45(4):301–7.
20. Korsch M, Walther W. Peri-Implantitis Associated with Type of Cement: A Retrospective Analysis of Different Types of Cement and Their Clinical Correlation to the Peri-Implant Tissue. Clin Implant Dent Relat Res. 2015; 17 Suppl 2:e434–43.

21. Korsch M, Robra BP, Walther W. Predictors of excess cement and tissue response to fixed implant-supported dentures after cementation. Clin Implant Dent Relat Res. 2015; 17 Suppl 1:e45–53.
22. Flanagan D. Zinc phosphate as a definitive cement for implant-supported crowns and fixed dentures. Clin Cosmet Investig Dent. 2017; 9:93–7.
23. Frisch E, Ratka-Krüger P, Weigl P, Woelber J. Minimizing excess cement in implant-supported fixed restorations using an extraoral replica technique: a prospective 1-year study. Int J Oral Maxillofac Implants. 2015; 30(6):1355–61.
24. Quaranta A, Lim ZW, Tang J, Perrotti V, Leichter J. The Impact of Residual Subgingival Cement on Biological Complications Around Dental Implants: A Systematic Review. Implant Dent. 2017; 26(3):465–74.
25. Linkevicius T, Puisys A, Vindasiute E, Linkeviciene L, Apse P. Does residual cement around implant-supported restorations cause peri-implant disease? A retrospective case analysis. Clin Oral Implants Res. 2013; 24(11):1179–84.
26. Ivanovski S, Lee R. Comparison of peri-implant and periodontal marginal soft tissues in health and disease. Periodontol 2000. 2018; 76(1):116–30.
27. Renvert S, Polyzois I. Risk indicators for peri-implant mucositis: a systematic literature review. J Clin Periodontol. 2015; 42 Suppl 16:S172–86.
28. Huang HH. Effects of fluoride concentration and elastic tensile strain on the corrosion resistance of commercially pure titanium. Biomaterials. 2002; 23(1):59–63.
29. Noguti J, de Oliveira F, Peres RC, Renno AC, Ribeiro DA. The role of fluoride on the process of titanium corrosion in oral cavity. Biometals. 2012; 25(5):859–62.
30. Wadhwani CP, Piñeyro AF. Implant cementation: clinical problems and solutions. Dent Today. 2012; 31(1):56–62.
31. Horasawa N, Marek M. Effect of fluoride from glass ionomer on discoloration and corrosion of titanium. Acta Biomater. 2010; 6(2):662–6.
32. Nawafleh NA, Mack F, Evans J, Mackay J, Hatamleh M. Accuracy and Reliability of Methods to Measure Marginal Adaptation of Crowns and FDPs: A Literature Review. J Prosthodont. 2013; 22(5):419–28.
33. Wadhwani C, Hess T, Piñeyro A, Opler R, Chung KH. Cement application techniques in luting implant-supported crowns: a quantitative and qualitative survey. Int J Oral Maxillofac Implants. 2012; 27(4):859–64.
34. C.P.K. Wadhwani (ed.), Cementation in Dental Implantology: An Evidence-Based Guide, 15 © Springer-Verlag Berlin Heidelberg 2015.
35. Liang T, Hu X, Zhu L, Pan X, Zhou Y, Liu J. Comparative in vitro study of cementing techniques for implant-supported restorations. J Prosthet Dent. 2016; 116(1):59–66.
36. Dumbrigue HB, Abanomi AA, Cheng LL. Techniques to minimize excess luting agent in cement-retained implant restorations. J Prosthet Dent. 2002; 87(1):112–4.
37. Rayyan MM, Makarem HA. A modified technique for preventing excess cement around implant supported restoration margins. J Prosthet Dent. 2016; 116(6):840–2.
38. Hess TA. A technique to eliminate subgingival cement adhesion to implant abutments by using polytetrafluoroethylene tape. J Prosthet Dent. 2014; 112(2):365–8.
39. Sancho-Puchades M, Crameri D, Özcan M, Sailer I, Jung RE, Hämmerle CHF, et al. The influence of the emergence profile on the amount of undetected cement excess after delivery of cement-retained implant reconstructions. Clin Oral Implants Res. 2017; 28(12):1515–22.
40. Agar JR, Cameron SM, Hughbanks JC, Parker MH. Cement removal from restorations luted to titanium abutments with simulated subgingivalmargins. J Prosthet Dent. 1997; 78(1):43–7.
41. Long L, Alqarni H, Masri R. Influence of implant abutment fabrication method on clinical outcomes: a systematic review. Eur J Oral Implantol. 2017; 10 Suppl 1:67–77.

Received: 02.09.2019 • Accepted: 02.12.2019

Biološke komplikacije cementom retiniranih nadoknada na implantatima

Minja Miličić Lazić[1], Milica Jakšić[2], Ana Todorović[1], Igor Đorđević[1], Vojkan Lazić[1]

[1]Univerzitet u Beogradu, Stomatološki fakultet, Klinika za stomatološku protetiku, Beograd, Srbija;
[2]Univerzitet u Beogradu, Stomatološki fakultet, Odeljenje za humanu genetiku, Beograd, Srbija

KRATAK SADRŽAJ

Materijali za fiksiranje zubnih protetskih nadoknada utemeljeni su u stomatološkoj praksi od 1878. godine, a tehnološki napredak na polju implant-protetike direktno je uticao i na razvoj materijala u ovoj oblasti.

Iako mehanizam vezivanja fiksnih nadoknada može biti dvojak, danas se zna da je ukupna stopa tehničkih komplikacija veća kod cementno retiniranih nadoknada za 2% u odnosnu na retenciju šrafom. Biološke komplikacije u koje se ubrajaju periimplantatni mukozitis, periimplantitis, gubitak kosti oko implantata, recesija mekih tkiva i pojava fistule, takođe su učestalije kod cementno retiniranih zubnih nadoknada. Najzastupljenija među njima, periimplantitis, često se dovodi u vezu sa „lekar-zavisnim" parametrima.

Ključne reči: cementi; implant-protetika; biološke komplikacije

UVOD

Protetske komponente predstavljaju transmukozni deo implantata i nadoknađuju nedostajući krunični deo zuba. Važna odluka u implant-protetici je izbor tipa retencije definitivne zubne nadoknade na abatmentima. Kruna može biti retinirana zavrtnjem ili cementom. Osnovna prednost retencije šrafom jeste mogućnost da kliničar ukloni nadoknadu u slučaju pojave komplikacije, i da naknadno istu vrati u funkciju po saniranju problema. Nedostaci ovakvog vida retencije su: tehnički zahtevan postupak, skuplja izrada nadoknade, nemogućnost kompenzacije izrazite divergencije ose implantata i ose abatmenta, i zahtev da otvor za zavrtanj mora biti u nivou okluzalne površine bočnih zuba i oralne površine prednjih zuba [1, 2].

S druge strane, postupak cementiranja je široko rasprostranjen, pre svega zbog jednostavnog postupka fiksiranja zubnih nadoknada na implantatima i činjenice da su cementi u stomatološkoj protetici prisutni preko sto godina.

Wismeijer i *Wittneben* su istakli da klinički uspeh u radu sa cementno retiniranim nadoknadama korelira sa poštovanjem indikacija za njihovu izradu (pojedinačne krune ili mostovi malog raspona, situacije kada je vertikalna dimenzija interokluzalnog prostora veća od 7 mm, situacije kada bi nadoknada retinirana šrafom ugrozila estetiku, i u slučaju kruna na implantatima uskog promera, na kojima bi otvor šrafa kompromitovao okluzalnu kontaktnu šemu) [3, 4].

Podaci iz literature navode da je pojava bioloških komplikacija u vidu periimplantitisa, sa prisustvom fistule, nastalog kao posledica rezidualnog cementa, veća za 2,2% kod cementno retiniranih nadoknada u odnosu na retenciju šrafom [5]. Pojedini autori ipak sugerišu na prednosti retencije cementom [6, 7, 8]. To je, pre svega, pasivniji odnos komponenata (s obzirom na činjenicu da cement ima mogućnost da popuni mikroneslaganja i na neki način deluje kao amortizer). S druge strane, idealno naleganje protetskih komponenata kod šrafom retiniranih nadoknada mora da postoji, jer to obezbeđuje da se šraf ne olabavi ili, još nepoželjnije, polomi usled cikličnog zamora [9, 10, 11]. Dodatne prednosti cementne retencije jesu poboljšan smer opterećenja, estetika, jednostavnost izrade i ekonomičnost [12]. Pojava bioloških komplikacija kod cementno retiniranih nadoknada zahteva analizu specifičnosti vezanih za nadoknade na implantatima u odnosu na nadoknade na prirodnim zubima. Ujedno, ove specifičnosti jesu odgovor na pitanje zbog čega su komplikacije izazvane potisnutim cementom češće u fiksnoj-implantat protetici. Sličnosti u anatomskoj građi potpornih tkiva implantata i zuba odnose se prevashodno na predeo slobodne gingive, a čini je keratinozovani epitel koji popunjava prostor do dna gingivalnog sulkusa. Različitosti su u vezi sa tkivom koje je apikalno od dna gingivalnog sulkusa. Pripojni epitel prirodnog zuba je manje permeabilan i ima veću sposobnost regeneracije za razliku od pripojnog epitela koji okružuje implantat. Fibrozna vlakna oko prirodnog zuba su orijentisana u multiplim pravcima, dok su fibrozna vlakna koja okružuju implantat horizonlano-cirkularne orijentacije [13]. Ovakva građa periimplantatnih tkiva pogoduje lakšoj penetraciji kako mikroorganizama, tako i različitih agenasa spoljašnje sredine [13].

Cilj ovog rada je da se kroz prikupljenu literaturu prikaže direktna veza između pojave bioloških komplikacija i parametara vezanih za izbor cementa (vrsta, količina i tehnika cementiranja).

Prilikom pretraživanja literature korišćena je bibliografska baza MEDLINE. Dobijen je materijal od 41 originalnog naučnog rada. Činjenica da je klinička praksa suočena sa većom incidencom bioloških komplikacija kod cementom retiniranih nadoknada na implantatima uslovila je da su se poslednjih godina obogatile elektronske baze pojmovima periimplantitis i cement-zavisni faktori.

CEMENT KAO FAKTOR NASTANKA BIOLOŠKIH KOMPLIKACIJA

Analizirani radovi pokazali su multifaktorijalni uticaj cementa na razvoj komplikacija. Periimplantitis nastaje kao rezultat biološke interakcije organizma sa materijalom za fiksiranje nadoknada na implantatima [14–17]. Radi lakše evaluacije rezultata, etiologija nastanka problema objašnjena je kroz tri parametra – vrstu i količinu cementa, kao i samu tehniku cementiranja.

Vrsta cementa

Osnovne fizičke osobine koje direktno diktiraju jačinu retencije zubne nadoknade za abatment jestu kompresivna i zatezna čvrstoća, izražene u megapaskalima. Dobro poznate vrednosti čvrstoće omogućile su podelu cemenata na privremene, uslovno trajne i trajne [18]. Autori u radu [18] kao glavnu prednost privremenih cemenata naveli su lakše uklanjanje krune u slučaju pojave tehničkih komplikacija (najčešće fraktura fasetne keramike) radi sprovođenja reparature i ponovnog vraćanja krune u funkciju. Međutim, prilikom odabira tipa privremenog cementa kliničari su suočeni sa izazovom kom cementu dati prednost [19, 20, 21].

Jae-Hyun Lee i sar. [19] ustanovili su da privremeni cementi na bazi uretan metaktilata-MMA izazivaju znatno veći inflamatorni odgovor u periimplatatnom mekom tkivu za razliku od konvencionalnih cink-oksid eugenol cemenata. Metalkrilatne smole predstvaljaju bolju podlogu za formiranje biofilma, pokazujući veći broj oralnih patogenih bakterija u zaostalom materijalu periimplantatnog sulkusa. U prilog ovome govori i istraživanje *Korscha* i sar. [20, 21], koji su dokazali izrazito antimikrobno dejstvo cink-oksida i eugenola, sa dominantnim inhibišućim efektom na rast i razvoj bakterija. Cementi na bazi cink-oksida su rastvorljivi u prisustvu tkivnih tečnosti, za razliku od cemenata na bazi elastomernih smola (MMA), tako da vremenom dolazi do resorpcije viška potisnutnog materijala [22].

Ograničenja upotrebe privremenih cemenata su u vezi sa manjim višečlanim konstrukcijama na implantatima. Male vrednosti kompresivne čvrstoće ovih materijala mogu usloviti rascementiranje konstrukcije zbog popuštanja veze na jednom od nosača, dok na drugom veza retencije ostaje zadovoljavajuća. Tada most na implantatima postaje poluga koja teži da se rotira oko tačke oslonca. U ovom slučaju to je implantat na kom je kruna čvrsto vezana cementom. Problemi nastaju ako pomenuta situacija potraje duži period. Tada sile kompresije, koje se konvertuju oko implantata koji se ponaša kao tačka oslonca, dovode do gubitka kosti uzrokovanog traumom [23].

S druge strane, cementi za trajno fiksiranje zubih nadoknada našli su široku primenu u implant-protetici. Mnogobrojni radovi ukazuju na štetan efekat rezidualnog cementa u periimplatatnom tkivu [24–27]. Dejstvo zaostalog cementa na meka tkiva oko implantata je dvojako. Ogleda se u inflamatornoj reakciji organizma oko stranog tela, kao i činjenici da je zaostali materijal dobra podloga za bakterijsku kolonizaciju [24–27].

Legure titana pripadaju grupi biokompatibilnih materijala zahvaljujući sposobnosti pasivizacije, tj. stvaranja oksida na površini metala [28]. Razgradnja oksidnog sloja može nastati pod uticajem različitih agenasa spoljašnje sredine. Autori posebnu pažnju posvećuju glas-jonomernim i polikarboksilatnim cementima [28, 29, 30]. Joni fluorida koji se oslobađaju iz ovih cemenata pokazuju tendenciju ka destabilizaciji oksidnog sloja. Razgradnjom zaštitnog sloja oksida povećava se korozioni potencijal metala. Lokalni efekat korozije zavisi od koncentracije jona fluora i dužine vremena za koje se osobađaju iz cementa [31]. Smolom ojačani glas-jonomerni cementi otpuštaju fluor u većoj koncentraciji od konvencionalnih glasjonomernih cemenata. Posledica degradacije titanijum-oksida i pojave korozije je najčešće estetski problem u vidu diskoloracije mekih tkiva [31].

KOLIČINA CEMENTA

Količina cementnog filma neophodnog da obezbedi zadovoljavajuću retenciju definisana je prostorom između aksijalnih zidova abatmenta i unutrašnjosti zubne krunice. Kada postoji kongurentnost protetskih komponenata, krune i abatmenta, prosečne vrednosti ovog prostora su između 25 i 40 mikrona [32]. Kao jedna od prednosti cementne retencije u odnosu na retenciju zavrtnjem navodi se sposobnost cementa da popuni mikroneslaganja između suprastrukture i krunice. Međutim, u tom slučaju eksponirani cement može predstavljati dobru podlogu za bakterijsku kolonizaciju, a neprecizno naleganje ruba krune na marginalnu ivicu suprastrukture stvara anaerobnu sredinu idealnu za rast mikroorganizama [32].

Svako odstupanje u količini cementa neophodnog da obezbedi zadovoljavajuću silu retencije može imati za posledicu rane ili kasne komplikacije. Prekomerna količina materijala za fiksiranje protetske nadoknade može dovesti do nepreciznog naleganja krune usled zarobljenog cementa u prostoru između okluzalne površine abatmenta i unutrašnjojsti krune, supraokluzalnu poziciju krune ili ekstruziju viška materijala u periimplantatno tkivo. Nasuprot tome, nedovoljna količina cementa vodi ka smanjenoj retenciji [33].

PREVENCIJA NASTANKA BIOLOŠKIH KOMPLIKACIJA KROZ TEHNIKU CEMENTIRANJA

Tehnika cementiranja predstavlja način kliničke aplikacije materijala u toku fiksiranja nadoknade na suprastrukturu. Terapeut bi trebalo da sprovede procedure koje će osigurati optimalnu količinu materijala unutar krune, a sprečiti prekomernu ekstruziju viška. Imajući u vidu činjenicu da cementi pripadaju grupi niskoviskoznih tečnosti, *Wadhwani* [34] je kroz eksperimentalni prikaz dao preporuke za rad sa cementnim materijalima. Specifičnost cementa kao fluida je to što za razliku od vode ne pokazuje tečenje pod pritiskom koje pokazuje voda. Koeficijent viskoznosti materijala se smanjuje sa povećanjem pritiska. Ova osobina je važna za razumevanje u toku rada sa materijalom. Takođe, brzina kojom se kruna postavlja na suprastrukturu utiče na tečenje cementa. Najbolje je ne prebrzo i vibrirajućim pokretima aplikovati krunu na suprastrukturu, jer se na taj način stvara mogućnost da cement teče perpendikularno duž aksijalnih zidova krune i suprastukture u okluzalnom pravcu popunjavajući ravnomerno prostor između protetskih komponenata [34].

Jedan od glavnih pokazatelja kliničkog uspeha u implantprotetici svakako je sam postupak cementiranja. Poslednjih godina velika pažnja usmerena je na tehnike cementiranja. Istraživači [35–39] su dali predloge za različite praktične metode kojima se može postići najpovoljnija količina cementa. Jedna mogućnost kvantitativne verifikacije cementnog materijala neophodnog za fiksiranje krune na suprastrukturu jeste metoda korišćenja laboratorijskog abatmenta koju su opisali *Dumbrigue* i sar. [36]. Postupak se zasniva na kontrolisanom nanošenju materijala četkicom na zidove nadoknade prema vratnom delu neposredno pre cementiranja. Po unošenju materijala u krunu, ekstraoralno se u nadoknadu unosi laboratorijski abatment. Cement se potiskuje uz aksijalne zidove do okluzalnog prostora i iznosi van krune tako da višak ostaje na samom laboratorijskom

abatmentu, a u čauri krune zaostaje tačno dovoljna količina materijala neophodna za cementiranje.

Identična procedura može se izvesti ako se kopija abatmenta napravi od materijala vinilpolisiloksan [37]. Unutrašnjost nadoknade se izoluje politetrafluoroetilenskom trakom. Zatim se u krunu aplikuje elastični otisni materijal. Dok je materijal još u nevezanom stanju, postavlja se kočić u otisnu masu, koji ima za cilj da posluži kao budući nosač replike abatmenta. Po vezivanju materijala, dalji postupak je identičan kao kod primene fabričkog laboratorijskog abatmenta. Da bi se smanjilo prekomerno potiskivanje viška materijala u periimplantatno tkivo, pojedini autori predlažu korišćenje separirajućeg agensa u formi politetrafluoroetilenske trake ili nanošenje sloja vazelina na transmukoznu površinu abatmenta neposredno pre cementiranja i njegovo uklanjanje posle vezivanja cementa [38].

Konačno, na uspeh u radu utiče i dizajn samog abatmenta. Mogućnost nastanka bioloških komplikacija kod cementno retiniranih nadoknada je utoliko veća ukoliko je subgingivalna lokalizacija ruba krune apikalnije pozicionirana [39, 40]. Kada je marginalna ivica ramena abatmenta postavljena dublje od 2 mm u odnosu na slobodnu ivicu gingive, uslovi za kontrolu potisnutog materijala u meka tkiva i uklanjanje viška su otežani. Preporuka je koristiti individualizovani umesto fabrički dizajniranog abatmenta [41].

U sklopu analize svega navedenog, idealni cement mogao bi da se okarakteriše kao sredstvo za fiksiranje nadoknada na implantatima sa ciljem da obezbedi ravnotežu između dobre retencije nadoknade i istovremeno stvori uslove za eventualno lakše uklanjanje u slučaju pojave komplikacija.