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KRATAK PREGLED BEZMETALNIH KERAMIČKIH SISTEMA

SHORT REVIEW OF NON- METAL CERAMIC SYSTEMS

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Rezime

Upotreba bezmetalne keramike, kao gradivnog materijala za izradu protetskih restauracija, postavlja određene zahteve pred sam bezmetalni sistem. Snagu gradivnog materijala treba usaglasiti sa indikacijom, mora da postoji hemijska stabilnost i, iznad svega, postoje visoki zahtevi za izradu nadoknada estetskih karakteristika.
Na osnovu ideje da je budućnost bezmetalnih sistema u korišćenju PRESS i CAD-CAM tehnologije razvijen je novi sistem pod nazivom IPS e.max (Ivoclar Vivadent, Schaan, Liechtenstein). On obuhvata vrhunske estetske i visoko-otporne materijale za PRESS i CAD-CAM tehnologiju. U proizvodnji IPS e.max Press ingota se koristi nova tehnologija obrade. Ingoti se više ne proizvode preko praškaste faze, kao što je slučaj sa IPS Empress i IPS Empress 2 ingotima, već putem kalupljenja osnovne sirovine. Kao posledica toga nastaje materijal koji je apsolutno bez pora.
Novi bezmetalni keramički sistemi, kao što je IPS e.max, pokazuje mnoga potencijalna polja primene. Ovaj materijal se može da koristi za izradu inleja, onleja, faseta, tročlanih prednjih i bočnih mostova, kao i kod minimalno invazivnih, adhezivnih restauracija u bočnom segmentu. Prednosti ovakve procedure su minimalna invazivnost, gingivalno zdravlje, relativno laka procedura i niski troškovi.
IPS e.max (Ivoclar Vivadent, Liechtenstein) pokazuje visoku otpornost, dobar optički kvalitet koji otvara put ka uspehu, a nova presujuća tehnika za oblikovanje materijala predstavlja značajan doprinos daljem razvoju bezmetalnih keramičkih sistema.

Ključne reči: *bezmetalna keramika, CAD-CAM tehnologija,*

Abstract

Using of non-metal ceramics, like building material for making prosthetic restaurations, makes fixed requierements in front of non-metal system itself.The power of building material needs to accord with indications, chemical stability must exists and, overall, high accords for making prosthetic restaurations with esthetic characteristics.
Basic on idea that the future of non-metal systems will be in using PRESS and CAD-CAM technology was developed a new system under tittle IPS e.max (Ivoclar Vivadent, Schaan, Liechtenstein). It embraces the most esthetic and high-stifness materials for PRESS and CAD-CAM technology. In a production of IPS e.max Press ingots we use a new technology of prcessing. The ingots don't more produce via powder phase, like in a case with IPS Empress 2 ingots, then with the molding of raw material. Like result, we have a material which doesn't have pore.
New non-metal ceramic system, like is IPS e.max, shows many potential fields of the using. This material can be used for making inleys, onleys, veneers, three-unit frontal and lateral bridges and in a case of adhesive restaurations in lateral segment. The advantages of this procedure are minimal invasivity, gingival health, easy procedure and low cost.
It is leucit-glass ceramic which has good stiffness, optical quality and new pressing procedure for shaping materials and those characteristics have opened a way to success, and new pressing procedure for shaping of materials represents important contribution to the development of non-metal ceramic systems.

***Key words*:** non-metal ceramic, CAD-CAM technology

Uvod

Upotreba bezmetalne keramike, kao gradivnog materijala za izradu protetskih restauracija, postavlja određene zahteve pred sam bezmetalni sistem. Snagu gradivnog materijala treba usa-

Introduction

Using of non-metal ceramics, like building material for making prosthetic restaurations, makes fixed requierements in front of non-metal system itself.The power of building material glasiti sa indikacijom, mora da postoji hemijska stabilnost i, iznad svega, postoje visoki zahtevi za izradu nadoknada estetskih karakteristika.

Prvi pravi prodor u razvoju bezmetalnih keramičkih sistema načinila je firma Ivoclar Vivadent sa IPS Empress sistemom (1991godine). To je leucitna staklena keramika kojoj su otpornost, optički kvalitet, kao i nova presujuća procedura za oblikovanje materijala otvorili put ka uspehu. Upotreba nove presujuće procedure, zasnovane na principu viskoznog toka, rezultira odličnom preciznosti i marginalnoj adaptaciji nadoknada. Dalji razvoj staklenih keramika je postignut 1998 godine pojavom IPS Empress 2 sistema (Ivoclar Vivadent AG) koji je zasnovan na litijum- disilikatu čiji visoki udeo u staklenom matriksu rezultira povećanjem otpornosti i proširenjem polja primene. Za postizanje estetskih efekata razvijen je IPS Eris for E2 gde kristali fluoroapatita predstavljaju glavni deo koji je odgovoran za optičke karakteristike.

Na osnovu ideje da je budućnost bezmetalnih sistema u korišćenju PRESS i CAD-CAM tehnologije razvijen je novi sistem pod nazivom IPS e.max (Ivoclar Vivadent, Schaan, Liechtenstein). On obuhvata vrhunske estetske i visoko-otporne materijale za PRESS i CAD-CAM tehnologiju.

IPS e.max sistem pokriva širok spektar indikacija za bezmetalne restauracije i to kao veoma pogodan za izradu inlej-retiniranih nadoknada u bočnoj regiji, kombinujući veliku čvrstoću, estetiku i jednostavnost izrade[1].

Osnovne komponente IPS e. max sistema

– **IPS e.max Press** je litijumska –disilikatna keramika za tehniku presovanja čija je otpornost od 400 Mpa. Ovakav materijal je izuzetno pogodan za izradu tročlane mostne konstrukcije do drugog premolara kao distalnog nosača.

– **IPS e.max CAD** je zasnovan na litijumdisilikatnoj staklo keramici gde su blokovi u metasilikat fazi pre kristalizacije. Plave su boje, mekani i mogu da se frezuju. Procesom kristalizacije dobijaju se završne forme kristala litijum-disilikata, kada blokovi dobijaju čvrstinu od 360 Mpa.

– **IPS e.max Zir CAD** je presinterovan cirkonijum-oksid blok koji sadrži male količine itrijum-oksida, u cilju stabilizacije meta-sta-

needs to accord with indications, chemical stability must exists and, overall, high accords for making prosthetic restaurations with esthetic characteristics.

First breakthrough in development of non-metal ceramic systems have done firm Ivoclar vivadent with IPS Empress system (1991 year). It is leucit-glass ceramic which has good stiffness, optical quality and new pressing procedure for shaping materials and those characteristics have opened a way to success. Using of new pressing procedure, which is based on princip like viscosity, results with best precision and marginal adaptation of restaurations. Distant development of glass-leucit ceramics was accomplished in 1998 year when appearanced IPS Empress 2 system, which is based on lithium-silicat, and whose great part in glass matrix results increased of stiffness and expansion of using. For accomplishing esthetic effects was developed IPS Eris for E2 where crystals of fluoroapatits represent main part which is responsible for optical characteristics.

Basic on idea that the future of non-metal systems will be in using PRESS and CAD-CAM technology was developed a new system under tittle IPS e.max (Ivoclar Vivadent, Schaan, Liechtenstein). It embraces the most esthetic and high-stifness materials for PRESS and CAD-CAM technology.

IPS e.max system covers wide spectar of indications for without-metal restaurations especially for inley-restaurations in posterior region and it combines a great solidity, esthetic and simply using[1].

Basic components in IPS e.max system

IPS e.max Press is leucit-disilicat ceramic for pressing technology which has stiffness 400 Mpa. This material is very practical for making a bridge with three members, but only to second premolar like distal supporter.

IPS e.max CAD is based on lithium-disilicat glass ceramic where the bloks are un metasilicat fase befor crystalisation.They have a blue color, softly and they can cuting. With crystalisation process we get finishing forms of litium/disilicat crystals, when the blocks are getting soundness of 360 Mpa.

IPS e.max ZirCad is presyntered zirconium-oxid block which contents a little itrium-oxid, in a point of stabilisation meta-stabil tetragonal bilne tetragonalne faze. U pre-sinterisanoj fazi blok je porozne morfologije, a nakon frezovanja osnove cirkonijum oksid se gusto sinteriše na temperaturama do 1500^{o}C. Na taj način se dobija završni materijal čvrstoće koja je veća od 900 Mpa[2]. Cirkonijum oksid se koristi samo za osnovu koja se fasetira providnijom keramikom da bi se postigli estetski efekti.

Hemijska struktura

IPS e.max Press sadrži oko 70% kristala grubih granula litijum-disilikata, koji su uronjeni u stakleni matriks (SiO_2 63%; Li_2O 28%; K_2O 2,5%; ZnO 3,3%; P_2O_5 1,5%) sa nekim drugim sastojcima (MgO, Al_2O_3, CeO_2). Kristali su 3-6µm dužine.

Odlika staklenih keramika je što kristali ne rastu sporadično, slučajno ili bez reda u staklenom matriksu. Razlika između strukture staklenih i konvencionalnih keramika je što se staklene kreramike dobijaju isključivo kristalizacijom staklene faze, dajući fino-granuliranu i homogenu strukturu. Postupak dobijanja staklo-keramike najčešće podrazumeva topljenje specifičnih staklo-komponenti u prisustvu određenih oksida kao agenasa nukleacije, nakon čega sledi ukalupljenje u stakleni blok. Aditivi ubrzavaju nukleaciju koja se dešava u staklu. Oksidi se zajedno tope sa staklom koje pokazuje ograničenu rastvorljivost u odgovarajućoj osnovi. Većina nanokristala se stvara na niskoj temperaturi čineči podlogu na kojoj rastu kristali koje vidimo u završnom produktu. Ovaj proces se zove heterogena nukleacija.

U proizvodnji IPS e.max Press ingota se koristi nova tehnologija obrade. Ingoti se više ne proizvode preko praškaste faze, kao što je slučaj sa IPS Empress i IPS Empress 2 ingotima, već putem kalupljenja osnovne sirovine. Kao posledica toga nastaje materijal koji je apsolutno bez pora. Ova nova procedura ne obuhvata dodatak pigmenata boje, jer bi oni nestali na toploti topljenja. Iz tih razloga ovakav proizvod pokazuje manje defekata, što mu povećava čvrstinu i prozirnost u odnosu na konvencionalnu tehnologiju sinterovanja.

Vrednosti otpornosti zavise od metoda korišćenih za merenje. Može se reći da su srednje vrednosti 400 ± 40 Mpa. Hemijska rastvorljivost je 40 ± 10 µg/cm^2. IPS e.max Press je pokazao najveću transparenciju od svih testiranih visoko-otpronih keramičkih materijala[3]

phase. In a presyntered phase block is porous morphology and after cutting of zirconium-oxid it is syntherised on temperature 1500^{0}C. On this way we get perfect material with soundness which is more than 900 Mpa[2]. Zirconium-oxid uses only for framework which is coated with transparent ceramics if we wish great esthetic effects.

Chemical structure

IPS e.max contents about 70% crystals of cryde granules lituim-disilicat, which are immersed in glass matrix (SiO_2 63%; LiO_2 28%; K_2O 2,5%; ZnO 3,3%; P_2O_5 1,5%) with some others containers (MgO, Al_2O_3, CeO_2). The crystals are 3-6µm long.

The main characteristic of glass-ceramics are that crystals don't grow sporadic, accidentally or without order in a glass-matrix. Different between structure of glass and conventional ceramics is that glass-ceramics et exclusively with crystalisation og glass-phase, which gives fine granulated and homogenous structure. Procedure of getting glass-ceramic often understands the melting of specific glass-components in presence of definite oxids like nucleotic-agens, after that follow the molding in glassblock. The aditivies accelerate a nucleation which happens in a glass. The oxydies melt othether with glass which shows restricted dissolving in appropriate base. The most part of nanocrystales create on low-temperature and they make a base on which the crystals grow and we see them in final product. This process is heterogenic nucleationa.

In a production of IPS e.max Press ingots we use a new technology of prcessing. The ingots don't more produce via powder phase, like in a case with IPS Empress 2 ingots, then with the molding of raw material. Like result, we have a material which doesn't have pore. This new procedure doesn't envelope addition of colour pigments, because they would dissapeare on a high-temperature. From this reasons a product shows less defects and it has a good stability and transparency in a relation on traditional technology of sintering.

Validity of resistance depends of methods which used for measuring. We can say that middle-measure are 400 ± 40 MPa. The chemical dissolving is 40± 10 µg/cm^2. IPS e.max Press

Karakteristike IPS e.max ZirCAD

Cirkonijum oksid se zbog izuzetnih osobina često opisuje i kao « keramički čelik». To je hemijska smesa Zr^{4+} jona metala i O^{2-} kiseoničnih anjona. Kao rezultat nastaje oskidna smeša jonskog karaktera, koji uprkos Zr^{4+} jonu metala, ne pripada metalima nego grupi nemetalnih neorganskih supstanci. Cirkonijum oksid je pravi primer oskidne keramike sa finom, granulastom, polikristalnom strukturom.

Osnovni materijal IPS e.max ZirCAD je blok u pre-sinterovanoj fazi, sa materijalom koji nema još potrebnu gustinu, ali pojedinačni kristaliti – koji kasnije formiraju gustu strukturu – povezani su jedni sa drugima samo sinter grlima. Rezultat je slaba, porozna struktura sa svega 50% od završne gustine. Posle oblikovanja, materijal se konačno zgušnjava u visokotemperaturnoj peći, koja je specijalno razvijena za oksidne keramike. Proces finalnog ojačanja, u kome se pojedini kristaliti približavaju jedni drugima u procesu difuzije zbog toplotne aktivacije, dok virtuelno ne nestanu sve spore u strukturi, zove se sinterovanje. Ovaj proces se odigrava na 1500^{o}C. U ovom procesu je važno da gradijenti hlađenja i grejanja budu koordinisani sa parametrima procedure sinterovanja. Celokupni proces pečenja u Sintramat peći traje oko 8 časova pri čemu se materijal smanjuje u svakom smeru za oko 20% u odnosu na prvobitnu veličinu.

Ova vrsta materijala pokazuje visoku vrednost čvrstoće 927 ± 57 Mpa[4]. Ova oksidna keramika je već bila u kliničkoj upotrebi i veoma je pogodna, zahvaljujući velikoj čvrstoći, za primenu kod skoro svih indikacija koje su do sada bile rezervisane isključivo za protetske nadoknade ojačane metalom.

Karakteristike IPS e.max Zir Press

IPS e.max Zir Press je sastavljen od silikatnog stakla i apatitne staklo-keramike. Jedini prirodni materijal koji je korišćen jeste kvarcni pesak. Ovaj materijal ne sadrži komponente feldspata ili kristala leucita. Staklo iz SiO_2-Li_2O-Na_2O-K_2O-AL_2O_3 sistema se koristi za mešanje komponenti. Za staklene keramike koje sadrži fluoroapatit, bazna stakla dodatno obuhvataju CaO, P_2O_5 i F jone.

IPSe.max ZirPress sadrži igličaste i kristale fluoroapatita nano veličine. Iglice su dužine 1-

showed the most transparency in relation on all high-resistance ceramic materials[3].

Characteristics of IPS e.max Zir Cad

Zirconium-oxid has often describe like " ceramic steel". It is a chemical mixture Zr^{4+} metalions and O^{2-} oxygenions. As a result is oxyd mixture with ionscharacteristics, which doesn't belong to the metals, then to the group of nonmetal and anorganic substances. Zirconium oxyd is really example of oxydceramic with fine, granulated polycristal structure.

The main material IPS e.max Zir Cad is a block in pre-syntherised phase, with material which doesn't have necessary density, but individual crystality – which later form the density structure – are connected each other only with sinter-necks. The result is a week, porous structure with only 50% from final density. After remodeling, the material is finaly condensed in a high-temperature furnace, which is developed for oxyd ceramics. The process of final strongering, in which some crystalities closed each other in a diffusion process because warmth activation, while the spores were disappearing in a structure, is syntherising. This process takes a place on 1500^{0}C . In this process is important that gradients of cooling and warming were coordinated with parameters of synthering procedure. The whole process of abking in Sintramat furnace continue 8 hours when material reduced for 20%. This kind of material shows high value of hardness 927±57 MPa[4]. This oxyd ceramic has already been in a clinical usage in all indications which were reserved exclusively for prosthetic restaurations which reinforced with metal.

Characteristics of IPS e.max Zir Press

IPS e.max Zir Press is consisted from silicat –glasses and apatit –glass ceramics. Only nature material which was used is quartzsand. This material doesn't consist components of feldspats or crystal of leucit. The glass from SiO_2-Li_2O-Na_2O-K_2O-Al_2O_3 systems uses for mixing of components. For glass-ceramics which have fluoroapatit, basic glasses include additionally CaO, P_2O_5 and fluor ions. IPS e.max ZirPress consists needle-shaped and crystals of fluoroapatit with nanodimension. The needles are 1-

2μm i manje su od 200 nm u prečniku[5]. Kristali nano veličine rastu po longitudinalnoj osi i imaju dužinu manju od 200 nm. Njihov prečnik je manji od 100 nm. Ova vrsta materijala se može da tretira fluorovodoničnom kiselinom da bi se dobile prednosti koje daje nagrižena površina. Ona omogućava dobru vezu sa kompozitnim cementnim sistemima, kao što su Variolink II ili Multilink.

Biaksijalna fleksuralna otpornost IPS e.max Zir Press materijala iznosi 110±10 Mpa. Veza IPS e.max Zir Press sa IPS e.max Zir CAD osnovom i IPS e.max Ceram fasetirajućim materijalom je homogena, neporozna i bez pukotina.

Klinička istraživanja sa IPS e.max sistemom

Imajući u vidu da je IPS Empress 2 uveden 1998, do danas je na raspolaganju mnogo istraživanja iz proteklog perioda vezana za in-vitro i in-vivo proučavanja ovih restauracija. Zbog sličnog hemijskog sastava ovog i IPS e.max Press sistema, ovi podaci su dragoceni..

Studija Upshaw i sar.[6] je pokazala visoku stopu uspešnosti od 93% za litijum-disilikatne mostove posle 2 godine, koja je bila malo niža od 95-97% stope uspeha za metal-keramičke nadoknade. Primećena su dva preloma u okviru 30 restauracija i to kod jednog pacijenta koji je pokazao izuzetnu mastikatornu snagu (1031 N), ali ipak nije nađena veza između žvačne sile i predispozicije za prelom.

Marquardt i saradnici[7] su u toku pet godina sproveli istraživanje na 58 IPS Empress 2 restauracija koje su obuhvatale prednje, bočne krunice i mostove. Kod mostova je u 6 slučaja registrovan neuspeh, dokazana visoka preciznost marginalne adaptacije, nema prisustva marginalne diskoloracije, a estetika je bila na zadovoljavajućem nivou. Kao uzrok neuspeha su naveli nedovoljnu ekstenziju dimenzija konektora koja je glavni uzrok preloma cele restauracije. Veći deo neuspeha se desio u anteriornoj regiji.

Studija Van Steyern-a i saradnika[8] je na In-Ceram sistemu pokazala uspešnost u 90% slučajeva za bočne mostove kod 18 pacijenata i to u periodu od 5 godina. Pukotine su se javile na prelazu između osnove i fasete. Takođe, Edelhoff[9] je upoređivao presujuće i kompozit-

2mm long and they are less from 200nm in a diameter[5].

The nanodialmeter crystals grow along longitudinal axis and they are long less than 200nm. Their diameter is less from 100nm. This kind of material can be treated with fluor-hydric acid that we would get advantages of damaged surface. This acid make possible good connection with composite systems like Variolink II or Multilink. Biaxial flexural rigidity IPS e.max Zir Press material is 110±10 MPa. The connection between IPS e.max Zir Press with IPS e.max Zir CAD base and IPS e.max Ceram veneering material is homogenous, unporous and without fracture.

Clinical investigation with IPS e.max system

If we know that IPS Empres is introduced 1998, we have many investigations from last period which are connected for in-vitro studies of this restaurations. Those two materials have similar structure and those informations are valuable.

Upshaw and co[6]. have shown a high incidence of succesfull in 93% for lithium-disilicate bridges after two years, which was a little bit lower from 95-97% succesfuly for metal ceramic restorations. They noticed two fracture in 30 restaurations by one patient which showed extremely masticatory power(1031N), but they didn't find a connestion between masticatory power and predisposition for fracture.

Marquardt and co[7]. investigated in a 5-year period on 58 IPS Empress 2 restorations which included frontal and lateral crowns and bridges. In a 6 bridge-cases registrated failure, high-precision of marginal adaptation was presented, marginal discoloration wasn't presented, and esthetic was on satisfactional level. As a reason of failure is unsuficient extension of connector dimension which is a main reason of fracture. The most part of failure was happened in a frontal region.

Van-Steyern and co[8]. have shown In Ceram system that in 90% cases for lateral bridges by 18 patients in a 5-years, the fractures noticed between base and veneer. Also, Edelhoff[9] compared pressing and fiber-glass reinforced ne restauracije ojačane staklenim vlaknima. U rezultatima pokazuje neuspeh u jednom slučaju od 23 nadoknade kada je primećena naprslina u keramici uslovljena neprikladnom veličinom konektora.

Zaključak

Novi bezmetalni keramički sistemi, kao što je IPS e.max, pokazuje mnoga potencijalna polja primene. Ovaj materijal se može da koristi za izradu inleja, onleja, faseta, tročlanih prednjih i bočnih mostova, kao i kod minimalno invazivnih, adhezivnih restauracija u bočnom segmentu[10]. Prednosti ovakve procedure su minimalna invazivnost, gingivalno zdravlje, relativno laka procedura i niski troškovi.

IPS e.max (Ivoclar Vivadent, Liechtenstein) pokazuje visoku otpornost, dobar optički kvalitet koji otvara put ka uspehu, a nova presujuća tehnika za oblikovanje materijala predstavlja značajan doprinos daljem razvoju bezmetalnih keramičkih sistema.

composite materials. In his result is registered failure in on cases from 23 restaurations when was noticed a little crack in ceramic because the connector dimension was unsuitable.

Conclusion

New non-metal ceramic system, like is IPS e.max, shows many potential fields of the using. This material can be used for making inleys, onleys, veneers, three-unit frontal and lateral bridges and in a case of adhesive restaurations in lateral segment[10]. The advantages of this procedure are minimal invasivity, gingival health, easy procedure and low cost.

It is leucit-glass ceramic which has good stiffness, optical quality and new pressing procedure for shaping materials and those characteristics have opened a way to success, and new pressing procedure for shaping of materials represents important contribution to development of non-metal ceramic systems.

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