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Feasibility Study of zirconia based restorations in dental applications: A review of desirable properties to enhance and facilitate the existing restorations

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ABSTRACT

Cermet restorations were considered as the most accepted standard for reliable implant materials. Increasing demand for aesthetic appearance supported the commercialization of fairly new metal free restorations. Demand of zirconia prostheses have increased in near future. Zirconia ceramic restoration has a higher fracture occurrence rate than their counter metal ceramic restoration. Surface treatment methods are implemented to improve fracture performance of ZCR. This generate residual stresses on veneering ceramic causing crack initiation and ending with a fracture. In order to overcome the stress in the material zirconia surface coating is used as a surface treatment for increased fracture resistance and to accommodate stresses along the ZCR layers. The cost of replacing the implant is high. Therefore, an attempt is made in this paper to experimentally analyze the feasibility of various surface restoration methods.

Key words: Zirconia restorations, Review, Feasibility

INTRODUCTION

When restoring a tooth, the dentists faces the dilemma: The material selection is the most challenging aspect [1] The major factors which influence the final choice are aesthetics, strength of the prostheses etc.to name a few. Metal ceramic fixed partial dentures (FPDs) are considered as the best standard in implants in dental restorations, as preferred materials. However, the requirement for aesthetic in dentistry as well as the concerns regarding bio compatibility of dental alloys, supports the new products-based innovations for commercial use [2]. Nowadays, all ceramic prostheses are being replaced by metal-based restorations by bio compatible composite materials [3]. A variety of ceramic systems are developed for single crowns or fixed dental prostheses with more favourable aesthetic outcome [4].

Conventional ceramics (glass- glass-reinforced, and Feld spathic ceramics) and Al2O3-reinforced ceramics have faced problems which has a negative impact, especially in the molar region [4]. Ceramic materials for which core-veneered bond-strength, as well as crown thickness are the major factors to overcome occlusal forces [5]. The reliability of industrially prefabricated ceramic blocks exhibits more consistent compared to laboratory manually processed ceramics [6, 7]. Transformation-toughened zirconia is prone to be a successful option in different clinical situations when compared to other all-ceramic systems [8]. Their mechanical and optical properties allowed them to be used as a popular material. Vitro studies demonstrated a flexural strength and fracture toughness. The restorations are processed either by soft machining of pre sintered blanks followed by sintering at high temperature, or by hard machining of fully sintered blanks.

A review paper discusses the current status of fixed restorations based on zirconia, including the clinical success of such restoration findings from existing in vitro studies [14]. Direct ceramic soft machining of pre-sintered 3Y-TZP is now available in the market, after its production in 2001[12]. At high temperature the restoration is further sintered [13]. Hard-machining Y-TZP blanks comprises friction restorations in high blocks of mass, pre-sintered at 99% of the theoretical density. Because of the high hardness and low machinability of fully sintered Y-TZP [13], the milling method has to be robust.

FRACTURE RESISTANCE

The enhanced mechanical properties of zirconia have proved to be feasible for use in subsequent FPDs, and help in reducing the core thickness [13]. The temperature at atmospheric pressure will adverse the crystallographic properties of unalloyed zirconia. Monoclinic structure is kept at room temperature and heating to 1170 ° C. Around 1170 and 2370 °C it is tetragonal and above 2370 ° C temperature, and is cubic to the point of melting [24]. There will be a substantial increase in volume once the transformation from the tetragonal (t) phase to the monoclinic (m) phase is cooled. That will result in catastrophic failure. Adding CaO, MgO, Y2O3 or CeO2 to zirconia-alloys enables the preservation of the tetragonal framework at room temperature. This will monitor the stress-inducing process. Compressive stresses formed in the vicinity of a crack end, arrest propagating crack and result in high toughness [13, 25, 26].

The composition, particle size and shape, type and necessity of stabilizing oxides, zirconia processing and interaction with other phases are the major factors that directly affect the transformation metastability [26]. However, grinding or sandblasting is the cause of transformation which alters the material's phase integrity and increases the susceptibility to aging {27, 28]. Water presence will worsen the well-documented "Low Temperature Degradation" (LTD) [29, 30]. The Y2O3 can react with the yttrium hydroxide producing aqueous environment (Y [OH] 3H2O) [31, 27]. The results of this aging process are recorded as grain pullout and micro cracking as well as decreased strength [13, 32]. This phenomenon is subjected to frameworks or parts of a framework that are not veneered, and to zirconia implants and abutments that are exposed to the oral environment. Consequently, unveneered zirconia should be avoided during frame design [27]. Innovative bio-ceramics such as zirconia magnesia (Mg- PSZ with bioactive glass coating) and stabilized alumina composites TZP are recently reported as materials free from degradation [35].

The in vitro and in vivo studies showed that connector fracture in all-ceramic type FPDs was the exclusive mode of failure [36, 37]. Connector fracture at gingival embrace was initiated. At the gingival embrasure, concentration of tensile stresses may be decreased by the greater radius of curvature. Whereas sharp occlusal embrasures had no negative effect on the resistance to fracture of FPDs [39, 40]. A 2.5 mm occlusogingival height and a 2.5 mm buccolingual width of the connectors (6.25 mm2 connector surface) are sufficient to ensure long-term performance of metal-ceramic FPDs [41]. Similar measurements can be met in the anterior segments as well as in the posterior ones.

Zirconia frameworks' mechanical strength is up to three-times greater than all other Ceram frames. In the posterior region, it can withstand various physiological occlusal forces [4, 14]. Fractures in the connector region in all-ceramic FPDs were recorded [42, 43, 44-46, 4]. The connector dimensions are therefore crucial for the resistance to fractures [40]. Fracture propagated toward the pontic from the gingival surface of the connector [47]. A connector length of 3x3 mm increased the fracture strength of zirconia-based FPDs by 20% [44, 48, 49]. The measurements required for the connector can be reduced to smaller sizes than other core all-ceramic materials. Even so, some authors suggested a 4x4 mm connector size and that the frame would accommodate porcelain veneering, which does not contain more than 2.0 mm of unsupported veneering material [14, 27, 50-52 It should be noted that fracture in bulk is very uncommon [13]. The greatest challenge faced is the cracking of porcelain. The difficulties faced are unique to products with an incidence rate of 8 to 50%. This has also played a crucial role in the thickness ratios or system design. For comparison, it was reported that porcelain problems on metal – ceramic prosthesis studied over a 10-year period, for most alternative alloys, were no more than 6 per cent. For gold-based alloy, 98 percent of total intact porcelain was recorded at 5 years. Therefore, compatibility with porcelain – zirconia is to be remembered. During operation zirconia – porcelain interface may be involved in cracking and chipping. Stresses may be related to surface properties, as the cause does not appear to be the bulk thermal expansion / contraction variation [13]. The aggressiveness of silicate glasses at a higher temperature as solvents of refractory materials is known [57]. The aluminum oxide is readily soluble in dental porcelain under firing conditions. Cerium and zirconium are diffused into glass for absorption of a partly sintered Ce-TZP powder [59]. Lessing of stabilizing dopants may induce changes in the surface of zirconia resulting in destabilization of the t-phase with relatively high local strains [62]. Analogous to Y-TZP water penetration, liquid silicate can penetrate the grain boundaries [13, 63].

CHIPPING AND FAILURES

Chipping is defined as "a typical failure of contact loadings that occurs when a crack caused or propagated by contact loads deflects due to the presence of a nearby free surface."[64, 65] Tensile stress induces fracture in brittle ceramic materials that acts perpendicular to the force applied [66]. Mismatches and intrinsic material defects in the thermal coefficient can increase the risk of crack propagation under continuous loading [67]. Thereafter, brittle ceramic fracture may be caused in adjacent zones [66]. For better bonding, an adherent oxide layer is added in the case of metal-ceramic prostheses. This should enhance the ceramic's wettability and adherence. As a certain level of temperature reaches, part of this oxide will be dissolved into the bottle. In the case of nickel chromium alloys the development of excess oxide would result in poor bonding between the two [68]. High-gold alloys can provide a proper oxide layer for solid porcelain bonding [68].

The zirconia core – veneer bond should also provide ample for benefit from the framework's exceptional assets. However, this bond power is lower than for other all-ceramic systems according to Aboushelib [69]. It can contribute to friction inducing chipping and delamination. Framework surface treatment process, surface finishing, and veneer ceramic application method is directly proportional to the bonding system [70]. If no fractures of the zirconia system were reported [2], chip-off fracture rates of up to 20 per cent were observed at a follow-up time of five years [4, 5]. In the case of metal framework FPDs, a literature review revealed either no veneering ceramic fractures [71] or significantly lower fracture rates ranging from 2.7 per cent to 5.5 per cent for observation periods of 10 to 15 years [2,72,73].

The numerous factors involved in ceramic survival are frame size, proper veneering ceramic support and thickness [74]. In addition, occlusal forces, such as direction, magnitude, and frequency, should be considered [2, 75]. The ruggedness of the veneer can result in chipping from occlusal contacts or grinding. Study of fractography showed that propagation of cracks originated from area under excessive wear and occlusal changes [27, 76, 77]. Studies have shown that sandblasting and deep indentations are very dangerous for the long-term survival of zirconia, even at very low loads [78-80]. Marchack et al. have shown that the scanning of complete contour waxing can help to promote optimum porcelain thickness with correct coping design [81]. This will-fracture in porcelain [14, 82]. It has been proposed that the thickness of the veneer does not exceed two times the core thickness. The pontic structure has to provide an anatomical shape to sustain the cusps of veneers [83]. A truly appropriate veneer method has still not been identified, however. To stop chipping it is recommended to use good veneering systems [4].

For others, the coefficient of thermal expansion (TEC) plays a significant role well before the power of the zirconia-veneer bond [77, 85, 86]. Manufacturers providing porcelain veneering was found with a mismatch between their porcelain and zirconia, with the porcelain having clear TEC lower than the TEC zirconia [84]. In the veneering ceramic, beneficial residual properties such as compressive stress are observed when a frame material with a higher TEC is used [87]. In comparison, when the TEC of Zirconia is lower than ceramics, veneer delamination and micro cracks occurred [69, 88]. This form of method is also used for most of the all-ceramic metal-ceramic and non-zirconian systems [89, 90, 13]. Therefore, if a performance issue arises with Y-TZP, it is not just due to a mismatch between the bulk materials by thermal expansion coefficient [13]. Grain size may also have a part to play [2]. The high temperature of sintering has a direct effect on the particle size at first and later on the phase stability of zirconia-yittria [13].

Recent studies described a layering method in which use of indirect composite onto a zirconia framework [61-66]. A short term in-vitro study revealed that a superior bond strength can be obtained by using a priming agent containing the functional monomer MDP [61]. Plastic and viscoelastic effects, as well as susceptibility to creep and recovery [67, 68] are the functional properties of using composite, especially in areas of high occlusal stress [69, 87]. Zirconia presents a thermo conductivity much lower than that of other framework materials [6, 9]. This low thermal conductivity adversely affects the ceramic cooling rate at the interface. This generates thermal residual stress [91, 92]. It may induce thermal cycling delamination of the veneering porcelain [2]. The different cooling rates such as rapid and slow cooling has direct impact on the bond strength between layering porcelain and zirconia ceramics has been assessed [93, 94]. Prolonged cooling phases have been proposed to reduce this stress and veneer chipping [83, 95, 96]. Slow cooling time will facilitate the resistance of the veneered zirconia restorations [76, 97], and enhanced the shear bond strength [94]. However, Gostemeyer et al. argued that adding 5 min cooling in the furnace lowered the bond strength. Komine observed that these conflicting findings are due to the result of different cooling and testing methods [87].

LAYERED VENEERING CERAMICS

Cohesive and adhesive failures of the veneering ceramics are recurrent complications of veneered zirconia frameworks [76]. To counteract this tendency, the "over pressing technique" has been proposed. A specific type of ceramic is pressed onto the zirconia framework [100]. This technique is reliable since there is no chipping has been detected [14].

Fabrication of conventional dental porcelains usually consists of a frit condensation then followed by a sintering process. Sintering may introduce thermally induced residual stresses [102]. This can modify the measured biaxial flexure strength [102-105]. The moisture content present in the veneering material during sintering will induce changes to the zirconia/veneering interface and will be responsible for the transformation from the tetragonal phase to the monoclinic phase [106]. Preconized that residual stresses and contact-induced cracking will develop chip-fracture [100]. It is reported that CAD/CAM veneering ceramic have higher strength compared to the layered veneering technique. Pressed ceramic may reduce the chipping incidence [4], as the heat pressing fabrication method would reduce the formation of large defects and minimize the thermally induced residual stresses [102,105]. The manufactured blanks are reported flawless. Greater porosities are entrapped in the material during fabrication stages in the dental laboratory, added to human errors [107, 108]. The shrinkage level of the porcelain may be directly linked to the ratio of the mixed powder/liquid veneering ceramic. Minimal three firing cycles are needed. Catastrophic failures can be induced by the incorporation of small impurities like in homogeneities, pores, since cracks cannot be healed but slow growth may occur under oral conditions [108, 109]. The pressing technique will help in the creation of desired tooth anatomy while minimizing the risk of firing shrinkage [110].

The manufactured CAD/CAM veneer will be enforced to the zirconia framework by fusion glass ceramic or by using resin cement [111]. Lithium disilicate has been proposed to be used for connecting to zirconia framework by glass fusion ceramic [76, 112]. Higher tensile strength shown by press-on veneers and the superior quality of the interface will prevent porcelain from chipping [84]. These materials exhibited better fracture strength and fatigue behaviour when compared to the hand-layered ceramics. The latter show much early veneer failures when exposed to under mouth motion cyclic loading [76, 113].

In recent studies, over pressed zirconia three-unit posterior prostheses had observed significantly less fractures and chippings when compared with layered ones [114]. In another study no chipping was observed [101, 108]. Ishibe and Aboushelid recommended the application of press-on veneer ceramics directly onto air-borne-particle-abraded surface [70, 84, 115, 116]. However, other studies found no difference in fracture incidence between the pressed and layered techniques [100, 108, 117].

SHEAR BOND STRENGTH AND INFLUENCE OF ARTIFICIAL AGEING

In metal-ceramic prostheses, as determined by the International Standards Organization (ISO) [119], the minimum required bond strength between metal and layering porcelain is 25 MPa. No such estimate has been yet determined for all-ceramic [87]. When compared theses zirconia and metal ceramic restorations revealed a similar bond strength [88, 115, 120, 121]. Greater bond strength between porcelain and zirconia than for metal-zirconia were the reported in recent studies [2 122]. Results are conflicting [87].

Thermo cycling has no effect on zirconia-ceramic bond [2]. Yet, Silva noticed that in contrast to Y-TZP systems where failures were directly accelerated by fatigue, metal-ceramic restorations failures occurred due to a function of load and not fatigue [123]. SBS could be reported to the dissimilar adhesion mechanisms. If mechanical interlocking and chemical bond resulting from suitable metal oxidation and interdiffusion of ions are essential in the metal ceramic interface, the Y-TZP ceramic bonding mechanisms are still unclear [124, 125]. For the latter, some micromechanical interactions are usually assumed for the wettability of zirconia-core by veneering ceramic [2].

When Ishibe and Aboushelib compared zirconia-layered ceramic shear bond strength to zirconia-pressed one, they found equivalent results [70, 84, 115]. Oral fluids are known to facilitate stress corrosion of ceramic materials. Water molecule will diffuse into the glass and in turn will help the corrosion mechanism [126]. Dissolution of ceramic can happen through 2 ways: by ionic exchange during exposure to an acidic solution [127], or by breakdown of Si-O network in a basic solution. The intensity of chemical deterioration is based mainly to the glass matrix composition and the ratio of crystal incorporation [66]. This will result in slow crack growth and may lead to failure of ceramic restorations in the oral cavity complex situation [2, 128, 129]. So some concerns are mainly assessed regarding zirconium dioxide structural stability when it is exposed to oral environment [6, 27].

Wide variety of zirconia systems were tested in vitro, introducing to various processes such as artificial aging, through dynamic loading and thermal cycling. No significant effects on the fracture load were observed for 3-unit FDPs, and no failures occurred [4, 130, 131]. Thermo cycling had no incidence on the zirconia-layered-ceramic bond [2, 88]. The bond strength stability is verified as equivalent to the results shown by bonding of porcelain-metal framework [87, 88, 132. Another study found no difference between the two veneering methods after aging [108]. There is no significant difference in the fatigue properties of the Zirconia Everest® core material post sintering or heat pressing of the veneering material was detected [133]. Analyses of the fracture surfaces for the pressed ceramic, revealed a combined adhesive and cohesive failure scheme independent of the ageing of the material [76]. Even on polished zirconia, the failure was mostly seen in the cohesive within the veneering ceramic [69, 86]. The flexure strength varied between 70 and 100MPa, depending of the product [134, 108]. The flexural strength of the zirconia veneering porcelain, similar to that of metal-ceramics, will block the propagation of the crack due to the tetragonal phase [69, 108].

Stawarczyk concluded that single crown frameworks exhibited similar or better fracture load compared with layered ones in pressed veneering porcelains for zirconia [108]. Guess noticed that hand-layer-veneered zirconia crowns reported high susceptibility to mouth-motion cyclic loading which leads to early veneer failures [113]. Other factors such as grain size and shape and porosity should also be considered [26] .Grain size strongly affect the mechanical properties of 3Y-TZP [14, 20, 21]. On the other hand, sintering temperatures will influence the phase stability and grain size of the 3Y-TZP [13]. Soft machining restorations are sintered at a later stage. This will prevent the stress-induced transformation from tetragonal to monoclinic.

The final surface will virtually be free of monoclinic phase unless grinding adjustments are needed or sandblasting is performed [13]. A contradicting fact that, the hard-machined restorations of fully sintered 3Y-TZP blocks contain a significant amount of monoclinic zirconia [26]. This may result in surface micro cracking, higher susceptibility to LTD and lower reliability [27].

Several searches studied the fatigue behaviour of 3Y-TZP [28, 29-31]. When tested in cyclic loading, both sandblasting and sharp indentations even at very low loads are harmful to the long-term performance of 3Y-TZP. The presence of residual stresses was detrimental in promoting LTD [13]. Worth to be noticed that the pressable ceramic materials exhibited significantly less change in marginal opening than metal ceramic and copy milled ceramic crowns [16].

COLOR AND ESTHETICS

Tooth Enamel, consist of 97% hydroxyapatite mineral, which is very translucent and can transmit light up to 70%. Dentin is also able to transmit up to 30% of light. The aesthetic dilemma for metal-ceramic restorations is that opaque porcelain is needed to mask a metal substrate. It will reflect light and decrease translucency. Consequently, they will often appear brighter intraorally [5, 1115]. Zirconia framework is aesthetically better accepted than metallic framework, but it remains clinically too white and opaque. Therefore, manufacturers introduce coloured zirconia framework to ameliorate the overall matching colour [156].

Different techniques have been proposed and developed: adding pigments to the initial zirconia ceramic powder, dipping zirconia milled frameworks in dissolved colouring agents, applying liner material to sintered framework [69, 137]. Thinner veneer is then required to mask the underlying framework [138]. In addition, the palatal aspect of anterior crowns and FPDs may be fabricated and produced of the core material exclusively in situations of extensive vertical overlap and lack of space for lingual veneering porcelain [40, 139]. Individualized coloured over pressed ceramics have been also proposed as a quick and easy technique [108]. Excellent aesthetic and perfect matching are difficult to attain, as appearance will rely on pre-coloured ingots. To enhance aesthetic, a layering ceramic can also be applied over a pressed-on veneer [140]. Lava system (3M ESPE Dental Products), which is relatively translucent but may still mask coloured abutment, is proposed in 7 shades, permitting shading from the intaglio surface to the outer [139].

The increase of the concentration of the colouring pigments at grain boundaries could be at the expense of the stabilizing elements. This may result in higher percentage of tetragonal-monoclinic transformation. If this transformation occurs on the surface of the framework, this will provoke grain pull-out and surface lifts. Stabilizing elements by the metallic pigments is the result from competitive displacement in the liquid state. The latter have a melting point lower than the yttrium oxide. A minor alteration in the location or the concentration of the stabilizing elements can affect all the mechanical properties of the Zirconia framework. A fatigue process started on individual surface areas will lead to monoclinic spots and results in surface micro cracking and lifts [70]. The colour pigments at grain boundaries replacing the reduction of yttrium will slowly affect the extend of this process toward the bulk of the material [142, 143]. Another recent study showed that the bond strength of coloured zirconia is significantly lower compared to non-coloured zirconia [70]. When the framework is coloured by dipping in pigment solution, the pigments will concentrate on the outer surface. These surface pigments tend to crystallize on the surface and weaken the strength of the bond with the veneer ceramic [70].

DISCUSSION

Variable study conditions and plethora of materials available made the comparison of the results from relevant literature, a challenging issue [5]. Usually, a failure in any clinical trial results from a combination of causes or events [13], even though some of these studies lack scientific support [144]. Reproducing intra-oral conditions, during the in vitro studies, is quite difficult. An effort was made to create artificial oral environments by applying cyclic forces in artificial saliva, under fluctuating temperature [145]. Long-term clinical studies are still needed to make conclusions [5]. In the era of evidence-based dentistry, reinforcing standardization of clinical cohort studies will permit more efficient conclusions [4]. It has been noted that some granted research centres may be reluctant to publish bad results [146].

There is different dilemma in metal-ceramic restorations biocompatibility limitations and optical qualities provoked the shift to all ceramic restorations placement. All-ceramic crowns provide superior gingival response while achieving marginal accuracies equal to that of metal-ceramic crowns [147]. Even those with a densely sintered alumina core, showed brittle fracture in the posterior region in glass ceramic crowns. Patient selection is one of the factors, which may be critical and the technique remains sensitive [149]. Poor oral hygiene, high caries incidence, moderate gingival inflammation and severe para function are some of the exclusion criteria cited [150]. The stress factors in the core can be reduced by coping design allowing optimal ceramic layering thickness, a uniform cement film, and an adequate TEC matching between the laminate [148].

Studies have shown that the zirconia ceramic flexure strength and fracture toughness are twice that of the alumina counterpart [151]. The partially stabilized tetragonal modification of zirconia to a monoclinic phase, induce by a tensile stress, exhibits 4% volume expansion. To propagate, the crack must overcome the compressive stresses generated at the crack tip [152, 155]. The aim of this review was not to evaluate the survival and failure of different types of restorations. The Y-TZP can withstand physiologic functional loading forces and are comparable to metal-ceramic FPDs [27, 154]. Strength and marginal fit of these zirconia ceramic has been confirmed by extensive using laboratory testing. Still 5 to 10-year clinical studies are needed to determine primary mode of failure and success rate [157]. The major complication reported is chipping of the veneer with a rate that will increase from 6% to 10% between 3 and 5 years, whereas these values are reported on a 10-year period of observation for metal-ceramic restorations [27, 55]. Fracture of the zirconia framework is not probable. Long-term success is essentially dependant of the performance of the veneering [74]. Minor chip-off of the layering ceramic is the most frequently reported complication [2]. Short-span posterior frameworks are reliable, whereas data is lacking for long span and cantilevers types [4].

If bond failure has been pointed as chipping reason [158], differences in thermal coefficients [159], liner material and poor core wetting [84] , veneer firing shrinkage [85,86] , phase transformation [160], loading stresses, flaw formation [161], colouring pigments [70] and surface properties have been reported as potential causes. Upon fracture, similar to porcelain-alloys [162], a thin porcelain layer remained attached to the zirconia surface, showing that cohesive strength was lower than adhesive bond strength [27]. Even scientific evidence was lacking in giving proper explanations, Fischer assumed that bond between zirconia and ceramic was chemical [86]. Others suggested that it is mechanical interlocking added to cooling compressive stresses [163]. The ability of zirconia to counteract crack propagation will result in a crack deflection [164]. Framework design must provide uniform support for veneering [14, 165, 166]. Pressable materials with increase in the crystalline contents generally improve the various mechanical properties [26]. Ceramic crowns made only of zirconia, monolithic zirconia crowns, are not used extensively in clinical practice because there is absence of a sound standard and the possibility of wear of the opposing teeth due to the hardness of zirconia [65].

Even if zirconia frameworks are preferred in posterior situations, compared to other all-ceramic materials [5], some limitations still exist and proper diagnosis is critical for success [167]. The quantity, size within, and chemical properties of the crystals within the ceramic matrix will determine the opacity of the ceramic material [168]. In ceramic Zirconia (VITA Zahnfabrik, Bad Sackingen, and Germany) is reported the least translucent when compared to other ceramics [169, 170]. While success rate for 35% partially stabilized zirconia has been evaluated promising [171], long-term clinical data remain rare [172]. The mechanical [173], aesthetic [174], biocompatible [175], and metal-like radiopaque [176] properties allow the zirconia ceramics to be versatile, even though the opaque core limits their use in the anterior sextant [170]. Careful patient selection and operating technique are essential. Bruxers, periodontal involved teeth exhibiting increased mobility, and cantilever prostheses are to be avoided [172]. Fracture, located in the area between the retainer and pontic is the primary mode of failure. Under high tensile stress, it emanates from the gingival surface of the connectors, leading to catastrophic loss [177].

A framework design allowing for a uniform thickness and support of veneering porcelain has been shown to optimize the strength of bilayered specimens [178]. Radial surface cracks can be generated by Intaglio wall adjustments of the framework, either with a 50 micron or coarser diamond rotary cutting instrument, and under dry or water cooling. This will adversely affect the strength of the zirconia core [179]. Marginal fit has been reported moreover similar to that of metal ceramic restorations [180]**.** Cementation of zirconia-based FPDs with either composite resin, glass ionomer, or resin modified glass ionomer cements have been proposed, even long-term data are lacking [154, 174, 181].

CONCLUSION

Zirconia restorative material is well positioned to fulfil aesthetic requirements and functional needs. Further studies should be carried out to resolve the complications that can reduce the longevity of restorations.

This analysis has pointed to some of the strengths and drawbacks of this innovative content within its limitations.

1. Zirconia can withstand the posterior physiological forces.
2. The attachment with Zirconia-veneer is still not well discussed.
3. Studies should be carried out aimed at reducing veneer chipping.
4. Ageing process, pigment colouring and liner materials have a negative effect on the strength of the veneer-zirconia bond.
5. Pressed porcelain veneer shows decreased frequency of cracking relative to coated veneer.
6. New high strength ceramic veneers will reduce the incidence of chip-offs.
7. Structure design will provide structural support for the veneering ceramic sheet.

Understanding each of these processes should increase the reliability of the zirconia as a material for multipurpose use.

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