REVIEW ARTICLE

Narrative Review on Dental Porcelain and Ceramics: A New Classification

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Abstract

In recent years, there has been a surge in the development and introduction of various ceramic materials in restorative dentistry. It has become increasingly evident that there is growing interest in ceramic materials in dentistry. These materials are preferred over traditional ones because of their superior esthetic qualities and ability to meet patients' demands for improved appearance. The advent of computerized systems for producing dental restorations and the development of novel microstructures for ceramic materials have significantly changed the clinical workflow for dentists and technicians. This has led to new treatment options being available to patients. This review includes a comprehensive search of literature and clinical survival papers on ceramic materials in dentistry published between the 1960s and 2024. Major databases, such as PubMed, Scopus, and Google Scholar, were used for the investigation. The aim is to summarize the literature and update clinicians' knowledge about dental ceramics and their clinical applications. This review suggests a new classification of dental ceramics based on their composition, considering commercially available materials. A summary of each category's mechanical properties and clinical applications is also provided. The purpose is to simplify the understanding of dental ceramics and assist clinicians in choosing appropriate materials for their patients.

Key words: Ceramics, glass-ceramics, porcelain, zirconia

INTRODUCTION

In dentistry, the term porcelain refers to a lab-fabricated restorative material with a non-crystalline glassy composition. In contrast, ceramic refers to a lab-fabricated restorative material of crystalline glassy or non-glassy composition or particle-strengthened glass.[1-3] Porcelain has crystals in its composition, but many authors metaphorically describe porcelain as a non-crystalline material since the crystal concentration is low. Furthermore, the term "pure crystalline" is also used for a few ceramic materials. While there is a glassy element in their microstructure, it is almost negligible. Dental porcelain and ceramics contain both metal and non-metal constituents. Under liquid conditions, these constituents move freely.[4-6] Studies have been conducted on producing strong ceramic materials to substitute the metal core of metal-ceramic restorations.[7] The first effective model of a strengthened ceramic substructure was created by filling a feldspathic glassy matrix with 40–50 wt% aluminum oxide particles (Al_2O_3), as developed by McLean and Hughes.[6] Al_2O_3 increase the flexural strength and improve the fracture toughness of the final porcelain.[6] Moreover, the first crystalline filler was added to feldspathic porcelain called "leucite."[8] The primary purpose of adding leucite crystals is to decrease the flaws in the veneering porcelain of metal-ceramic crowns after firing.[8,9] Leucite can also be utilized for dispersion strengthening at percentages of approximately 40–55 wt%. For example, it can be added mechanically to the porcelain matrix by simply mixing leucite and glass powders before firing. Since these crystals and particles are derived chemically from atoms of the porcelain itself, thus the remaining atoms in the porcelain matrix will participate in the reaction process (termed "creaming"). More evolved ceramic systems were introduced, exhibiting 70 vol% of lithium disilicate, alumina, or zirconia, entitled "glass-ceramics."[5] Therefore, when a crack is initiated through a crystalline structure, it has to break more atomic bonds per unit area to propagate than a crack initiated within a material of unstructured particles. This is why ceramics are generally stronger than porcelain.[3] Dental

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Received: 12-05-2025
Revised: 24-06-2025
Accepted: 30-06-2025

manufacturers have had to investigate additional methods to strengthen ceramic restorations while preserving their esthetic qualities. Polycrystalline ceramics, such as polycrystalline zirconia and alumina, lack glassy components; all the atoms are compactly organized into closely packed crystals, resulting in mechanical properties at least one-third superior to glass ceramics.[5] Nevertheless, they are less esthetically pleasing, more costly, and more challenging to process. Recently, manufacturers have significantly enhanced the optical characteristics of these opaque materials by modifying dopants, crystalline ratios, the arrangement of manufacturing-influenced crystals, and vitrification.[3] Before introducing computer-aided design and computer-aided manufacturing (CAD/CAM) machines, achieving well-fitting fixed prostheses made from polycrystalline ceramics was quite difficult.[5] In the early 1980s, a significant advancement in dental ceramics occurred with computer technology in restorative and prosthetic dentistry.[10,11] Over the past 20 years, several techniques for producing ceramic restorations, including casting, pressing, and milling, have been developed, significantly simplifying the production process.[12] Today, a vast array of dental ceramic materials are available for restoring various defects and missing teeth, suitable for different levels of occlusal forces, further encouraging the trend of "free metal dentistry."[12] Although these ceramics are durable and visually appealing, they are susceptible to brittle fractures under stress concentrations; still, given their recently attained strength, this weakness is considered relatively minor.[4,13] A restorative material is deemed successful if it maintains a minimum survival rate of 95% after 5 years and 85% after 10 years.[14,15]

METHODS

This review involved a thorough search of the relevant literature and clinical survival studies on all available ceramic materials in dentistry. The search included articles published between the 1960s and 2024 and was conducted by a single independent reviewer. Major databases, such as PubMed, Scopus, and Google Scholar, were utilized for this comprehensive investigation. Information related to the composition, properties, classification, and clinical applications of dental porcelain and ceramics were extracted from the used databases. Given the absence of standardized reporting guidelines for most narrative review types, the author of this narrative review structured the content to systematically present the mechanical properties of dental ceramic materials in ascending order. The manuscript is organized into sections covering introduction, methods, classification, and conclusion.

CLASSIFICATION

The following types are classified according to composition regarding commercially available materials [Figure 1 summarizes the different types]. Table 1 summarizes the new classification components. Table 2 give example of products available in the market of each category.

FELDSPATHIC PORCELAIN (DENTAL GLASS)

It primarily consists of 81 wt% of a glassy matrix known as "feldspar" (which has 63 wt% silica and 18 wt% alumina particles), along with silica crystals referred to as "quartz" (SiO_2) and aluminosilicate crystals identified as "kaolin" ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$). These proportions may differ slightly across various brands. It is regarded as the most visually appealing dental material.[16,17] Nevertheless, it has an average flexural strength of 70 MPa.[18,19] Due to its reduced mechanical strength and excellent esthetics, it is recommended for use either as a monolithic material in veneers or as a veneer atop a glass ceramic or glass-infiltrated support structure, and is quickly produced using the powder-slurry method. Applying conventional feldspathic porcelain to veneer a metal core is not advisable because of the significant difference in the coefficient of thermal expansion between the two materials, which can affect the cohesive fracture under occlusal forces.[7,20-22] Research indicated no notable decrease in the

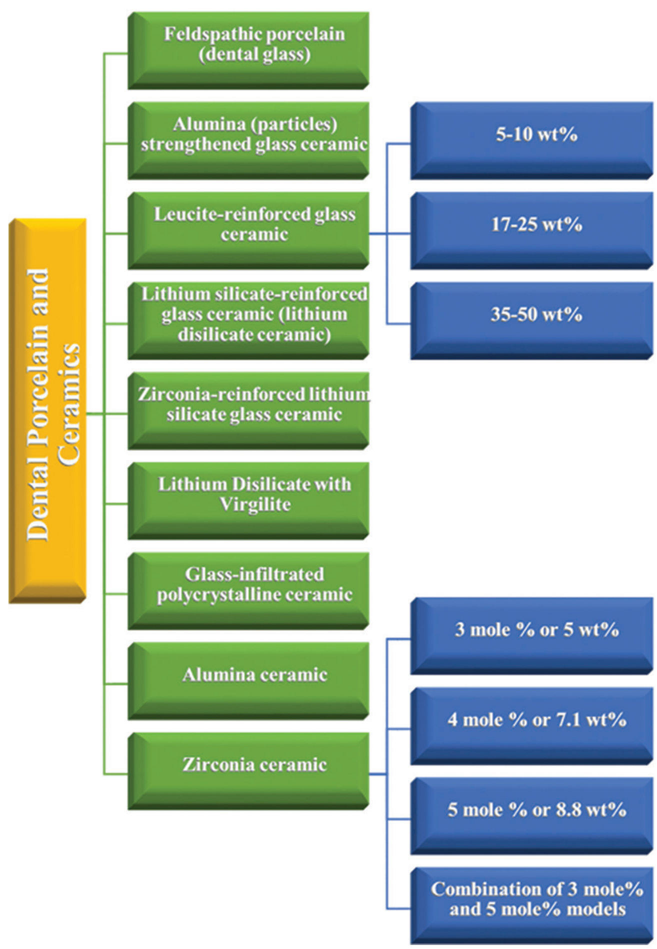

Figure 1: Classification of dental porcelain and ceramics

Table 1: Summary of new classification of dental ceramics

Category	Composition	Key features	Clinical applications
Feldspathic porcelain	81% glassy matrix (feldspar: 63% silica, 18% alumina), silica crystals (quartz), aluminosilicate crystals (kaolin)	Most esthetic dental materials have low flexural strength (~70 MPa)	As a monolithic material in veneers or as a veneer atop a glass ceramic or glass-infiltrated support structure
Alumina-strengthened glass ceramic	40–50% aluminum oxide particles (Al_2O_3) in a glass matrix	Improved bending strength compared to feldspathic porcelain (120–150 MPa) and crack resistance	Anterior crowns
Leucite-reinforced glass ceramic	Feldspathic porcelain reinforced with leucite crystals ($KAlSi_2O_6$)	Flexural strength ranges from 160 to 240 MPa depending on leucite concentration	5–10 wt% is employed in veneers and veneering polycrystalline substructures 17–25 wt%, it is utilized in veneers and veneering metal substructure 35–50 wt% is recommended for veneers, inlays, onlays (only for premolars), and crowns (only for anteriors and premolars)
Lithium silicate-reinforced glass ceramic	Lithium silicate crystals (Li_2SiO_3) incorporated into the feldspathic matrix to create 60–70 wt% lithium disilicate crystals (LiS_2O_3)	Increased flexural strength from an average of 360 MPa in the milled system to 400 MPa in the pressed system and reduced translucency compared to earlier glass ceramics	Inlays, onlays, anterior and posterior crowns, and cores for anterior 3-unit bridges
Zirconia-reinforced lithium silicate	58% crystals (25% lithium silicate, 11% lithium disilicate, 10% zirconium oxide)	Superior mechanical properties (~450 MPa), enhanced polishability, and excellent optical qualities	Same as lithium disilicate ceramic
Lithium disilicate with virgilite	90% lithium disilicate crystals with virgilite (lithium aluminum silicate)	Enhanced mechanical properties and improved esthetics with smaller crystals. 243.61±35.10 Mpa.	Single units
Glass-infiltrated polycrystalline ceramic	70% polycrystalline microstructure with a 30% lanthanum glassy matrix	Excellent flexural strength (~360 MPa) for alumina-based; 280 MPa for SPINELL-based; 510 MPa for zirconia-based	alumina-based, Crowns, three-unit anterior fixed partial dentures (FPDs); SPINELL-based, crowns and inlays; for zirconia-based, posterior FPDs
Alumina ceramic	Almost 100% alumina crystals	High flexural strength (~480–700 MPa)	Frameworks for posterior bridges (up to three units)
Zirconia ceramic	Polycrystalline, stabilized with yttrium oxide (Y_2O_3)	High mechanical strength (~600–1400 MPa) depending on yttrium oxide (Y_2O_3) concentration. Transformation toughening.	3 moL% Y-TZP, core for anterior teeth and full contour for posterior teeth when considering 4–5-unit bridges; 4 moL% Y-TZP core for anterior teeth and full contour for posterior teeth in the case of 3-unit bridges; 5 moL% Y-TZP, molar onlays and crowns in a monolithic form.

Table 2: Example of products available in the market of each category

Category	Example of products available in the market
Feldspathic porcelain	Duceram LFC and duceram plus from dentsply; VITAVM®7 from VITA Zahnfabric; Cercon® ceram S from DeguDent; and Vintage LD from Shofu
Alumina-strengthened glass ceramic	Vitadur N®, Hi-Ceram®, and VITA Zahnfabric
Leucite-reinforced glass ceramic	5–10 wt% (powder: VITAVM®9, VITA Zahnfabric; IPS e.max Ceram, IvoclarVivadent; Celtra Ceram, Dentsply Sirona; Cercon® ceram Kiss, DeguDent; Vintage ZR and Vintage ZR Uni-Layer, Shofu/pressed: IPS e.maxZirPress HT and LT, IvoclarVivadent; Finesse® All-Ceramic, Dentsply)
	17–25 wt% (powder: VITAVM®13 and 15, VITA VMK 95, VITA VMK Master®, VITA Response and VITA OMEGA 900, VITA Zahnfabric; IPS InLine and IPS d.SIGN, IvoclarVivadent; Ceramco® II and Ceramco® 3, Dentsply Sirona; Avanté®, Pentron; Reflex®, Wieland Dental; Exp 1, Exp 2 and Carrara Vincent, Elephant Dental Industries B.V.; Vintage MP, Vintage MP Uni-Layer, Vintage Pro and Vintage Halo, Shofu/ pressed: IPS InLine POM, IvoclarVivadent; VITAPM®9, VITA Zahnfabric)
	35–50 wt% (powder: Optec-HSP®, Generic; Cerinate®, DenMat; Fortress, Mirage Dental Systems/pressed: IPS Empress Esthetic, IvoclarVivadent; OPC®, Jeneric/milled: ProCAD®, IPS Empress CAD, IvoclarVivadent, Paradigm™ C, 3M ESPE; Initial LRF, GC Japan)
Reinforced glass ceramic of high-melting glasses other than leucite, such as fluormica, nepheline, and sanidine	35–50 wt% crystals (pressed: Dicor, Dentsply Int./milled: Dicor MGC, Dentsply Int.; VITABLOCS® Mark I, VITABLOCS® Mark II, VITABLOCS® RealLife, VITABLOCS® TriLuxe and VITABLOCS® TriLuxe forte, VITA Zahnfabric).
Lithium silicate-reinforced glass ceramic	Empress 2, IPS e.max Press and IPS e.max CAD from IvoclarVivadent; OPC® 3G™, from Pentron; Vintage LD Press from Shofu; Initial LiSi and LiSi Press from GC Japan; Livento Press from Cendres+Métaux; and Obsidian from Glidewell Laboratories. Empress 2, the predecessor to IPS e.max Press, was limited to use as a core.
Zirconia-reinforced lithium silicate	Celtra Press, Celtra Duo, Dentsply Sirona; VITA SUPRINITY® PC, VITA AMBRIA®, VITA Zahnfabric.
Lithium disilicate with virgilite	CerecTessera, Dentsply Sirona
Glass-infiltrated polycrystalline ceramic	VITA In-Ceram® ALUMINA, VITA In-Ceram® SPINELL, VITA In-Ceram® ZIRCONIA, VITA Zahnfabric
Alumina ceramic	Procera® AllCeram, Nobel Biocore, VITA In-Ceram® AL, VITA Zahnfabric, InCoris AL, Sirona, Techceram, and Techceram Ltd.
Zirconia ceramic	3 moL% or 5 wt% Y-TZP (IPS e.max® ZirCad LT and MO, IvoclarVivadent; Lava™ Plus, 3M; BruxZir®, Glidewell Laboratories; KATANA™ HT, Kuraray Noritake; InCoris ZI and InCoris TZI, Sirona; VITA In-Ceram® YZ, VITA Zahnfabric; Cercon® Base, DeguDent; DC Zircon, DCS Dental AG)
	4 moL% or 7.1 wt% Y-TZP (Zpex® 4, Kraun; IPS e.maxZirCAD MT, IvoclarVivadent; KATANA™ ST/STML, Kuraray Noritake)
	5 moL% or 8.8 wt% Y-TZP (Lava Esthetic, 3M; Cercon® XT, Dentsply Sirona; BruxZir Anterior, Glidewell Laboratories; KATANA™ UT/UTML, Kuraray Noritake; and Zpex Smile, Kraun)
	Combination of 3 mole% and 5 mole% models (IPS e.max® ZirCad Prime, IvoclarVivadent)

adhesion performance of feldspathic porcelain when used to veneer ceramic frameworks following thermocycling.[23] Furthermore, Borba *et al*. found no significant reduction in the flexural strength of feldspathic-veneered ceramics after undergoing artificial aging through mechanical cycling (2 Hz, 37°C, artificial saliva) and autoclaving (134°C, 2 bars, 5 h).[24] An assessment of the micro-tensile bond strength of feldspathic veneers bonded (relyX) to regular teeth and those with moderate fluorosis showed no significant differences between the two groups.[23] However, when used to veneer ceramic cores, this material's most prevalent failure mode is its frequent cohesive fracture.[24,25] Many manufacturers advocate using feldspathic porcelain in inlays and onlays. Still, according to existing literature, this type exhibits physical and mechanical characteristics that fall short of what is required for restoring posterior teeth.

ALUMINA (PARTICLES) STRENGTHENED GLASS CERAMIC

The alumina ratio is augmented by incorporating 40–50 wt% Al_2O_3 in a broad dispersion within the glassy matrix of standard porcelain.[9,26,27] The goal is to improve the mechanical strength of ordinary porcelain so it can endure bending stresses greater than the typical tolerance of 120–150 MPa while enhancing its resistance to crack propagation.[28] As a result, this advancement allows for its use in anterior crowns; however, it still falls short of enabling its clinical use for posterior teeth.[27] This approach is considered outdated and is no longer employed due to the development of more sophisticated alternatives.

LEUCITE-REINFORCED GLASS CERAMIC

Leucite ($KAlSi_2O_6$) was the initial crystalline filler incorporated to enhance the strength of traditional feldspathic porcelain.[24,29,30] Nonetheless, several studies in the literature often confuse conventional porcelain with leucite-reinforced versions by categorizing leucite-reinforced commercial ceramics as conventional porcelain. The original objective was to elevate the coefficient of thermal expansion in feldspathic porcelain to enable its application in veneering over metal substructures.[27] Its flexural strength varies between 160 and 240 MPa, depending on the quantity of leucite crystals included.[4,29] The amount of leucite varies based on its clinical application,[27] leading to a subdivision of this category into three classifications:

A concentration of 5–10 wt% is employed in veneers and veneering polycrystalline substructures. For a leucite content of 17–25 wt%, it is utilized in veneers and veneering metal substructures. A leucite content ranging from 35 to 50 wt% is recommended for veneers, inlays, onlays (only for premolars), and crowns (only for anteriors and premolars).[5,27,29].

There are highly esthetic laminate veneer materials featuring crystals aside from leucite, composed of high-melting glasses, such as fluormica, nepheline, and sanidine.[12,13,27,29] Fradeani and Redemagni documented a survival rate of 95.2% for 93 anterior and 32 posterior teeth restored with leucite-reinforced (IPS Empress Esthetic) crowns over 11 years.[31] Furthermore, Guess *et al*. evaluated 40 molars restored with leucite-reinforced (ProCAD) onlays, 42 anterior leucite-reinforced (IPS Empress Esthetic) veneers, and 24 anterior leucite-reinforced crowns after 7 years, reporting survival rates of 97%, 97.6%, and 100%, respectively.[32] A study by Sjogren *et al.* indicated a 6% fracture rate of 110 leucite-reinforced (IPS Empress Esthetic) crowns after 3.6 years and 11% failure of 61 inlays (VITABLOCS® Mark II) over 10 years, mostly in posterior placements.[33] Malament and Socransky assessed 1444 Dicor crowns over 16 years, estimating an overall survival rate of 87.3%.[34] Notably, Otto and Schneider concluded a remarkable clinical performance for 200 inlays and onlays (VITABLOCS® Mark I) with an 88.7% survival rate after 17 years; most failures were attributed to fractures.[35] After reviewing additional trials in the literatureit wasnoted that leucite, fluormica, and sanidine-reinforced glass ceramics are restricted for Onlays and crowns on molars because of their moderate and long-term survival rates.[22,27]

LITHIUM SILICATE-REINFORCED GLASS CERAMIC (LITHIUM DISILICATE CERAMIC)

Lithium silicate crystals (Li_2SiO_3) are incorporated into the feldspathic matrix, bonding with silicon dioxide particles to create 60–70 wt% lithium disilicate crystals (LiS_2O_3).[27,36,37] This enhancement leads to increased flexural strength from an average of 360 MPa in the milled system to 400 MPa in the pressed system and reduced translucency compared to earlier glass ceramics.[36,38] As a result, its clinical applications have broadened to include the restoration of teeth with up to 3-unit anterior fixed partial dentures (FPDs). Due to its translucency level, it is not the best for use in creating veneers, anterior monolithic crowns, or monolithic bridges, they have to be layered.[39,40] Present evidence indicates successful clinical applications, such as inlays, onlays, cores for anterior crowns, posterior crowns, cores for anterior 3-unit bridges, and veneering posterior polycrystalline substructures.[41] Esthetic lithium disilicate cores have replaced opaque alumina or metal substructures where appropriate.[38,39] Archibald *et al*. noted an acceptable short-term clinical performance of lithium disilicate onlays (IPS e.max Press and IPS e.max CAD) with a survival rate of 91.5% over 4 years, with all failures occurring in molars. However, Reich and Schierz observed a successful survival rate of 96.3% for lithium disilicate posterior crowns after 4 years, primarily placed on molars.[42,43] Another investigation by Toman and Toksavul 2016 reported an 87.1% survival rate among 121 lithium disilicate crowns (98 anterior and 23 posterior) after 8 years. The use of lithium disilicate for fixed bridges in posterior regions has not been successful due to high fracture rates, as indicated by Pieger *et al*.[44] In addition, Pieger *et al*. reviewed 12 studies on lithium disilicate single crowns and FPDs, reporting excellent cumulative survival rates of 100%, 97.8%, and 96.7% for short, moderate, and long terms, respectively, along with unfavorable survival rates of 83.3%, 78.1%, and 70.9%, for the same periods.[44] Furthermore, Salo-Ruiz *et al*. reported disappointing clinical outcomes for 19 three-unit anterior lithium disilicate FPDs, which showed a survival rate of 71.4% after 10 years.[45] Conversely, Kern *et al*. evaluated 36 lithium disilicate three-unit bridges (6 anterior and 30 posterior, including molars). They found excellent clinical outcomes, with a 100% survival rate at 5 years and 87.9% at 10 years.[46] There is still limited reliable evidence regarding the moderate and long-term use of lithium disilicate ceramics for molar onlays, molar crowns, and anterior FPDs.

ZIRCONIA-REINFORCED LITHIUM SILICATE GLASS CERAMIC

This model consists of roughly 58 wt% crystals (25 wt% lithium silicate and 11 wt% lithium disilicate) reinforced with 10 wt% zirconium oxide crystals.[47] It displays an average flexural strength of 450 MPa.[48,49] These materials provide superior mechanical characteristics to lithium disilicate glass-ceramics while offering excellent optical qualities.[47] Notably, zirconia-reinforced lithium silicate glass ceramic demonstrates higher translucency than lithium disilicate glass-ceramic, as reported by Awad *et al*.[50] Due to its chemical composition, CAD/CAM blocks made from this material are much simpler and quicker to mill than those made from lithium disilicate glass-ceramic blocks. Compared to the lithium disilicate variant, a key advantage of zirconia-reinforced lithium silicate glass ceramic is its enhanced polishability, attributed to its smaller Li_2SiO_3 sizes.[47] No clinical evidence has been available since its introduction in 2013.

LITHIUM DISILICATE WITH VIRGILITE

In 2022, Dentsply Sirona unveiled Cerec Tessera, a new ceramic model that boasts enhanced mechanical properties and is considered a superior alternative to traditional lithium disilicate. However, independent data supporting this claim are limited. The material comprises rod-shaped crystals that increase their density and prevent crack propagation. In addition, including virgilite (lithium aluminum silicate), which is commonly found in glass ceramics, improves its esthetic properties. The material comprises approximately 40–45% glass, with submicron particles measuring approximately 0.5 µm. It contains approximately 90% LiS_2O_3 and 5% lithium phosphate, and the remaining 5% comprises tiny platelet-shaped virgilite crystals that are <100 nm in size.[51] It exhibits a reported 3-point flexural strength of 243.61 ± 35.10 Mpa.[52] A study found that seven cerec tessera restorations placed in a single patient had a 100% survival rate after 1 year of follow-up.[53]

GLASS-INFILTRATED POLYCRYSTALLINE CERAMIC

The material comprises a 70 wt% polycrystalline microstructure infiltrated with a 30 wt% lanthanum glassy matrix during the final sintering process. The initial model (VITA In-Ceram® ALUMINA, VITA Zahnfabric) was launched in 1989, featuring alumina as its crystalline component.[5] It has a flexural strength of 360 MPa.[54] This material is suitable for crown fabrication and was the first all-ceramic restorative option recommended for constructing three-unit anterior FPDs.[55] A few years later, the manufacturer introduced a more translucent variant by substituting alumina with spinel ($MgAl_2O_4$) crystals (VITA In-Ceram® SPINELL, VITA Zahnfabric).[27] However, it has a lower strength (280 MPa) than In-Ceram ALUMINA.[56] As a result, its clinical use is confined to crowns and inlays.[27,55] Evidence-based dentistry indicates that crowns made from VITA In-Ceram® ALUMINA and VITA In-Ceram® SPINELL perform exceptionally well in the short term.[57] A more potent version than alumina exists, with a flexural strength of 510 MPa and composed of a zirconia crystalline phase (VITA In-Ceram® ZIRCONIA, VITA Zahnfabric), which was developed to enable the application of all-ceramic models in posterior FPDs.[54] Glass-infiltrated zirconia ceramic FPDs demonstrate acceptable survival rates in the short term.[58] Consequently, the results were not promising enough to replace the porcelain-fused-to-metal (PFM) system for posterior FPD fabrication. The manufacturer has recently classified these three materials under the commercial designation VITA in-ceram classic to categorize them more effectively.[54] Due to the opacity levels of the VITA in-ceram classic system, it is intended solely as a core for all ceramic prosthetics.[5] This system has been phased out. It is no longer in use because of the complex laboratory procedures, the requirement for highly skilled dental technicians to meticulously follow the manufacturer's guidelines and the development of more advanced alternative systems.[54]

ALUMINA CERAMIC

This polycrystalline model comprises nearly 100 wt% alumina crystals and displays a flexural strength ranging from 480 to 700 MPa.[27] It is suitable for creating frameworks that can support up to three-unit posterior bridges.[58-60] Due to the impressive advancements and results of zirconia ceramics, this system and the VITA in-ceram classic system have been discontinued.

ZIRCONIA CERAMIC

Zirconia ceramics are polycrystalline materials that contain a tiny glass matrix.[58,61] A distinctive characteristic of zirconia ceramics is their capacity to impede crack extension, referred to as "transformation toughening." This effect occurs when a crack develops, leading to a crystalline transformation to another form, which is associated with an increase in volume. This volume change occurs predominantly around the crack, preventing its progression.[58,59] To maintain the optimal properties of zirconia, it is essential to stabilize a tetragonal crystalline structure at room temperature post-firing by incorporating a specific concentration of metal oxide into its composition.[31,59,62] Yttrium oxide (Y_2O_3) serves as the most effective stabilizer for zirconia ceramics.[38] Manufacturers commonly use 3, 4, or 5 moL% yttria-stabilized tetragonal zirconia ceramics.[50,52]

Zirconia with 3 moL% or 5 wt% Y-TZP exhibits the most significant mechanical strength (1000–1400 MPa) with 85–90% tetragonal crystals.

Zirconia with 4 moL% or 7.1 wt% Y-TZP has lower mechanical strength (600–900 MPa) but offers more excellent translucency compared to the 3 moL% version.

Zirconia with 5 moL% or 8.8 wt% Y-TZP shows the least strength (700–800 MPa) with approximately 50% cubic crystals but possesses the highest translucency.[63]

Combination of 3 moL% and 5 moL% models is a new type of zirconia recently introduced. This zirconia is unique in that it combines the characteristics of the 3 moL% and 5 moL% zirconia models using gradient technology. According to the manufacturer, it can be used for various dental applications, from single monolithic crowns to multiple unit bridges.

Numerous recent studies have indicated that polished zirconia demonstrates better wear resistance than glazed and PFM surfaces. In terms of evidence-based dentistry regarding clinical assessments and common complications associated with zirconia ceramics, the following uses are advised: 3 moL% Y-TZP should be employed as a core for anterior teeth and full contour for posterior teeth when considering 4–5-unit bridges, although some manufacturers advocate for its use in entire arch fixed dental prostheses; 4 moL% Y-TZP is suggested as a core for anterior teeth and full contour for posterior teeth in the case of 3-unit bridges; 5 moL% Y-TZP is recommended for use in molar onlays and crowns in a monolithic form.[64-66]

CONCLUSION

The most crucial element for successful ceramic restoration lies in the clinician's advanced clinical skills and extensive materials and bonding systems knowledge. It is imperative for the clinician to accurately select the appropriate materials based on the specific case requirements. In addition, meticulous adherence to the manufacturer's detailed fabrication guidelines is essential to ensure that the restoration functions effectively and meets esthetic goals. This thorough approach is vital for attaining the best possible intraoral performance while maintaining a pleasing appearance for the patient.

DISCLOSURE

The author declares that there is nothing to disclose.

DATA AVAILABILITY STATEMENT

No underlying data were collected or produced in this study.

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Source of Support: Nil. **Conflicts of Interest:** None declared.