Complete-Arch Implant-Supported Fixed Monolithic Zirconia Restorations

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In full-arch rehabilitation with implant-supported fixed prostheses, using monolithic zirconia seems to have several advantages regarding function and esthetics. However, the current scientific evidence is still limited.

edentulous | dental prostheses | dental implants | ceramics | survival rate | complications

1. Introduction

Full-arch implant-supported fixed prostheses are one of the best treatment options for rehabilitating edentulous patients [1][2][3]. Full-arch rehabilitations differ in four parameters: retention mode (screw-retained or cemented), design (single piece or two pieces), prosthodontic material (acrylic/composite metal–resin, metal–ceramic, monolithic zirconia, or zirconia–ceramic), and material to mimic the gingiva (acrylic/composite resin, ceramic, or just gingival shade pigmentation) [2]. Combining a metal infrastructure with veneer ceramics is still considered the gold standard due to its cost, high modulus of elasticity, easy ceramic application and casting, and pleasing esthetic associated with a high success rate [4]. Over the years, the design of full-arch metal–ceramic prostheses has demonstrated success in rehabilitating completely edentulous patients [5]. Therefore, the proper selection of the prosthetic material is critical for the longevity of fixed dental prostheses (FDPs) supported by dental implants. The type of material used can affect how stress is distributed during the chewing cycle and ultimately determines the load-bearing capacity of the FDPs [6][7][8][9][10]. Zirconia has joined this field because of esthetic demands, combining esthetics with excellent mechanical properties [3].

Zirconium (Zr) is a metal with chemical and physical properties similar to titanium (Ti). Zirconium oxide (ZrO_2) or zirconia has been used in Dentistry for over 15 years with many indications, focusing on replacing metal and improving esthetics [11]. Zirconia is a polymorphic material with three forms: monoclinic, tetragonal, and cubic [12][13]. It has optimal properties for medical-dental use [11][12][14]. Moreover, zirconia has an excellent survival rate, minimal technical complications, and good biocompatibility and esthetics [2][3][4]. On the other hand, zirconia has an opaque white color, which it has been suggested to stain to improve the esthetics of the structure. However, in recent years, more translucent zirconia has appeared [15].

Within this context, prosthetic restorations in monolithic zirconia retained by dental implants have shown a survival rate of 99.3% in 5 years, compared to metal–ceramics, which have a survival rate of 98.2 to 98.8% in 5 years [5][16][17]. Monolithic zirconia restorations appear to cause wear on the opposing dentition similar to metal–ceramics and

seem to have a better fit than zirconia prostheses [18][19]. According to Sailer et al. [20], fixed zirconia and fixed metal–ceramic prostheses exhibited excellent 10-year survival rates, with no statistical differences and similar overall technical results. Therefore, metal–ceramic prosthetic rehabilitations had technical complications of 4.5% in 5 years and 14% in 10 years [21]. In contrast, clinical complications for zirconia were found in the prosthetic infrastructure, the fracture of the ceramics (chipping) (ranging from 15% to 54%) [11], and the fracture of the distal extension (cantilever) [22].

2. Complete-Arch Implant-Supported Fixed Monolithic Zirconia Restorations

The success of rehabilitation is defined by its function, good esthetics, stability, no infection presence, and patient satisfaction [23]. Zirconium oxide (ZrO_2) has been used in Dentistry for over 15 years with many indications, focusing on replacing metal and improving esthetics [11], with an excellent survival rate, minimal technical complications, and good biocompatibility and esthetics [2][3][4]. It has optimal properties, such as superior tenacity, resistance to fatigue and bending, excellent wear properties, biocompatibility, osseointegration, and less bacterial colonization, which makes it a suitable biomaterial to be used as a dental implant [11][12][14]. It is most often stabilized by yttria (Y_2O_3), being called polycrystalline tetragonal zirconia (Y-TZP), which has a high stiffness (ranging from 5 to 10 MPa) and flexural strength (ranging from 900 to 1400 MPa) [11][13]. These physical properties are the highest available dental ceramics [11]. On the other hand, due to zirconia having an opaque white color, most dental zirconia systems suggest staining the structure to improve the esthetics of crowns with full anatomical contours. However, more translucent zirconia has appeared, improving the esthetics, but with a lower strength to fracture [15].

Its success directly depends on the survival of each associated element (implants and restorations). Then, the survival of prostheses is directly associated with their functional presence within the mouth [23]. Moreover, the survival rate can be divided into follow-up intervals, which can be considered short term (1 to 5 years) or long term (5 to 20 years) [24].

Rehabilitation can suffer several complications. The biological complication involves dental implants with inflammatory processes that can reach peri-implantitis, and, if not treated, may lead to implant loss and failure of the prosthesis. A typical biological complication in all included studies was implant loss. However, no inference can be made regarding the fact that the prostheses were made of monolithic zirconia. The implant loss in strategic areas can compromise the viability of the entire rehabilitation, implying the creation of a new one, but this does not mean that the monolithic zirconia has failed. The mechanical/structural complications associated with the prosthesis material's integrity may range from simple chipping to catastrophic fracture of the rehabilitation [25][26][27].

Mechanical/Structural Complications

A common complication in all articles included was the loss of covering material in the screw access hole. This is a non-specific complication for zirconia restorations. It cannot be defined as a "compromising" complication because

it did not alter the functional/esthetic quality or the mechanical characteristics of the zirconia, being easily repaired with the addition of new material.

Survival Rate

In Papaspyridakos et al.'s study [17], the complications of 55 full arches rehabilitated with implant-supported metal–ceramic prostheses were studied in an average follow-up time of 5 years. The prostheses exhibited a 98.2% survival rate, with only one failure after 5 years. Complications were divided into minor complications (ceramic wear in 20 prostheses, 84 chipping points in 29 prostheses, and 7 pillars lost in 4 prostheses). Regarding major complications, there were 26 fractures of the veneering ceramic in 9 prostheses, 1 fracture of the infrastructure, and 6 fractures of the screws in 2 prostheses. Gonzalez-Gonzalez et al. [5] reported a 98.8% survival of 80 prostheses in the 5-year follow-up, presenting the loss of the covering material for the screw access cavities, chipping of the covering ceramic, and loss of retaining screws as the main complications.

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