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Types and efficiency of dental bridge supporting implants

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Abstract:

A dental bridge is the fixed dental restoration used to replace the missing teeth. However, after introduction of implants, dentist replace many of missing teeth in this method. Nevertheless, dental bridges can, certainly, still be utilized efficiently, and this article will briefly discuss the many approaches of bridge construction and relate them to their applicability and current acceptance of the practicing dentist and the treated patient. And specifically focus on efficiency and risk associated with tooth-implant FPDs. A Narrative search was conducted using a combination of the search terms: "Dental bridge", "dental implants". An electronic search for data published until August 2018 was undertaken using the MEDLINE, EMBASE and Cochrane Library databases. The elusive search for a strong, lasting, esthetic, biocompatible dental material utilized to support several pontics has been an objective of dental scientists for long period of times. In most cases, these structures have to be veneered with a porcelain material and have to have compatible thermo-elastic properties. Research studies of PFM bridges have been revealed to have significantly higher crack strengths than all-ceramic bridges, and will remain to do so for the immediate future. Zirconia is the most up to date material being made use of however, as reported above, it does not have the very same prognosis as metal bridges. Time

will tell if the dense zirconia material will certainly become the state of the art of non-metallic bridges.

Introduction:

The subject of tooth-implant supported fixed partial dentures (FPDs) has reported in literature since the early 1980s [1]. Since this time, publishers have been seeking more studies either in vitro or in vivo to investigate the biological and mechanical factors of rigid and nonrigid incorporation of natural teeth and implants. Esposito et al proposed that an effective osseointegrated dental implant should include: function (ability to munch), tissue physiology (presence and maintenance of osseointegration, absence of pain, and other pathological processes), and user gratification (esthetics and absence of pain) [1]. Similarly, the implant success criteria suggested by Albrektsson et a limited to machined-surface implants: (1) The personal, unattached implant is immovable when checked clinically, (2) no radiographic proof of periimplant radiolucency, (3) vertical bone loss less than 0.2 mm yearly after the first year of loading, (4) absence of persistent and/or irreparable signs and symptoms such as pain, infections, neuropathies, paresthesia, or violation of the mandibular canal, (5) considering the formerly specified requirements, minimal success levels of 85% after 5-year follow-up and 80% after 10-year follow-up [2]. One benefit of tooth-implant supported FPDs versus implant-implant FPDs is raised tangible perception of natural teeth abutments, revealed to be 8.8 times more than implant abutments, and in turn provides patients with increased chewing comfort [1,2]. Other signs for tooth-implant supported FPDs are individual patient preference and limiting invasion of anatomical frameworks by implant-supported prostheses. Several anatomical and biological elements contribute to the intrinsic threat related to tooth-implant supported FPDs such as the mobility of natural teeth as a result of the periodontal ligament (PDL); a 0.1 N force has been shown to result in movements of 50 to 200 μm [2]. On the other hand, osseointegrated implants relocate less than 10 μm when linked to an FPD hence the prostheses likely will act as a cantilever.

A dental bridge is the fixed dental restoration used to replace the missing teeth. However after introduction of implants, dentist replace many of missing teeth in this method. Nevertheless, dental bridges can, certainly, still be utilized efficiently, and this article will briefly discuss the many approaches of bridge construction and relate them to their applicability and current acceptance of the practicing dentist and the treated patient. And specifically focus on efficiency and risk associated with tooth-implant FPDs.

Methodology:

A Narrative search was conducted using a combination of the search terms: “Dental bridge”, “dental implants”. An electronic search for data published until August 2018 was undertaken using the MEDLINE, EMBASE and Cochrane Library databases. Eligibility criteria included clinical human studies published in English language.

Discussion:

- **TYPES OF FPD'S (BRIDGES)**

During the past decades, myriad sorts of FPDs or "bridges" have been utilized to replace losing teeth. With the introduction and extensive use of osseointegrated implants, many missing teeth are now being replaced in this method rather than with FPDs. Nevertheless, dental bridges can, certainly, still be utilized efficiently. Types: cast-gold, stress-broken bridges; resin-bonded, etched retainers; porcelain-fused-to-metal (PFM) bridges; and all-ceramic bridges, including zirconia.

Cast-Gold and Stress-Broken Bridges

The oldest fixed method of replacing missing teeth is using cast gold. Depending on the case, the retaining abutments can be pinledges, inlays (figure 1), onlays, seven-eights crowns, or full-cast crowns often covered with composite or porcelain for esthetics [3]. Cast gold stays the "standard of care" to which all other materials are considered [3]. Advantages of using high-noble gold are longevity, biocompatibility, precision of fit, marginal integrity, strength, and adaptability. The only drawback in some cases is esthetics, however with proper planning, preparation, and laboratory assistance, cast-gold bridges can be made more esthetic.

Also, it is common for cast-gold bridges to be stress broken to enable micro-movement of the abutment teeth during function and bruxing. When bridges are installed and are under function, stresses might advance in the connectors [3]. This stress can bring about fracture and loosening of the bridge and ache for the patient. By constructing bridges with a non-rigid connector, this stress can be reduced.

Figure 1. Four-unit, cast-gold, stress-broken bridge with vented distal abutment.

Resin-Bonded, Etched Partial Dentures

In 1973, Rochette first published on a wing-like bridge, which had holes in the wings that were then bonded to displace a missing tooth [4]. Composite resin would go through the small orifices and put in mechanical retention to the bonding to enamel. These early bonded bridges were applied by many dental experts to displace former and posterior teeth, but did not have lasting success. In fact, in 1977 Howe and Denehy declared, "dentists should bear in mind it a transient restoration" [5]. The initial metal used was a ceramic non-precious alloy 1 mm to 1.5 mm thick with feathery margins and without preparation of the teeth, which was a primary advantage of these first resin-bonded bridges.

Livaditis and Thompson developed the Rochette bridge by c hemically etching the metal framework applying 3.5% nitric and 18% hydrochloric acid, therefore intensifying the bond strength to enamel and dentin [6], [7]. This sort of retainer was called the "Maryland Bridge" (figure 2).

One 11-year medical study including 127 r estorations revealed a success rate of 92.9% [8]. Different efforts were made to increase the resistance kind of the preparations by adding an occlusal rest, the establishment of guide planes through axial reduction, and a proximal extension to the face surface to stand up to lingual displacement [8].

Alternative components have been used to make these winged-type bridges, such as composite and fired ceramic, including a mix of both with a porcelain veneer on the facial of the composite pontic [8]. Shillinburg et al claimed that these bridges are "probably ideal fit for use as a long-lasting provisional restoration or immediate replacement of a missing tooth" [9].

Figure 2. Seated and bonded resin-etched retainer.

Porcelain-fused-to-metal (PFM) Bridges

One of the most popular kind of bridge applied today by practicing dentists is the PFM bridge. The alloys used are most frequently a noble metal mix of palladium and silver or high palladium. Various other metals made use of consist of a high noble of gold-platinum, or gold-palladium, or gold-palladium and silver. A classification system of the American Dental Association based upon the noble metal content splits the courses into high noble (60% with a minimum of 40% gold), noble (25%), and predominantly base metal (less than 25% noble).

The dental literary works remains to support their use because of their foreseeable durability and reasonable esthetics [10]. As a result of improvements in dental porcelains, new and advanced firing methods, along with the improved abilities of lots of porcelain specialists, the esthetics of PFM crowns and bridges has improved dramatically throughout the last 30 years and, sometimes, approaches that of all-ceramic crowns (Figure 3).

As a result of its fundamental strength, PFM can be used to cover more than one edentulous site, be used on natural teeth along with implants (although in preference not together), and be used with stress breakers when indicated.

Recent reports have been publicized pertaining to using computer-aided design and computer-aided manufacturing (CAD/CAM) of the metal frameworks for PFM bridges [11]. These were pilot studies, but they did reveal that it was feasible to achieve. This treatment is now being done much more regularly utilizing zirconia as the substrate. When a massive one-piece bridge is being constructed, it is recommended that a cement be utilized that is strong sufficient to sustain the bridge in the mouth however will likewise permit extraction by the dentist, such as a polycarboxylate-type cement when using a PFM bridge. The ability to remove a bridge is in some cases crucial, specifically after fracture of the porcelain veneering material. When more adhesive cements are utilized, such as resin cements, the elimination may be more tough.

Figure 3. Retracted anterior view of cemented full-arch PFM bridge cemented to implants.

Screw-Retained vs Cemented Implants and Bridges

Bridges have been placed on osseointegrated implants since their introduction in the early 1980s. In those days, all bridges were screw-retained with channels that allowed the operator to reach the screw attaching the abutment to the implant fixture. The successful long-term prognosis of screw retention has been documented by the Brånemark group, which introduced osseointegrated implants in the early 1980s [12]. Since then, there have been many articles published on t he advantages and disadvantages of either screw retention or cementing bridges directly to the titanium or other alloy abutments. Part of the reason for dentists beginning to cement bridges on implants was esthetics - because with screw-retained restorations, the access holes must be filled and many times can be noticed by esthetically driven patients. Chee and Jivraj reported on these two attachment options and discussed esthetics, retrievability, retention implant placement, passivity, provisionals, occlusion, immediate loading, impression procedures, and long-term treatment planning [13].

Connection of Implants and Natural Teeth

One of the unusual occurrences that have been noticed by restorative dentists is the intrusion of natural teeth when they are connected to implants with a bridge. This was first seen in the early 1990s, and various methods were suggested to prevent its occurrence. One of these was the use of a stress breaker to, theoretically, allow the movement of the natural tooth because of its periodontal ligament (figure 4).

One of the theories that have been reported by Pesun was the idea that when a natural tooth was connected to an implant, it lost the normal stimulation of the periodontal ligament, which then produced atrophy of the ligament and intrusion of the teeth [15]. More recent literature supports the rigid connection of implants to teeth. This research supports the conclusion that if a strong cement is used on the bridge, it may not completely prevent but will minimize the intrusion phenomena [14].

Figure 4. Three sections of stress-broken, full-arch PFM cemented bridge for insertion on implants

Non-Metallic Bridges

During the past 3 decades, clinical dental practitioners have been placing non-metallic bridges made of all ceramic materials. They have been constructed of many different sorts of materials, involving: feldspathic porcelain, leucite-reinforced glass ceramic, aluminum oxide, lithium disilicate, and, most recently, zirconium oxide [16]. The feldspathic bridges were not very strong and were prone to fracture in both the anterior and posterior of the mouth. It was not till pressed leucite-reinforced ceramic started to be used for anterior bridges that any kind of level of success was attained.

Other stronger ceramics have been attempted as systems, such as aluminum oxide, and a more recent material called lithium disilicate (pressed or CAD/CAM), however studies have shown that these had a higher failure rate than when zirconia was used. Zirconia crowns and bridges are the most recent addition to the clinician's choices for a non-metallic restoration (figure 5). Unlike PFM, there has been little research study performed with the zirconia/porcelain mix [16].

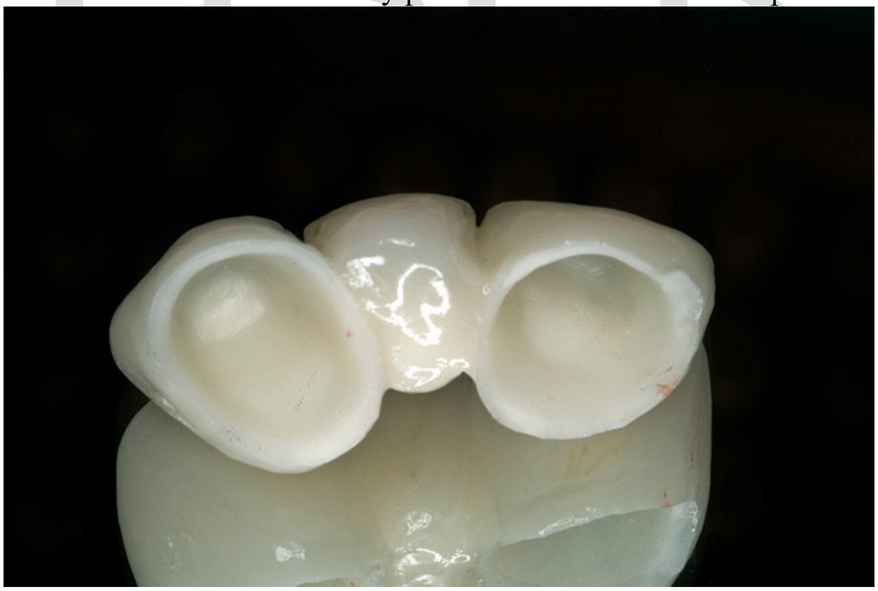

Figure 5. Zirconia-fused-to-porcelain three-unit bridge.

- **ADVANTAGES OF TOOTH-IMPLANT SUPPORTED FPDS**

Lang et al discussed the ability for tooth-implant FPDs to offer patients with the unique ability to improve partially edentulous or nonfunctional occlusal schemes with fixed prostheses [17]. Table 1 lists the benefit of using all-natural teeth in mix with implant-supported prostheses, which include however not limited to: reduced cost, avoidance of important frameworks (relying on proposed dental implant placement closeness to structures such as mandibular nerve or mental foramen), decreased need for advanced graft (if dental implant is suggested in location of ridge deficiency), and boosted patient acceptance [17].

Table 1. Advantages of Tooth-Implant Supported FPDs [17].

Benefits of Tooth-Implant Supported FPDs
Increased tactile perception-greater chewing comfort and efficiency
Avoidance of vital structures
Reduced cost
Reduced need for advanced graft
Improved patient acceptance

- **RISKS ASSOCIATED WITH TOOTH-IMPLANT FPDS**

One of the significant concerns surrounding tooth-implant supported FPDs is intrusion of the natural tooth. This occurrence may be explained by the following theories: disuse degeneration (because of splinting to a dental implant a hypofunctional state is induced), differential energy dissipation (natural teeth are revealed to higher-than-normal pressures as a result of rigid nature of implants, which activates osteoclastic activity of the PDL), mandibular flexure (due to the muscles of mastication and facial expression on opening, closing, and other face movements), FPD flexure (framework flexure during function), damaged rebound memory (constant stress on PDL causes loss of flexible memory), particles impaction or microjamming, and ratchet impact (comparable to inable rebound effects, as a result of unknown binding consequences related to the socket or attachment device) [18]. Intrusion of prostheses happens in 20% of cases for providers with less than 4 years' experience, which reduces to less than 4% for providers with more than 10 years' experience [19]; however, these numbers were gotten with a study of 45 participants from a pool of 110 distributed studies. Other respondents from the study suggested that dealing design resulting in a lack of retentiveness may impact tooth movement and that teeth with mesial inclination were prone to move [15]. Rieder and Parel go on to state that apical movement of teeth normally cannot be discussed with a single causative aspect, rather the occurrence is random and the cause could be mechanical or biological [15].

Fugazzotto et al in a retrospective research of 2 private practice setups throughout 10 (ranged from 3 to 14 years) years discovered that 843 patients received 1206 tooth-implant supported FPDs [20]. All FPDs were screw kept, the writers specified that all FPDs were removed a minimum of once per year and extra regularly if troubles warranted FPD elimination. Of the 1206 FPDs, just 9 intrusion problems arose; all intrusion events were attributed to loss or fracture of retention screws [20]. In a survey of the American Academy of Osseointegration in June 1995, 2384 members were asked, with 775 respondents (32.5% response rate) a series of questions pertaining to implant-assisted FPD [21]. The writers found that the occurrence of intrusion connected with tooth-implant FPDs was 3.5% [21].

Naert et al performed a case study with follow-up (1.5-15 years; typical 6.5 years) consisting of an examination team of 123 patients (339 implants fixed to 313 abutment teeth) and a control group (random) of 123 patients (329 implants fixed to implants d123 stand-alone FPD) were followed (1.3-14.5 years; typical 6.2 years) [22]. In time, problems with the implant-tooth team included: periapical lesions (3.5%), tooth fracture (0.6%), removal (decay or periodontal disease)

(1%), intrusion (3.4%), and cement failure (8%). Most of implant failings remained in the implant-tooth team (10) compared to only 1 in the implant-implant team, recommending that the stand-alone option must be considered [22]. Furthermore, authors suggested that to avoid intrusion, abutment connections need to be rigid [22].

Gunne et al conducted a 23-patient, 10-year longitudinal, posterior mandible, split-mouth design study with short implants (7-13 mm) [23]. Twenty patients finished the 10-year follow-up, without implants lost after 2 ye ars of observation, and no c ontrast in dental implant failure rates in between tooth-implant or implant-implant supported FPD. Results obtained from this study revealed brief implants are a f easible choice for treatment in the posterior mandible as t he implants utilized in this research study were 7 mm [37 implants 54%] and 10 mm [29 implants 42%], with comparable frequencies of failures (3 and 4, s pecifically) [23]. Although taking into consideration the anatomical restrictions, research studies suggest that there are no distinctions in between an implant-supported FPD and tooth-implant- supported FPD over 5 or 10 years [23]. Table 2 lists all the possible threats related to tooth-implant FPDs [20-23].

Table 2. Risks of Tooth-Implant Supported FPDs [20-23].

Intrusion of natural tooth
Biomechanical complications Fixture-abutment failure Crown fracture Loss of retention Screw loosening/fracture (implant) Cement failure (implant/tooth) Fracture (tooth) Caries (tooth)
Loss of natural tooth Endodontic involvement Fracture Caries Periodontal disease
Peri-implantitis

Conclusion:

The elusive search for a strong, lasting, esthetic, biocompatible dental material utilized to support several pontics has been an objective of dental scientists for long period of times. In most cases, these structures have to be veneered with a porcelain material and have to have compatible thermo-elastic properties. Research studies of PFM bridges have been revealed to have significantly higher crack strengths than all-ceramic bridges, and will remain to do so for the immediate future. Zirconia is the most up to date material being made use of however, as reported above, it does not have the very same prognosis as metal bridges. Time will tell if the dense zirconia material will certainly become the state of the art of non-metallic bridges.

Although the long-term success of natural tooth-implant FPDs remains to be determined, the present literature supports tooth-implant FPD clinical usage. To avoid possible complications, mindful preparation and prosthetic design are crucial. Via complete upkeep and preparation, tooth-implant FPDs can be effective; nonetheless, continuous interest needs to be provided by provider and patient. To improve predictability, cases for combination FPDs ought to consist of excellent proposed dental implant place, healthy natural abutment teeth, and outstanding patient factors such as occlusion, oral hygiene, and motivation.

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