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Review Article

Implant hybrid prosthesis: A systemic review

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ABSTRACT:
A healthy occlusion is characterized by absence of pathology, satisfactory function and adaptive capacity. Treatment is rendered in three phases namely, 'systemic phase,' 'stabilizing or preparatory phase' and 'definitive or corrective phase.' Dental implants have become increasingly important in oral reconstruction. The high rate of success of rehabilitation with implant-supported prostheses has increased esthetic demands of patients and clinicians. To obtain satisfactory functional and esthetic results, it is essential to achieve osseointegration and the ideal location of implants to support the intended restoration. Hybrid prostheses have a great number of advantages including reducing the impact force of dynamic occlusal loads, being less expensive to fabricate and highly esthetic restorations.
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INTRODUCTION

Edentulism is a debilitating and irreversible condition and is described as the "final marker of disease burden for oral health". Although the prevalence of complete tooth loss has declined over the last decade, edentulism remains a major disease worldwide, especially among older adults. A healthy occlusion is characterized by absence of pathology, satisfactory function and adaptive capacity. Loss of one or more teeth disturbs the functional balance of the remaining teeth and may result in migration, widening of proximal contacts and food impaction, bone resorption, occlusal interferences, loss of vertical dimension, altered mastication, anterior overloading, temporomandibular dysfunction with para-functional activities, altered phonetics, and aesthetics and psychological problems such as affected self-esteem and confidence.[1- 3]

Treatment is rendered in three phases namely, 'systemic phase,' 'stabilizing or preparatory phase' and 'definitive or corrective phase.' The first two phases involve the elimination or control of patient's systemic disorders that will affect the overall treatment outcome and ensuring that the patient is well maintained to undergo definitive therapy. The definitive phase includes oral surgery, periodontal surgery, implant placement, endodontic therapy, occlusal modifications, occasional orthodontic therapy, and final prosthetic rehabilitation. Anterior teeth influence the border movements of the mandible and also the shape of the occlusal surfaces of the posterior teeth. Therefore, these are restored before posterior teeth. An efficient occlusal scheme can be developed by restoring opposing posterior segments at the same time through application of additive wax technique.[4- 6]

Treatment for partially edentulous patients with advanced periodontal disease involves selective retention of few strategically located key abutments for subsequent overdentures, or for extensive FPD treatment or for implant supported fixed prostheses. Dental implants have become increasingly important in oral reconstruction. The high rate of success of rehabilitation with implant-supported prostheses has increased esthetic demands of patients and clinicians.

To obtain satisfactory functional and esthetic results, it is essential to achieve osseointegration and the ideal location of implants to support the intended restoration. Hybrid prostheses have a great number of advantages including reducing the impact force of dynamic occlusal loads, being less expensive to fabricate and highly esthetic restorations. Furthermore, they may be successfully used by a combination of tilted and axially placed implants in partial edentulism in the posterior part of resorbed maxillae. However, food impaction, speech problems or difficulties in dealing with hygiene were reported by authors.

Despite the favorable long-term outcomes achieved with prosthetic rehabilitations with implants, biological and technical complications such as surgical complications, implant loss, bone loss, peri-implant soft-tissue complications, mechanical complications, and aesthetic/phonetic complications are frequent. The authors implied that such complications are affected by many factors, including the operator's skills and judgments in treatment planning, prosthesis design, materials, patient-specific factors, and local and systemic conditions and habits such as bruxism, smoking, presence of periodontal disease, and maintenance. Furthermore, the communication between the prosthodontist and surgeon is emphasized as critical to ensure adequate restorative space for the various prosthetic designs, appropriate implant angulation, and minimizing cantilevers.[5- 7] Hence; in the present dissertation, we aim to highlight the important aspects of implant hybrid prosthesis.

HISTORY

The history of dental implants is as fascinating as it is ancient. There do not appear to have been any geographical restraints to the desire of early dental practitioners to provide replacements for missing or diseased teeth. Dental implants and transplant history can be traced to Africa (Egyptians), to the Americas (Mayans, Aztecs and Incas), and to the Middle East. Also in this earliest historical period, tooth transplants can be traced to the Greeks, the Etruscan, and the Romans. The first endosseous implant that present oseointegration is probably from the Mayans (7th century AD) where sea shells were carved as tooth shape and placed in the mandible. Today dental implants have become one of the most exciting and rapidly developing aspects of dental practice. The rapid increase in the acceptability of dental implants as regular treatment in the late 20th and early 21st centuries is largely attributable to Swedish Professor Per-Ingvar Brånemark during the 1950's, an orthopedic surgeon who turned an accidental discovery into a dental revolution a new form of attachment mechanism; the osseointegration. Osseointegration is a biological concept and refers to the incorporation within living bone of an inanimate (metal) component. Most implants are made out of titanium and placed into the bone of the jaws by surgical means, and protrude through the mucosal tissues to provide attachment anchorage of replacement artificial teeth.[8- 10]

The fixed-removable prosthesis resembles a flangeless denture that is retained solely by several osseointegrated implants. There is no contact between the prosthesis and the tissues of the alveolar ridge. Brånemark has stated that "critical to the maintenance of osseointegration the carefully controlled and prosthetic-induced loading of the implant-tissue interface". He stressed that a controlled mechanical environment is necessary to assure adequate remodeling stimulus for maintenance of integration. Osseointegrated implants supporting fixed prostheses are exposed to both dynamic and static loading. Dynamic forces on the implants may arise due to chewing and can reach various magnitudes. Static loading on the other hand may be induced by the tension in the bridge locking screws, when securing a misfitting framework to the implants. To help clinicians understand the importance of controlled loading, he stated the precision of the prosthesis fit should be at the 10 µm level.[11- 15]

Esthetic demands tend to be more dramatic with maxillary prostheses than mandibular prostheses. Unlike mandibular implant prostheses were hygienic type designs have proven to be functionally and esthetically acceptable, maxillary implant prostheses demand different sized and shaped labial/buccal flanges that may or may not compensate for optimal esthetics, phonetics, and masticatory function. Additionally prosthetic gingival tissues are often required due to resorptive patterns of edentulous maxillae. Resorptive patterns in maxillae are dissimilar to mandibular resorption pattern: maxillae resorb superiorly, posteriorly, and medially: mandible resorbs inferiorly, anteriorly, and laterally. Implant supported hybrid prosthesis can provide satisfactory results where esthetic and functional requirements are demanding and challenging as in increased intra-arch space that remains following conventional implant replacements, the dentist needs to plan for an alternative treatment procedure that best suits the situation.[16- 18]

REVIEW OF LITERATURE

Tischler M, Patch C, Bidra AS (2017) studied the failure rate of dental implants as well as the fracture rate of zirconia CAFIPs. This retrospective clinical study from private practice included 128 patients rehabilitated between January 1, 2013, and December 31, 2016, with 1072 implants supporting 191 zirconia CAFIPs for single-jaw as well as double-jaw rehabilitations. All zirconia prostheses were of 1-piece design and were veneered with feldspathic porcelain only at the gingival region and therefore considered as predominantly monolithic. Additionally, all prostheses were bonded to implant

manufacturer's titanium cylinders that provided an intimate contact with the implants. The primary outcome measures were implant failure rate and prosthesis fracture rate. Findings from their retrospective clinical study from private practice showed that prosthodontic treatment of edentulous patients with a 1-piece, complete-arch fixed implant-supported zirconia prosthesis with veneered porcelain restricted to the gingival region had high survival rates for implants and prostheses. Minimal technical complications related to this type of treatment for edentulous jaws and no chipping of the veneered gingival porcelain were encountered.[18]

Bidra AS, Tischler M, Patch C (2017) evaluated the survival outcomes of 1-piece complete arch fixed implant-supported zirconia prostheses fabricated by a single dental laboratory supporting several clinicians. Outcome data were collected over a 5-year period from a large commercial dental laboratory that fabricated 2039 1-piece complete arch fixed implant-supported monolithic zirconia prostheses. No prostheses were returned because of chipping of the veneered gingival porcelain. Practice-based evidence from this large sample, short-term retrospective study showed that 1-piece complete arch fixed implant-supported zirconia prostheses with veneered porcelain restricted to the gingival region showed a cumulative survival rate of 99.3% in a 5-year period. The technical complication rate related to this type of prosthesis was minimal.[19]

Menéndez-Collar M, Serrera-Figallo MA, Hita-Iglesias P, et al (2018) evaluated, over a 2-year period, the treatment outcomes for maxillary full-arch fixed dental prostheses (FDPs) supported by a combination of both tilted and axially-placed implants and compared the marginal bone loss (MBL) and implant survival rates (SR) between tilted and axial implants. A retrospective study has been carried out. Thirty-two patients (16 males and 16 females) treated with maxillary full-arch FDPs were included in this retrospective study. A total of 187 implants were inserted to rehabilitate the fully edentulous maxillary arches: 36% of them were tilted (T group, n = 68) and the remaining 64% were axially placed (A group, n = 119). From the total, 28% of the implants (n=53) were immediately loaded with screw-retained provisional acrylic restorations, whereas 72% underwent conventional delayed prosthetic loading 6 months post-operatively. Marginal bone loss measured at 2 years after definitive prosthetic loading was of -0.73 ± 0.72 mm (maximum MBL of 1.43 mm) for axially positioned implants vs. –0.51 ± 0.92 mm for tilted implants (maximum bone 1.45 mm). Differences in MBL were statistically significant when comparing immediately and delayed loaded implants. Based on the results of this retrospective clinical study, full-arch fixed prostheses supported by a combination of both tilted and axially placed implants may be considered a predictable and viable treatment modality for the prosthetic rehabilitation of the completely edentulous maxilla.[20]

Zhuang R, Liu C, Han Z, Li J, Geng W (2018) described a sequence of treatments for a severe mandibular defect. Two patients with severe hard and soft tissue defects had physiological function restored in 4 steps, including alveolar distraction osteogenesis, implant insertion based on a prosthesis, application of dermal matrix membrane in reconstruction of attachment gingiva, and the use of a hybrid prosthesis designed via computer-aided design and computer-aided manufacturing, to produce an adequate bone tissue volume, an adequate amount of attached gingiva, and a reliable prosthesis. On the basis of the current 4-year follow-up, this study shows that a treatment sequence can be predictable and effective for severe mandibular defects, which suggests that it could be considered a potential protocol for patients with severe mandibular defects.[21]

Ciocca L, Meneghello R, Savio G, Scheda L, Monaco C, Gatto MR, Micarelli C, Baldissara P (2019) determined the trueness and precision of frameworks manufactured with a selective laser melting/milling hybrid technique (SLM/m) and conventional milling by comparing the implant-platform/framework interface with those of the original computer-aided design (CAD). Using a virtual 6-implant-supported full-arch framework CAD drawing, 27 titanium replicas were manufactured by 3 independent manufacturing centers (n = 9/center) using a hybrid SLM/m technology (labs 1 and 2) or the conventional milling technique (lab 3). The 3D misfits of new hybrid (SLM/milling) and conventional (milling) procedures differed significantly among them, with the milling technique the less accurate and precise. The largest errors in all groups were found between the most distant implants, resulting in a correlation between the framework span and the inaccuracies. This article is protected by copyright. All rights reserved.[21]

Mangano F, Margiani B, Admakin O (2019) presented a novel, full-digital protocol for the design and fabrication of implant-supported monolithic translucent zirconia crowns cemented on customized hybrid abutments. The present retrospective clinical study was based on data from patients who had been treated with single Morse-taper connection implants (Exacone®, Leone Implants, Florence, Italy) and were prosthetically restored with monolithic translucent zirconia crowns, cemented on customized hybrid abutments. At delivery, the marginal adaptation was perfect for all crowns. However, there were occlusal issues (2/40 crowns: 5%), interproximal issues (1/40 crowns: 2.5%), and aesthetic issues (1/40 crowns: 2.5%). The overall incidence of issues at delivery was therefore 10% (4/40 crowns). At 1 year, one implant

failed; thus the survival of the restorations was 97.5% (39/40 crowns in function). Among the surviving implant-supported restorations, three experienced complications (one loss of connection between the hybrid abutment and the implant, one decementation of the zirconia abutment, and one decementation of the zirconia crown). The success of restorations amounted to 92.4%.[22]

Nevins M, Chu SJ, Jang W, Kim DM (2019) evaluated the safety, efficacy, primary stability, and wound healing of a hybrid dental implant with a unique macrogeometry design in which the coronal section is narrower and cylinder-shaped followed by a wider, tapered apical portion, each comprising approximately one half the length of the implant. Eighteen hybrid macrogeometry-designed dental implants were placed bilaterally into three foxhounds in the mandibular third and fourth premolar and first molar (P3, P4, and M1, respectively) extraction sockets of different dimensions immediately following full periosteal flap elevation and removal of teeth without socket grafting.. All 18 implants were stable and osseointegrated both clinically and radiographically. The analyses revealed that the amount of hard tissue alteration and bone fill that occurred during the healing period was significantly influenced by the thickness of the bone plate, the size of the horizontal buccal gap, and the implant diameter, position, and depth within the extraction socket. Their preclinical study provided clinical and histologic evidence to support the safety and efficacy of a new hybrid macrogeometry implant design that achieved excellent primary and secondary stability in immediate extraction sockets without grafting.[23]

DISCUSSION

The initial consultation is the first step in determining whether a patient qualifies for a reconstructive procedure. A preliminary treatment plan based on chief complaint of the patient, history of present illness, medical history, and clinical and radiographic examination, to be made. Diagnostic impressions should be made to obtain accurate study models. Bone mapping procedures may be carried out to assess the available bone volume. Based on this clinical examination, an appropriate imaging modality is selected to attain information about the proposed implant site. The patient's facial appearance should be documented with preoperative extraoral and intraoral photographs. The initial consultation should also serve to educate and orientate the patient. Visual aids (such as educational models, photographs, and videos) and printed literature are useful in this regard.[24]

The bone and soft tissue response following endosseous dental implant placement is controlled by wound healing factors, biomechanics, and mineral metabolism. Due to the complexity of the tissue response, osseointegration and maintenance of endosseous dental implants may be influenced by many factors including age, diet, drugs, systemic disease, and oral disease. In general, endosseous dental implant may be considered for any patient in reasonable health who desires the replacement of missing teeth and has enough bone in the area or can undergo a bone augmentation procedure. Various factors and their influence on dental implant therapy are physical status and age of patient, hypohidrotic ectodermal dysplasia, smoking, osteoporosis, diabetes mellitus, scleroderma, multiple myeloma, Parkinson's disease, etc.[25]

The main problem encountered with this restoration is related to the added bulk of metal used in the substructure to keep porcelain to its ideal 2 mm thickness. This amount of metal acts as a heat sink during casting procedures which results in porosities and increases the risks of fracture after loading. An alternative option in such situations is the hybrid prosthesis. Because acrylic acts as an intermediary between the porcelain teeth and metal substructure, the impact force during dynamic occlusal loading also may be reduced. Hence, hybrid prostheses are indicated for implant restoration in large crown height spaces as a general rule.

Arch relationships often are affected in edentulous ridges due to the faciolingual direction of resorption. As a result, implants often need to be placed more lingual in comparison to the original incisal tooth position. The final restoration is subsequently overcontoured facially to restore the incisal two-thirds for improved esthetics. This results in a cantilevered force on the anterior implant body. The maxilla is affected more often than the mandible because the incisal edge position cannot be modified and is dictated by esthetics, speech, lip position, and occlusion. Furthermore, the hygiene of the prosthesis is compromised due to the overcontour.

Anterior cantilevered crowns often require additional implants splinted together and an increase in the anteroposterior (A-P) distance between the most distal and most anterior implants to compensate for the increased lateral loads and moment forces, especially during mandibular excursions.[25- 28]

An implant placed in the improper position can compromise the final results in terms of esthetics, biomechanics, and maintenance. The most compromising position for an implant is too facial because no prosthetic ' “trick” exists to mask it, resulting in compromised esthetics, phonetics, lip position, and function. The permucosal position of the implant abutment is of particular importance for FP-1 prostheses. The ideal position is directly under the incisal edge position of the anterior natural tooth and under the central fossa of posterior natural teeth to be replaced.[26]

All implants in either arch should be splinted together when fewer implants are used. The final restoration may be segmented (canine to canine and two posterior segments) when the number of implants permits so. Posterior cantilevers in the fixed prosthesis should be

limited in the maxilla and rarely extend more than one tooth. However, posterior cantilevers in full arch mandibular restorations are not uncommon, but the cantilever length rarely extends more than two teeth. Of course, the number of cantilevered pontics in both arches depends directly on overall stress conditions.[28] Implants have become the treatment of choice in many, if not most, situations when missing teeth require replacement. Studies of the interaction between implant-supported restorations and the surrounding oral environment appear, fortuitously, to support the conclusion that the human host response to oral implants is favorable. The treatment planning for an implant restoration is unique regarding the number of variables that may influence the therapy. Of prime importance is the recognition of the fact that a definitive treatment plan should be developed sequentially to ensure the best possible service. With appropriate diagnosis and conscientious treatment planning, the use of implant hybrid prosthesis enjoys good prognosis.[22- 26]

CONCLUSION

Implant-hybrid prostheses can be fixed, or in the case of the bar-retained overdenture, attached and unmovable. Often, they don't require a flange because the support comes from the implants. More implants provide greater stability, and when they're fixed, as in a hybrid, or cemented, they perform like natural teeth. Hybrids and fixed prostheses can be less intrusive due to the elimination of the bar or framework. There is a higher cost associated with implant-supported prostheses because they involve more implants and, therefore, more surgery, particularly if significant grafting is required. Those screwed into place or cemented are harder to clean. Treating a gummy smile may require significant bone removal to hide the margin of the prosthesis, which may require pink porcelain to avoid abnormally long teeth.

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