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Research Article

OCCLUSION PRINCIPLES IN IMPLANT-SUPPORTED PROSTHESIS – A LITERATURE REVIEW

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ABSTRACT

The utilization of oral implantology in the field of dentistry is growing at a rapid rate. Dental implants are frequently preferred options for replacing missing teeth. However, unlike natural teeth, endosseous implants differ concerning the surrounding bone. Forces from occlusal overloading may cause mechanical and biological complications like early implant failure, early crestal bone loss, intermediate to late implant failure, screw loosening, uncemented restoration, component failure, porcelain fracture, prosthesis fracture, and peri- implant disease. Hence, dental implants require different biomechanical considerations from natural teeth as they are more prone to occlusal overloading. In case of increased biomechanical stresses in clinical conditions, the dentist should implement occlusal mechanisms to decrease the stresses. An occlusal scheme that should minimize the risk factors and permit the restoration to function in harmony with the stomatognathic system should be developed.

Implant-protected occlusion is proposed to overcome mechanical stresses and strain from the oral musculature and occlusion by avoiding loss of crestal bone surrounding implant fixtures. Implant-protected occlusion can be established by minimizing the width of the occlusal table, increasing the surface area of implants, reducing the occlusal force, and enhancing the force direction. The dentist can reduce overload on bone-implant interfaces and implant prostheses within the physiological limits, and ultimately provide long-term stability of implants and implant prostheses. This article encapsulates the principles of occlusion that provide biomechanically optimum load distribution in different implant prostheses.

INTRODUCTION

Dental implants have become a frequent treatment approach, revolutionizing dentistry in the last few decades[1]. The success of endosseous implants has led to increased quality of life for patients. Dental implants have high survival and success rates but are not immune to complications[2]. The factors that appear to be the most responsible for the failures are attributable to infectious factors (peri-implantitis) and the management of occlusal relationships.[3]

Dental occlusion plays a central role in clinical dentistry, dissipating forces to surrounding bone, and is essential for normal physiologic function.[4] Occlusion is critical for implant longevity because of the attachment of the bone to the titanium-surfaced implant.[5] Often, occlusal concepts and ideas designed for natural teeth are applied to implants without modification. As osseointegrated implants lack specific defense mechanisms, poorly restored occlusion on osseointegrated implants can result in deleterious effects on the prosthesis and supporting alveolar bone. The ultimate success and longevity of any restoration in the oral cavity depend on the forces acting on it and the ability of the underlying structures to absorb or react to these forces. An excessive occlusal load has been suggested as one of the potential challenges for the success of implants, their components, and the prostheses. It is also often regarded as one of the leading causes of peri-implant bone loss and implant prosthesis failure[6]. Literature has reported that dental implant's clinical success and longevity can be achieved by biomechanically controlled occlusion[7,8]. An implant protective occlusal scheme is widely accepted to minimize occlusal overload. Implant-Protective occlusion is an occlusal scheme that minimizes the forces at the crestal bone and implant interface. Biomechanical principles form the basis of this concept[7]. The principles guiding implant-protected occlusion are discussed in this article.

Principles of Occlusion in Implantology

Implant-protected occlusal was proposed by Dr. Carl E. Misch to overcome the excessive occlusal load and to establish a consistent occlusal philosophy[9]. Implant-protected occlusion concept addresses several conditions to minimize overload on bone-implant interfaces and implant prostheses, which maintains implant load within the physiological limit. Factors influencing implant-protected occlusion are

Occlusal table width

Occlusal table width and occlusal contacts contribute to the amount of force, type, and direction and may be modified to

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reduce crestal loads[10, 11, 12]. The width of the occlusal table is proportionally related to the width of the implant body. The wider the occlusal table, the greater the force developed to penetrate a bolus of food. As a result, the occlusal table's width must be reduced compared to a natural tooth.

Premature occlusal contacts

Premature contacts are defined as occlusal contacts that divert the mandible from a normal path of closure; interfere with normal smooth gliding mandibular movement; and deflect the position of the condyle, teeth, or prosthesis. Occlusal prematurity between maximum intercuspation and centric relation occlusion should be considered, especially on implant-supported prostheses. Because non-mobile implants bear the entire load of the prosthesis when it comes in contact with the mobile natural teeth, hence during the occlusal adjustment between implants and natural teeth, premature occlusal contacts on the implants can occur as the natural teeth can move away from the centric during function. Hence, the implant prosthesis should just barely come into contact, and the surrounding teeth in the arch should exhibit greater initial contacts.[13]

Mutually protected articulation

Mutually protected articulation implies that the anterior guidance protects the posterior teeth during an excursion. In contrast, during centric occlusion, the anterior teeth have only light contact and are protected by the posterior teeth. When the natural canines are present during excursions, the teeth can distribute the horizontal load, and the posterior tooth can disocclude. This concept is known as canine guidance or mutually protected articulation. However, there should be no contact on the implant crown during the excursion to the opposing side and during protrusion[14]. The anterior guidance of implant prosthesis with an anterior implant should be shallow. This is because the steeper the incisal guidance, the greater the force on the anterior implants[15]. The rationale of mutually protected occlusion is that the forces are distributed to segments of the jaws with an overall decrease in force magnitudes.

Implant body orientation and location

The implant's location is considered a critical factor in avoiding occlusal overload. It is recommended that horizontal load be reduced as much as possible, and implants should mainly be vertically loaded. An implant is mainly designed for long- axis load[13]. To achieve this principle, the implant should be positioned so that it is in a straight line with the opposing antagonist. The utilization of surgical guides, radiographic examination, and diagnostic wax-up can establish a favorable location for the implant.

Influence of surface area

Sufficient surface area is required to withstand the load transmitted to the prosthesis. Therefore, when an implant of the decreased surface area is subjected to increased load in magnitude, direction, or duration, the stress and strain in the interfacial tissue will increase. When implants of decreased surface area are subjected to angled loads, the magnified stress and strain magnitudes in the interfacial tissues can be minimized by placing an additional implant in the region of concern[16-19]. In cases where forces are increased in magnitude, direction, or duration (parafunction), ridge augmentation, a reduction in crown height, or an increase in implant width or number may help compensate for the increased stresses.[5]

Crown cusp angle

Developing tooth morphology to produce axial loading is essential when constructing implant prostheses. Weinberg claimed that in the production of bending moment, cusp inclination is a significant factor[20]. The resultant bending moment can be minimized by reducing cusp inclination with a lever-arm reduction and improving axial loading force[21]. Therefore, the occlusal contact over an implant crown should be on a flat surface perpendicular to the implant body. This is achieved by increasing 2 to 3mm of the width of the central groove in the posterior implant crowns, and the opposing cusp is re-contoured to occlude the central fossa directly over the implant body.[13]

Length of Cantilever extension

Cantilever extension is a factor that can cause occlusal overload on osseointegrated implants; it is suggested that the extension part may cause a hinging effect which induces a significant compressive strength on the implants, especially the closest one to the extension[13]. Implants-supported prostheses with shorter cantilevers have better outcomes and longevity than Implant-supported prostheses with more extended cantilevers; the maximum recommended length of the cantilever was 15 mm, and a cantilever longer than that can significantly increase the failure rate[22]. Long cantilevers are correlated with increased crestal bone loss.

Crown height

Many times implant crown height is greater than the natural anatomical crown. The greater the crown height, the greater the resulting crestal moment with any lateral component of force, including those forces that develop because of an angled load[23]. Hence, a greater crown–implant ratio has been considered detrimental. Therefore any harmful effect of any feebly selected cusp angle, angled implant body, or angled load to the crown will be magnified by the crown height measurements.

Occlusal contact position

Occlusal theory by Peter K Thomas suggests that tripod contact should be on each occluding cusp, on each marginal ridge and central fossa[24]. The ideal primary occlusal contact should reside within the diameter of the implant within the central fossa. The secondary occlusal contact should remain within 1 mm of the periphery of the implants to decrease the moment loads.[13]

Time of loading and quality of bone

Classical classification of bone quality is categorized into four types, with bone type I being the densest bone and type IV being the least dense. It is suggested that bone types I and II promise the most successful implants due to their ability to withstand occlusal loads. A gradual bone loading should be suggested to reduce the possibility of implant overloading. In addition, less crestal bone loss and better bone density were noticed with progressive implant loading.[25]

CONCLUSION

A poor selection of occlusal schemes can lead to biological and mechanical complications. The various consequences that can be encountered are implant failure, early crestal bone loss, screw loosening, uncemented restorations, component failure, porcelain fracture, prosthesis fracture, and peri-implant disease. An implant-protected occlusion scheme addresses several conditions to minimize overload on bone/implant interfaces and implant prostheses, thus restricting implant loads within physiological limits. The guidelines need to be implemented in specific conditions to decrease stresses and develop an occlusal scheme to allow the restoration to function in harmony with the stomatognathic system and maximize the longevity of the implants and prosthesis.

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