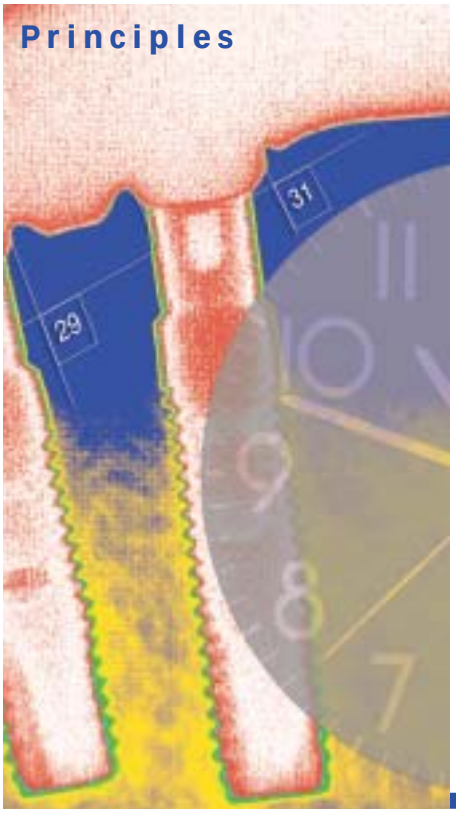

The Role of Complete Denture Principles in Implant Prosthodontics

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Abstract

During the past 30 years, there has been a growth of implant courses in dental schools at the predoctoral level to meet a burgeoning demand. At the same time, there has been a concomitant reduction in curriculum time devoted to clinical and technical aspects of complete denture construction. There will be a sizable cohort of patients with limited natural dental landmarks seeking implant reconstructions that may be difficult for the general practitioner to restore. This article reviews basic prosthodontic principles and procedures that are important to understand when designing an implant prosthesis.

During the past 30 years, there has been a growth of implant courses in dental schools at the predoctoral level to meet a burgeoning demand.[1-5] At the same time, there has been a concomitant reduction in curriculum time devoted to clinical and technical aspects of complete denture construction.[6,7] This lack of emphasis on removable prosthodontic principles may be the result of speculation that the need for dentures will decrease markedly in the future. However, Douglass and colleagues[8] projected an increase in adult population needing at least one denture from 33.6 million in 1991 to 37.9 million in 2020. Therefore, there will be a sizable cohort of patients with limited natural dental landmarks seeking implant reconstructions that may be difficult for the general practitioner to restore. This article reviews basic prosthodontic principles and procedures that are important to understand when designing an implant prosthesis.

Vertical Dimension

Treatment planning for a complete arch implant prosthesis includes deciding between fixed or removable designs and engineering the surgical position of the implants. One of the most important factors in these determinations is the space available for the implant components and restorative material. Using a reliable method for establishing the vertical dimension of occlusion is essential when natural tooth stops are lost. The physiologic rest position was suggested for this purpose in 1934.[9] This is a position of the jaw when the muscles of mastication are in a state of mild tonic contraction. Niswonger recommended subtracting 3 mm from this facial measurement for the vertical dimension of occlusion in Class I patients. Class II patients will require more interocclusal space, and Class III patients may need less than 1 to 2 mm. Other authors have contended that the rest position is dynamic.[10,11] Silverman[12] provided another guide to vertical dimension of occlusion by assessing the closest speaking space. He found that in

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most patients with a natural dentition the incisal edges of the mandibular anterior teeth should be slightly lingual to the maxillary incisal edges and between 1 to 2 mm apart when pronouncing the sibilant sounds. Shanahan[13] maintained that the eruption of teeth is held at the occlusal plane by the act of swallowing, establishing the vertical dimension of occlusion, and is unchanged after extractions. Tallgren[14] preferred a combination of mild fatigue followed by swallowing and relaxation with eyes closed. Pound[15] used a phonetic method of the /m/ sound and engaging the patient in conversation before establishing rest position. Babu and colleagues[16] showed that determination of vertical dimension of rest using swallowing and phonetic techniques was more accurate with a patient's denture in place. Willis[17] popularized a facial biometric measurement. He related that the distance from the pupil of the eye to an imaginary line coincident with the commissures of the lips should equal that from subnasion to gnathion. A combination of methods may be necessary to arrive at appropriate facial contours and sufficient interocclusal distance.

Restorative Space Allowance

AbuJamra[18] described a technique for evaluating interarch space in edentulous patients when the occlusal vertical dimension is established. A denture can be mounted on an articulator using a facebow and occlusal registration and a resilient cast made of polyvinylsiloxane putty. Removing one denture at a time from the cast, an assessment can be made of the distance available from the alveolar ridge mucosa to the antagonist incisal edge. The minimum intermaxillary space for a bar-retained implant overdenture is 10 mm.[19] When low-profile single-anchor retainers are used rather than a bar, the prosthetic assembly requires 8 to 9 mm. A removable implant complete denture requires 9 to 10 mm. A fixed implant complete denture may need 15 to 17 mm, while a fixed ceramometal implant prosthesis may require only 4 to 8 mm unless angulated abutments are used, which occupy at least 9 mm.[18] When there is insufficient space, an alveoloplasty may be indicated, if implant length does not limit the prognosis for success.

Intermaxillary Relationship

Another benefit of assessing the patient's correct facial height is accurately determining the intermaxillary relationship, which may alter the edentulous implant prosthetic design choice. Davis and colleagues[20] noted that with unfavorable maxillomandibular relations it is difficult to reconcile the position of the teeth and the position of the implants with a fixed implant complete denture. For instance, Naert[21] related that on the mandible, a Class III relationship in a fully edentulous patient would best be restored with an overdenture to increase the occlusal support in the posterior region. In a Class II relationship, an overdenture would allow for more freedom in stabilizing the occlusal scheme, and the mucosa can share in the support when the lateral offset is too great.

The Flange

The thickness of the buccal flange of an existing maxillary denture may also dictate whether a fixed or removable restoration will be acceptable. Lip- and cheek-support needs can be analyzed with either a duplicate denture or ideal wax-up, without the flange. Patients with high smile lines may best be restored on the maxilla with a buccal flange and a removable prosthesis to prevent esthetic problems.[22]

When an implant overdenture is planned, correct border molding[23] is necessary to establish a favorable contour to prevent food entrapment and to provide natural facial tissue scaffolding. The flanges should extend to the vestibule but not intrude on the dynamic movements of the mouth and cheeks. A posterior palatal seal will be required on the maxilla when there is palatal coverage with the prosthesis.

Midline

The appropriate arrangement of denture teeth in the anterior region is predicated on esthetic, phonetic, and functional considerations. The dental midline when not colinear with the facial midline should be at least parallel to it. Otherwise a visual tension is created.[24] The use of anatomical landmarks on an edentulous cast — bisecting the frenum, nasopalatine foramen, and the midpalatine suture — has been shown in 30 percent of patients to be as much as 5.5 mm off the facial midline.[25] A chairside evalua-

tion is most reliable and will reveal when adjustments need to be made for facial asymmetries. Patients tend to relate the midline to the tubercle of the lip rather than features more distant from the mouth.[26]

Selection of the Maxillary Central Incisor

The selection of anterior teeth when no pre-extraction records are available is still an artistic exercise in harmony and proportion. Biometric measurements have been proposed for the width of the maxillary central incisor, but there is no best single predictor accurate enough for clinical application. The use of the bizygomatic width divided by 16, using the Trubyte Tooth Selector, is not based on sound statistical procedure.[27] Interpupillary distance, interalar width, philtrum width, intercommissural width, and interbuccal frenum distance all lack strong correlation to the maxillary central incisor width.[27,28] It has also been shown that actual measurements of natural anterior dentitions do not follow the golden proportion.[29] The average central incisor width is approximately 9 mm for a white male and less for a female.[30]

The Arrangement of Teeth

The first step in developing an esthetic arrangement of maxillary anterior denture teeth is to determine the incisal edge of the central incisors, which should contact the vermillion border of the lower lip when an /f/ sound is produced. The placement should also provide sufficient lip support. Depending on the lip length, 1-2 mm of the incisal edge should be displayed in repose. Then the exposed incisal part should correspond to half the distance framed between the upper and lower lips during an /e/ sound.[31] The average length of the

central incisor is 10.5 mm.[32] Frush and Fisher[33] have detailed the esthetic impact of rotating and positioning the anterior teeth. The incisal edges of the maxillary anterior teeth should follow the envelope of the lower lip. A balanced asymmetrical setup with adequate incisal embrasures will provide variety and vitality. Once the maxillary anterior sextant is established, a significant vertical distance between the optimal placement of the artificial teeth and the underlying tissues signals the need for a removable implant design. It is also important to form an adequate palatal convexity in the rugae area for speech competence when there is moderate to severe resorption.[34]

Correct placement of the posterior teeth will foster a balance of the muscular and occlusal forces on implant prostheses. Posterior tooth position can be established by a selection of a neutral zone of the mandibular buccal and lingual tissues or placement of the teeth over the crest of the ridge.[35] The maxillary posterior teeth should then be evaluated in the frontal plane to assess the buccal corridor, which will affect visual perspective. The buccal-lingual positioning of the implants is critical. Implants placed away from the center of the mandibular ridge may cause the prosthesis to encroach on the tongue space or distend the labial or buccal soft tissues. This may lead to ulceration or instability of the prosthesis.[36] The plane of occlusion is a resultant of anatomic landmarks by using the retromolar trigone, lateral border of the tongue, lip commissures, and ridge parallelism.[37,38] In the sagittal plane, it should be parallel to Camper's line and one-quarter inch below Stenson's duct.[39] When the occlusal plane is not appropriately established, esthetics and the occlusal scheme may be compromised.

Occlusal Schemes

Occlusal schemes recommended for complete arch implant prostheses may be similar to complete dentures. Although non-axial loading has not been shown to be detrimental to the bone-implant interface,[40] prosthetic "lesions" have often been cited as resulting from overload.[41,42] Wie[43] also found, with both fixed implant complete dentures and implant overdentures, a higher incidence of failing screw joints with mutually protected occlusion as opposed to group function or balanced occlusion. Solnit[44] recommended bilateral balanced occlusion or anterior/posterior group function for complete-arch ceramometal fixed partial dentures. Wismeijer[45] also favored either bilateral balance or group function for mandibular implant overdentures depending on the opposing arch restoration. Arguably, the goal is to develop an absence of deflective contacts in centric closure position and excursions, while developing a free-gliding occlusion during articulation for equal load distribution and chewing efficiency. Lang[46] has recommended the lingualized concept because of its lack of complexity in execution and minimal reshaping of the cusps. Complete denture occlusal concepts can be helpful in equilibration and remount procedures to refine the scheme.

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Summary

Many of the concepts and procedures for complete denture construction seem integral to implant prosthetic treatment planning and designing. Interim restorative treatment for extensive fixed implant reconstructions may also involve a removable prosthesis. All complete arch implant restorations require an understanding and competence in basic removable prosthodontic principles and procedures. It is ironic that the most recent and revolutionary advance in dentistry appears to be married to one of the earliest treatment regimens. CDA

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