Occlusion and Concepts of Provisional Loading of Implant-Supported Restorations

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With the multitude of implant systems that support and restore fixed and removable restorations, it is difficult to identify definitive concepts of occlusion that are specific for individual systems. Chapman\textsuperscript{1} broadly set principles for implant prostheses as (1) bilateral, simultaneous contact of the jaws, (2) freedom from protrusive and lateral interferences, (3) absence of nonworking contacts or prematurities, and (4) equal distribution of occlusal forces. These principles could be applied to most implant-supported restorations during construction and placement, but, as in clinical practice, there is a need to examine the restorations on a regular, continuing schedule to see if they are maintained as they were planned and placed. The question arises to what extent these principles will be adhered to after normal occlusal and guidance wear is observed. Problems and complications can be the result of not monitoring the restorations in a timely manner.

Hobo et al\textsuperscript{2} and Jiménez-López\textsuperscript{3} agree that the occlusion of dental implant-supported restorations should follow fixed and removable prosthetic guidelines. An organic occlusion, mutually protected by anterior guidance either by the canines or group function, which would include the premolars and molars, should be the goal when the natural dentition is involved. Simultaneous posterior tooth contact without cuspal interferences establishes support and distributes stresses to implants. Misch and Bidez\textsuperscript{4} suggest that various vectors and biomechanical forces need to be considered and implants should have reduced initial mechanical load compared to that for natural teeth. The occlusal table could be narrowed to proportion according to implant size. With the use of diagrams, they stressed axial loading and implant trajectories with the elimination of lateral or angled loads. Adding implants for more surface area is an option to increase support for the restoration. Another option would be to utilize wider-diameter implants to effect a wider prosthetic diameter at the base of the restoration.\textsuperscript{5}

Recent research challenged some concepts of occlusion and loading. Oiso et al\textsuperscript{6} placed implants with a modulus of elasticity close to that of alveolar bone in monkeys and created occlusal prematurities that significantly increased the monkeys' vertical dimension of occlusion. One implant opposed three splinted teeth. Results showed no loss of implants but rather an increased amount of implant-bone contact and intrusion of the opposing natural dentition with histologic sections suggestive of orthodontic tooth movement. The vertical dimension of occlusion began to return to its original measurement. Hürzeler,\textsuperscript{7} after placing porcelain and resin-veneered restorations on Beagle dogs, discovered no significant bone loss or complications in bone. Occlusal materials have specific properties that limit esthetics, wear, and repair but may not have any effect on successful osseointegration. Richter\textsuperscript{8} set up strain gauges within the prostheses to test in vivo vertical forces on implants during function and clenching: implant-tooth-supported fixed partial denture, 60 to 120N during chewing; single molar or premolar, 120 to 150N; clenching on teeth or implants, 50N. A 200-μm occlusal prematurity resulted in no increase in loads on the implant. Dario\textsuperscript{9} followed 100 prostheses with TScan measurements and found that the occlusion of implant-supported
restorations changes after insertion. Forty-six per-
cent needed adjustments during an 18-month peri-
od. Fifteen percent, or one third, of the adjustments
occurred in the first 6 months. Ninety-six of the
adjustments were made to the implant abutments.
Increased load can cause changes on the temporom-
andibular joint that may result in remodeling of the
condyle-fossa relationship. Soft diets for totally eden-
tulous patients could create a muscular atrophy that
begins to increase in tone with efficient mastication,
increasing functional loads. The intrusion and migra-
tion of abutment or adjacent teeth have a definite
effect on the occlusal support and guidance of the
jaws in lateral excursions.10-13
The sequential loading of osseointegrated implants
requires close communication between surgical
and restorative dentists. The agreed treatment plan
should sequence each step of the procedure for
the patient. Indirect loading through the mucosa of
healing implants should be avoided. Transmucosal
overloading can be avoided by using fixed provi-
sional restorations or regular denture service
consisting of changing tissue-conditioning material
and making occlusal adjustments for the complete-
edentulous patient.
Occlusal loads can vary for each individual.
Occlusal forces or occlusal loads can be applied to
implants from mastication; sudden impact forces,
such as biting on hard or crunchy objects; or
parafunctional forces of bruxism. Occlusal loads
combined with lever systems established within the
prosthesis construction result in functional loading,
and excessive functional loads result from para-
function on the same lever systems. The final
sequence of interim or provisional restorations
depends on time for bone remodeling and the
definition of occlusal, functional, and parafunctional
loads that the implanted anchors are required to
support. Occlusal principles follow fixed and remov-
able prostodontic guidelines with modifications
that allow for the nature of the osseointegrated
implant-bone interface to maintain equilibrium be-
tween crestal loss, remodeling, and increased peri-
abutment bone density.
Concepts have been proposed for progressive bone
loading,14 progressive loading,15-18 progressive func-
tional loading20,21 provisional loading,22 and grad-
ual prosthetic loading.23 Loading concepts are just
that, concepts. They attempt to categorize, visual-
ize, or suggest that there is a procedure which, if
followed, would improve the results or success
rates of osseointegration. Progressive implies a
gradual increase of loads over time to effect
osseointegration. Provisional implies an interim re-
statement to evaluate, test, and design the final
prosthesis. Functional loads represent the occlusal
load magnified by any lever systems inherent to the
implant prosthesis or biomechanical considera-
tions.
There is no direct evidence that the use of resin or
other provisional restorations, removable pros-
theses, or progressive functional loading can pre-
dictably increase the success rates of implants. The
fact is that functional loads applied to implanted
anchors result in the phenomenon of osseointegra-
tion. One cannot quantify increments or size of
loads as they are applied or compare the amount of
increased success by these various procedures. To
enhance the result or increase success may, in
reality, only require time and space for remodeling
and mineralization to occur. The factors that are
unknown at this time are the patient's ability to heal
and remodel systematically and at the implant site
specifically. However, when bone quality or quantity
and implant number, size, or length are compro-
ised or in question, common sense will dictate a
cautious approach to the development of the defin-
itive restoration.
Biomechanical considerations play an important
role in defining the effective occlusal and functional
loads applied to implanted anchors. The vertical
dimension of occlusion, esthetics, contours, restor-
ative materials, and the occlusal scheme are essen-
tial parts of the prosthetic prescription. Only long-
term evaluation and maintenance of restorations
can determine if one concept of occlusion is more
significant than another. The concept of organic
occlusion has stood the test of time with conven-
tional fixed prostheses and the natural dentition.
There is no reason to believe that its principles can-
not provide and maintain a stable and successful
implant-supported restoration.
The biomechanical problems in implant dentistry
involve the transmission of functional and parafunc-
tional forces to the bone surrounding the implant. The design of the definitive restoration depends on bone quality, position, length, and number of implant abutments; bone healing and remodeling; and the adjacent and opposing dentition. Provisional restorations provide time for tissue and bone healing. They are an invaluable aid in designing the implant-supported restoration.

References


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