Using the Path of Insertion to Retain a Partial Denture .

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There are three principal forces that tend to dislodge the typical distal extension partial denture:

I. Muscle action during speech, occlusion, mastication and deglutition.

2. Forces exerted by the tongue on mandibular partial dentures.

3. Gravitational forces on maxillary partial dentures.

To resist these forces, dentistry has developed a wide variety of mechanical attachments that include circumferential clasps, bar clasps, indirect retainers, ring clasps, reverse loop clasps, hybrid clasps; and an assortment of *precision* attachments that include springs, flanges, snaps, latches, plungers and retentive arms. Despite dramatic differences in design, virtually all of these retention elements grip the abutment with enough rigidity to prevent any force from dislodging the prosthesis. Unfortunately, creating retention in this manner results in the following problems:

1. *Destructive Forces* on the abutment teeth

2. *Continual Wear* of the retention mechanism.

Destructive forces on the abutment teeth represent the greater danger, since they may affect the periodontal support of the existing dentition and limit the life of the restoration. With a rigid locking mechanism binding the partial to the abutment teeth at all times, the torque may become too excessive for the periodontal supporting structures and result in loosening of the abutments. Clinically this is often the case with clasp-retained removable partial dentures. The typical result is that clasps are moved forward as teeth are lost, until eventually the patient runs out of strategic teeth and ends up with a full denture.

The *ideal* retainer should be *passive* when the patient is not masticating or inserting/ removing the prosthesis. However, studies have shown that locking mechanisms are rarely passive. The retentive arm may remain flexed and continue to exert force on the abutment even when the patient is not chewing. This torque may cause undesireable stretching and compression of the periodontal membrane. The constant stress has an effect on the long-term stability and periodontal health of the abutment. The damage may not be limited to the abutments it the locking mechanism prevents the saddles from returning to a passive position. Thus the tissue may be subjected to constant pressure as well, resulting in ischemia, inflammation and resorption of the alveolar process.

The second danger of rigid locking mechanisms is excessive wear. In the case of a clasp on a natural tooth, the wear will concentrate in the enamel and may lead to erosion and caries. In the case of an attachment, the wear will concentrate in one of its components. To compensate for the lack of a retentive arm, attachments often rely on plungers, latches, or the compression of metal flanges to retain the prosthesis. The smaller the attachment, the greater the importance of these mechanical devices in retaining and stabilizing the prosthesis. All of these mechanical retentive devices flex during function, resulting in metal fatigue, frequent adjustment and even replacement.

A double-tilt alternative to conventional mechanical retention

There is a simple, quickly-learned technique that permits elimination of conventional locked-in retention mechanisms. This technique results in a prosthesis that is gentler to the abutments due to its functional stress-breaking action. In addition, it reduces wear, the need for retention adjustment, and the eventual replacement of the attachment.

The double-tilt technique was refined by Dr. I. Franklin Miller. Unfortunately the technique never gained wide popularity for several reasons. Until recently so few dentists were prescribing precision attachment cases that Dr. Miller's work went largely unnoticed. Also, the path of insertion was thought by some dentists to be too complicated for elderly patients with limited manual dexterity.

Traditionally, intracoronal attachments are paralleled so they form an approximate right angle to the occlusal plane. This means that the line of insertion is approximately the same as the vector of gravity and line of occlusion. The attachment's retention mechanism must consequently be strong enough to resist dislodging forces during mastication, and in the maxilla, strong enough to resist the forces of gravity.

Double-tilt retention relies on an unconventional path of insertion to retain the appliance. In this case the attachment's axis is distinctly different from the direction of gravity and line of occlusion, so the forces of gravity and mastication cannot dislodge the prosthesis. In fact, the path of insertion is unlike virtually any oral movement, such as the patient's tongue habits, so it is unlikely that normal flexing of the musculature will dislodge the prosthesis.

A "Passive" Stress-Breaker

Clinical evidence over the past quarter century has shown that the double-tilt technique provides some unique biological and mechanical advantages. Tradtional stress-breaking designs employ hinging mechanisms that direct forces away from abutments and onto the ridge. Research has shown that these devices are prone to breakage. (Wetherell and Smalles found that 82% of the partial dentures featuring stress-breaker design failed within six years.[2]) Other researchers have suggested that the excessive movement also impairs stability and encourages tissue damage and resorption.

When used in conjuction with a well-fitting base, the double-tilt technique creates a highly stable prosthesis ...one that will not move excessively or fishtail and damage the supporting structure. However, when one side of the prosthesis is overloaded, the cross-arch male may rise a fraction of a millimeter, and then slide back as soon as the force is removed. This barely-visible movement reduces stress on the abutment and gently massages the soft tissue. Clinical experience involving more than 1000 cases over a 25-year period suggest that this highly restricted movement serves a physiologic function, leaving the abutment stable, the soft tissue healthy, and the alveolar crest firm. This stress-breaking action can occur *only* if the attachment is free of locking mechanisms that prevent the attachment from rising to relieve stress. When the saddle is Overloaded by locking mechanisms, the major connector may act as a lever and exert extraction forces on the cross-arch abutment.

A Stronger Attachment With Less Mechanical Wear

Traditional retentive adjustment devices in intracoronal attachments contain slots cut into the attachment. When overadjusted, these slots can weaken the attachment. The double-tilt technique requires only precision fit and a minimum of 4mm vertical height. Slots, springs and latches can be eliminated or remain unactivated. The technique provides a more robust connection that is less prone to breakage*. Since the double-tilt technique does not rely on the flexing of metal components for retention, mechnical wear is significantly reduced. The attachment components last longer, and rarely require retention adjustments or replacement. The acrylic teeth and tissue surface, however, will require alteration or replacement as changes occur.

Concern about the patient's inability to insert and withdraw the partial is unsupported by clinical experience. Out of 1000 double-tilt cases, only one patient could not master the path of insertion with l5 minutes of instruction and practice.

Establishing the Double-Tilt Path of Insertion

After waxing the abutments on the master model, the model is mounted on a parallelometer (surveyor) with the occlusal table parallel to the floor. The heel (posterior) of the model is lifted 10 to 15% (*antero-posterior tilt)*. The model is tilted a second time either to the right or to the left 10 to 15% (*right or left lateral tilt).* The resulting *double tilt* is the correct line of insertion for the prosthesis. The parallelometer is locked so that the attachments can be placed.

The attachments and the double-tilt technique cannot substitute for biologically-sound case design. *All* partial dentures (whether fitted with attachments or clasps) should be designed to minimize stress on the resorption-prone edentulous ridge. Saddles should extend onto the retromolar pads in the mandible or up to the hamular notch in the maxilla. The major connector should be as rigid as possible, and in maxillary cases should make extensive use of the hard palate. The abutment teeth should be splinted whenever possible. The health of the soft tissue, the fit of the partial and the existing state of occlusion should be evaluated regularly (at least every six months). The partial should be relined when the partial becomes too loose or when the underlying tissue is affected. The occlusion should also be restored if worn.

SUMMARY

Traditional partial dentures have resisted the forces acting to dislodge them using retentive clasp arms. In some attachment-retained cases, this retentive arm has been replaced by plungers, springs, flexing metal flanges or latches. All these designs employ the same basic retention philosophy: grip the abutment teeth firmly so that the prosthesis cannot be dislodged. Since these "locked-in" designs depend on flexing metal components to retain the prosthesis, they are subject to wear and breakage. Worse, they subject the abutments to destructive forces. When intracoronal attachments are used, the path of insertion can be employed to resist dislodging forces without need for mechanical retentive mechanisms. Clinical experience demonstrates that appliances designed in this manner will require less servicing and last longer. Radiographic documentation of cases functioning for 20 years or more typically show firm abutments and a stable edentulous crest. A complex path of insertion can be mastered by even elderly patients.

References:
[1]Clayton, J.A. & Jaslow, C.: “A measurement of Clasp Forces on Teeth” <u>J. Prosthet. Dent. 25:21, 1971.</u>
[2]Wetherell, J.D. & Smales, R.J.: “Partial Denture Failure: A Long-Term Clinical Survey”; <u>J. of Dent. (Great Britain)</u> 8:4,333-340, 1980

*The Stern-Feinberg #7 attachment was developed specifically for the double-tilt technique. It is a precision-fabricated deep rest with no retention adjustment slots.
(The #7 Attachment is no longer manufactured by Sterngold. However, the Stern Latch Attachment (with the latch de-activated) can be employed in the same manner for equavalent results—Edward Feinberg, DMD)