CLINICAL ARTICLE

Guidelines for Implant Restoration for the Semiedentulous Patient

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ABSTRACT

Considering that there is no consensus for ideal crown design, what rationale does the restorative dentist use in the restoration of the natural dentition and endosteal implants? Is it simply a matter of making the new prosthesis match the antagonist? The purpose of this article is to define ideal crown design using the principles of engineering, to offer criteria to determine whether the existing dentition would benefit from an equilibration, and to give guidelines in the management of parafunction.

Keywords: Dental compression syndrome (DCS), Like endosteal, Semiedentulous.

INTRODUCTION

Restoration of the semiedentulous patient with endosteal implants is not just a matter of placing crowns on implants and making sure the occlusion is comfortable. There must be an evaluation of the stomatognathic system (the system) as well by comparing it to prevailing paradigms that dictate standards of excellence. But what if these paradigms are flawed? There also must be an understanding of how existing occlusal anatomy affects, or is affected by, the function and dysfunction of the system itself. This information will determine the morphology of the proposed implant crowns and will aid in determining whether the patients existing dentition would benefit from an equilibration. What is the best design for efficient function?

IDEAL CROWN DESIGN

Let us begin by discussing the most ideal design for an implant crown, or for that matter, any crown. Is it not rather strange that after all this time, the dental profession has not agreed on the best design for tooth replacement? To add to the confusion, we are offered four different designs for occlusal morphology in the restoration of removable dentures from 33 degrees to 0 degrees. Now, why would we want to install flat teeth in a denture for a patient who has already lost 75% of his/her mastication power? Not only is this a bad engineering idea, it defies common sense. So, what is the best design for a crown to replace a tooth?

There are design principles that appear to govern the structure-function relationship in organisms, i.e. there is an interface between mechanical engineering and biology. Since teeth were designed to do work, there has to be an optimum design for efficient work. To illustrate that design, all we have to do is to look at what nature gave us in the first place (Fig. 1).

These illustrations are cross-sections of molars of a 19-year-old patient who had no restorations and no wear from DCS. Upon examination, there are two noteworthy observations. One was that there is minimal contact confined to the tip of one functional cusp, not two, and the other was the generous space between the incline planes. From these observations, it is interesting to conclude that teeth do not require large areas of contact in order to maintain their position, work efficiently, and be comfortable. But what was nature's intention in providing such clearance between

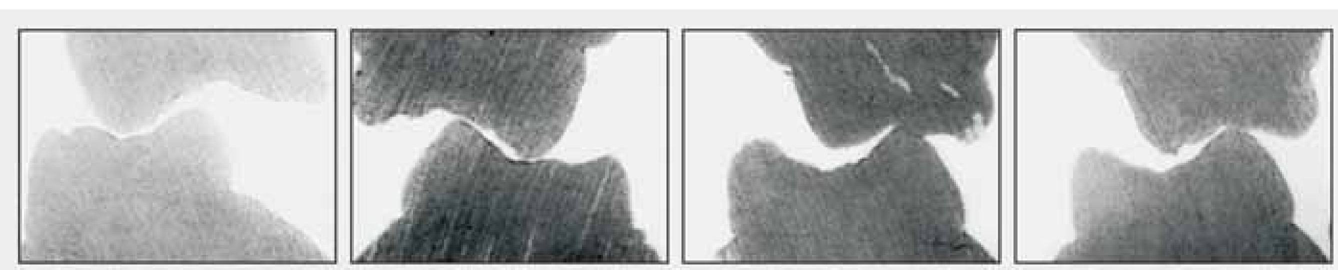

Fig. 1: Cross-sections of molars exhibiting nature's occlusion

the incline planes? From an engineering point of view, there are several advantages:

Vertical Loading

When the incline planes do not touch, vertical loading is assured. Misch and Bidez described these vertical compression forces as normal and explained that they act perpendicular to and maintain the integrity of the alveolar bone (Fig. 2).[1]

Prevention of Offloading

When the incline planes of the cusps are in contact, bending or offloading of the tooth is likely during mastication resulting in destructive shearing forces, which act parallel to the alveolar bone (Fig. 3).[1]

Neutralization

This is desired the buccal-lingual position of tooth by reciprocal action of the muscles of the tongue and cheek.

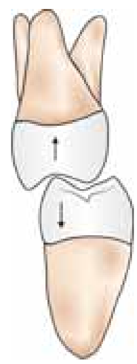

Fig. 2: Vertical loading

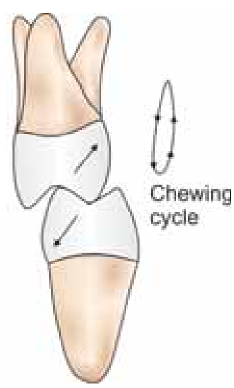

Fig. 3: Offloading

When the incline planes do not touch, the tooth is free to assume a neutral position (Fig. 4).[2]

Condylar Seating

Angle once stated (1899), "So it will be seen that the occlusion of the teeth is maintained first by the occlusal inclined planes of the cusps." This is a valid statement, but is it what we want? Our objective is for centric relation

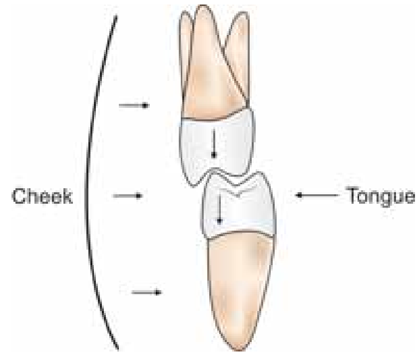

Fig. 4: Ideal occlusal relationship

(CR) to equal centric occlusion (CO) (Fig. 4). What if, due to clenching and grinding, the mandible has worked its way forward, so that CO is anterior to CR and that position is locked in by the incline planes? If the incline planes of the cusps do not touch, there would be no occlusal resistance when the contracting, swallowing muscles retract the mandible up and back upon closure. If there is no resistance, there should be no impediment to achieving CR.

Upon reviewing the early writing of some of our respected occlusal pioneers, such as Robert Lee, BB McCollum, CE Stuart, Niles Guichet and EH Angle, it becomes obvious that they all shared a common philosophy, such as harmony of the jaws, mandible centricity, hinge axis, and good physiology. Yet, not one stands alone in explaining exactly how teeth are supposed to touch each other in order to achieve maximum comfort and efficiency.

I believe Guichet's philosophy in explaining his 'optimum (best) occlusion' comes closest: "Our objective," he wrote, "is to define the specification of the occlusion, which endures minimal stress in the tissues of the gnathostomatic system or in other words, is most physiologic." But unfortunately, he does not elaborate on how to manipulate the occlusal scheme in order to achieve it. The illustration of our role model demonstrating tip of the functional cusp vertical loading and intraincline space to minimize offloading are the two key ingredients required to obtain that minimal stress.

So, there are many advantages to designing crowns to mimic the original design of natural teeth. What if the opposing dentition is flat? Regardless, design the implant crown with sharp morphology, so that the functional cusp is in contact (Fig. 5).

In this manner, you will have reduced the stress on both the implant crown and its antagonist.

THE EXISTING DENTITION

So, implants should be restored with anatomically correct crowns that mimic the original design of our secondary dentition. They should be designed, so that the occlusal contacts are confined to the tips of the functional cusps—

Fig. 5: Occlusal contact demonstration vertical loading

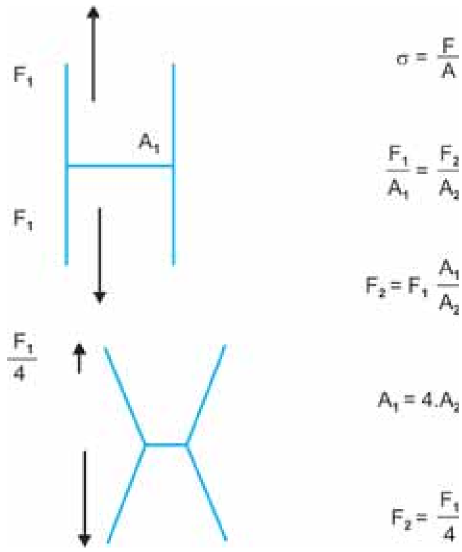

Fig. 6: Reduced contact results in reduced physical stress

the incline planes should not touch. Now, what about the existing dentition? Should the teeth be left alone or would they and the system as well, benefit from an equilibration? How do you determine this? And if an equilibration is indicated how exactly is the best way to do it?

When we first begin to receive our secondary dentition at age six, they are naturally sharp and fit loosely with their antagonists. But with time, due to DCS they begin to mill together increasing physical stress at the DEJ. Here's how it works; science editor Donald Graham[3] explains the perfect shape of a tooth:

"Using a very simple model, it is very easy to demonstrate, how sharper teeth might minimize the compressive forces on the teeth, alveolar bone and the TMJ. When we compress our teeth together, there is a maximum force that can be applied. The limiting factor is pain. If this pain is removed (using anesthetic), a significantly greater force could be applied by the subject.

Thus, a mechanism exists in the body to limit the force exerted upon closure. It is quite logical to postulate that when the threshold for pain is reached, a certain approximately fixed, pressure is applied to the teeth at the areas of contact during clenching.

Pressure is measured in force per unit area. Thus, if there is a larger surface area contact, the compressed teeth can apply significantly more force to the adjoining bone without exceeding this threshold value of pressure at the contact surfaces. To demonstrate this physical relationship, a simple mathematical analysis of two touching objects, one with four times the surface of contact of the other is illustrated (Fig. 6).

As you can see, reducing the contact area to one quarter its original size, and maintaining exactly the same pressure at the area of contact, will result in one quarter the force being exerted by the object on its anchoring surface. A similar relationship exists to amplify any change in the vertical compression forces when they are transferred to their pivot—the temporal mandibular joint.

Therefore, those with flattened worn teeth are probably sidestepping a natural biological feedback mechanism that prevents too forceful compression of the teeth. As a result, we should be seeing pathological symptoms commensurate with their excess compression, especially now people are living longer, giving their teeth even more opportunity to flatten out. Clearly, if such pathological symptoms are being observed, it is very likely teeth have not evolved to emerge sharp simply so that they can be worn flat, but they are, in fact, best sharp.[3]"

DETERMINING THE NEED FOR AN EQUILIBRATION

Generally, when examining the existing dentition, the need for an equilibration is obvious. If there are signs of occlusal deterioration, occlusal cupping and wedge shaped defects at the gingival, an equilibration is indicated. The next step is to determine how much of the occlusal surface is in contact with its antagonist. As Graham explained, the greater occlusal surface in contact, the more physical stress there is on the tooth. The best way to demonstrate occlusal contact area is not to use colored paper or ribbon, but indicator wax. Strips of wax are applied to the occlusal surface of one arch, moistened with saliva, and the patient is asked to squeeze his/her teeth together. The areas of displaced wax reveal the contact areas. How do we evaluate what we see?

Figure 7 exhibits occlusal indicator wax applied to the patient's lower-right quadrant. Evaluation: The contact area of tooth 27 is ideal—small and confined to the tip of the cusp. However, as we scan toward the posterior, you can see

Fig. 7: Indicator wax to demonstrate occlusal contacts

how the contact areas enlarge to the point where the first and second molars require equilibration to relieve the increased stress and return the contacts back to the tip of the cusp.

Let's look at three scenarios:

1. Dentition retaining original morphology.
   - If contacts are confined to tips of functional cusps, no equilibration required.
   - If incline planes of functional cusps are in contact, gently reduce contact areas so that contacts are re-directed to the tips of the cusps.
2. Dentition exhibiting moderate wear.
   Increase angulation of incline planes of functional cusps.
3. Dentition exhibiting extreme flatness.
   - When the dentition had deteriorated to zero degree occlusion, it is not recommended to recapture the original morphology. The damage has been done and usually these patients have adapted and are unusually comfortable.
   - A minor reduction of the outer edges of the occlusal surface may be considered and possibly as guard.

What about lateral excursions, anterior guidance, and mutually protected articulation? With all due respect, this popular paradigm does not make sense. What it says basically is that the anterior teeth disengage the posterior teeth in all mandibular movements and the posterior teeth prevent excessive contact of the anterior teeth in maximum intercuspation. This is just not true. What are we talking about? We can not be talk about mastication as teeth rarely and lightly touch when eating. When we eat, the vector is vertical not horizontal unless one is compromised by a flattened dentition. The horizontal excursions that we need protection from are the intense lateral excursions that occur during DCS. We cannot just assign certain teeth to protect others, it is not their job. Teeth were designed primarily for mastication. Guards are designed for protection. The important thing to remember about lateral excursions is that there be no interferences.

SUMMARY

The final goal in the restoration of the semiedentulous patients with implants is to minimize the intensity of DCS upon case completion. This entails restoring the implants with nice sharp crowns and equilibrating the remaining natural dentition as best as possible. Does this mean that after equilibration, the patient won't grind and clench? No. The new sharp implant crowns and the equilibrated dentition will result in a very comfortable occlusion from an engineering point of view, but it doesn't mean that the patient will not initiate DCS from a psychological point of view. Patients must be instructed to monitor themselves for DCS during waking hours and if the patient is clenching and grinding while sleeping, a comfortable guard is mandatory.

About the Author

Dr Gene McCoy graduated from Marquette University, where he received an outstanding achievement award from the International College of Dentists. A member of AES and an honored fellow in the AAID, he teaches equilibration at the University of Peking in Beijing. Dr McCoy has published over twenty articles on occlusion, plus a chapter on Bruxismo in the new text Brusismo by Marciel. He practices in San Francisco.

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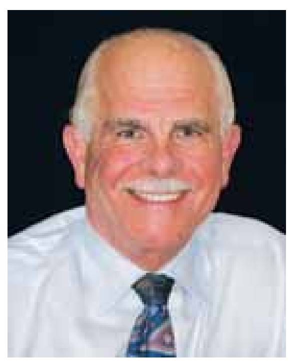

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