A comparative study of posterior occlusion

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Fifty years ago there was very little difficulty in selecting teeth for a denture patient, simply because there was very little choice. Contrast those days with the present when we are besieged with advertising in superlatives, with tooth carvings by the score, and the ingredients from which teeth are made constantly undergoing change in manufacturing techniques.

Dentists have learned from bitter experience that all products do not live up to what is claimed for them, and they rightfully have become wary.

The problem of choosing the best teeth for a denture patient today is likely to be very perplexing. There are men who feel that cusp posterior teeth are still the best, because this type imitates nature, or look better, or because the dentists are hesitant to change to one of the mechanical forms. The advocates of flat teeth claim that cusp teeth, by their inclines, cause movement of the denture bases and more resorption of the ridge than is necessary. Who is right?

To satisfy a personal curiosity, I have made a study of contrasting posterior tooth forms in the matters of efficiency and comfort, for the past two and one-half years. A preliminary article appeared in the JOURNAL OF PROSTHETIC DENTISTRY. Briefly, the technique is as follows: Duplicate dentures are built for a patient. The same mold of anterior teeth is used and set as nearly identical as possible. Posterior 33 degree cusp teeth are used in one set, and one of the mechanical tooth forms is used in the other. The occlusal planes are made as nearly the same height as possible.

To do this, impressions and Korogel molds are made. Duplicate casts can then be made, and baseplates will be interchangeable. A tactile centric relation record is made, and the casts are mounted on the Hanau articulator with the face-bow. An intraoral tracer is used to obtain the final centric relation at the proper vertical dimension. A plaster check bite is taken, with the mandible in protrusion, to set the condylar inclinations. Both sets of casts are mounted and must be interchangeable.

The anterior teeth are set by checking one upper set against the other lower, and vice versa, until they are the same. Then the posterior teeth are set up according to generally accepted practices.

The patient wears one set for two weeks, then the other set for two weeks, and finally uses both sets at the same meal, making notes on their performance.

Here are the exact remarks of one patient wearing steel insert teeth versus 33 degree teeth:

"Of the many kinds of food that I’ve eaten with both the regular set of teeth and the steel blade set, I find that many seem to be about the same. Such would be soft or boiled foods as potatoes, cabbage, peas, carrots, et cetera. The greatest contrast seemed to me to be in such foods as I would class as ‘crunchy’ as celery, lettuce, peanuts; and meats which I would call ‘stringy,’ such as steak, chicken, roast beef, pork, et cetera. My opinion is that the ‘steel set’ is superior for mastication when it comes to these foods.”

Next, the patient is put through chewing tests to see if the actual results correspond with his subjective experience.

Sliced carrots, pressed ham, and blanched peanuts make up the standard test menu. Each patient chewed each food until the swallowing action occurred. The total number of chewing strokes was halved and the chewing repeated. The partly chewed food was deposited on a plate for examination. The tests were again repeated, but the chewing was stopped just five strokes short of the swallowing action, and the more finely divided food saved for examination.

Varied age groups and ridge types were chosen and the differences in performance were startling.

Patient No. 1 was a white girl, age 15 years, in good health with teeth lost from caries. The posterior teeth tested were Myerson Tru-Kusp vs. Trubyte 33 degree. Chewing strokes to swallow: pressed ham 2 × 2” square, 9 strokes; carrots, 3 slices, 20 strokes; peanuts, 5 whole, 15 strokes. Results at about the half-way
mark showed that cusp teeth had broken the food into much smaller particles.*

Patient No. 2 was a white woman, age 60 years, who was diabetic and had lost teeth from pyorrhea. Posterior teeth tested were French’s vs. Trubyte 33 degree. Chewing strokes to swallow: pressed ham, $2 \times 2''$ square, 75 strokes; carrots, 3 slices, could not even go through; peanuts, 5 whole, 70 strokes.

Results showed that both sets chewed about equally, with a slight edge for the anatomic teeth. This patient had the poorest performance of any in her ability to force the teeth through tough food. Her ridges were also poor and the interridge space was large.

Patient No. 3 was a white man, age about 55 years, who was in good health. Posterior teeth tested were Hardy steel insert teeth vs. Trubyte 33 degree, Chewing strokes to swallow: pressed ham, $2 \times 2''$ square, 70 strokes; carrots, 3 slices, 65 strokes; peanuts, 5 whole, 70 strokes.

Results showed cusp teeth to be better on the initial breakdown. On chewing almost to the swallowing point, the cusp teeth were very slightly better on the peanuts, about the same on the carrots, but not as good on the meat. This was actual performance, even though the patient felt that the steel insert teeth were much superior, as mentioned in the report given previously in this discussion.

Patient No. 4 was a white man, age 76 years, who apparently was in good health. Teeth tested were French’s posterior vs. Trubyte 33 degree. Chewing strokes to swallow: pressed ham $2 \times 2''$ square, 35 strokes; carrots, 3 slices, 55 strokes; peanuts, 5 whole, 36 strokes.

At the half-way point, the cusp teeth were better on carrots, slightly better on meat, and quite a bit better on peanuts. At the terminal chewing, carrots were nearly the same, meat almost the same, but the cusp teeth still did better on the peanuts.

Patient No. 5 was a white woman, age about 40 years, who apparently was in good health. Posterior teeth tested were LaDue and Saffir Geometric vs. Trubyte 33 degree. Chewing strokes to swallow: pressed ham, $2 \times 2''$ square, 25 strokes; carrots, 3 slices, 43 strokes; peanuts, 5 whole, 38 strokes.

Results showed cusp teeth were better at half-way mark, but in the terminal chewing the flat teeth were better on carrots and peanuts. Meat seemed about the same.

Now, what are the facts? In the matter of efficiency, the performances of the teeth were fairly similar except with Patient No. 1 who did much better with the cusp teeth. For all practical masticating purposes, it wouldn’t have made much difference which kind of teeth were used. The advantage gained on initial breakdown of the food by the cusp teeth seems to be somewhat offset later by the flat teeth. It is interesting to note that all of these patients felt that the cusp teeth were better for chewing than the flat teeth, with one exception—the steel insert teeth were considered to be superior. This would certainly show that the sensation of “feeling the teeth go through food” makes the patient believe that they are more efficient over-all. The steel blades, like the cusps, penetrate with less initial resistance and give rise to this conclusion.

Another interesting fact came to light. Patients chewed very nearly the same number of strokes with some foods with either set of dentures without knowing what the count was. For example, Patient No. 5, with the cusp teeth, took 43 chews to swallow the carrots, 25 for the meat, and 38 with the peanuts. With the flat teeth, she chewed for the same foods, respectively, 40, 23, and 36 times. There seems to be a sense of muscle timing for a certain sensory evaluation of the kind of food. Whether or not this is a neuromuscular habit set up from continued experience with natural teeth, and continued on with dentures, would be hard to say. Our actions and reactions in driving an automobile become automatic, and we do not have to think about applying the brakes when someone steps in front of the car. The reflex is automatic. Our behavior in chewing food seems to be similar. We take a bite, evaluate the size of the bolus, our muscles set themselves for the consistency, and we attack the food while the saliva pours out to keep things lubricated.

If eating were the only use for dentures, our job would be much easier, but this is only the beginning. Shanahan2 separates denture function into masticating movements and nonmasticating movements. With these duplicate denture wearers, tracings were made of the chewing cycles which are the masticating movements, and also of the lateral free movements and lateral movements while maintaining tooth contact. These are, of course, nonmasticating in nature.

In these chewing cycles, the mandible moved downward on the opening movement, then proceeded laterally following a smooth curve, and then came from lateral up into centric. Looking at the patient from the

*The chewing tests described in this article were made by careful visual examination of the consistency, particle size, and uniformity of particle size of the food, both at the half-way point and at the swallowing threshold.

The use of mesh screen for testing tooth efficiency is scientific enough for the food which passes through the mesh, but does not take into consideration that which is left behind.

In evaluating the tooth form it is possible to statistically state that one may be 50 percent more efficient than another, whereas such a difference does not exist from a practical standpoint. A patient, for example, who concentrates on chewing two peanuts out of a group of five, will have a good breakdown on the two and have a fairly good rating by screen testing, whereas three practically whole peanuts would be left behind.

The author feels that, from a digestive viewpoint, uniformity of particle size throughout the entire bolus is more important.
side, the mandible moved downward and slightly backward, so the tracings could be recorded on a straight sheet of paper. As the bolus grew smaller the chewing strokes also shortened from the bottom upward. With the cusp teeth, the strokes came sharply into centric position; in the 15-year-old girl, the same point was reached with the flat teeth. In the teeth tested in the older people, the strokes closing into centric position were not as precise with the flat teeth. With the steel insert teeth, to my surprise, the patient opened, then closed toward centric position, and then moved straight into lateral. This produced a plateau effect across the top of the tracing. This occurred with all of the foods. That patient did not chew this way with the cusp teeth, but followed the conventional cycle. He could also chew in these conventional cycles with the steel teeth when he was asked to do so. He felt more efficient with the sliding movement. In obtaining tracings from another man wearing the steel insert teeth, the top of the chewing cycle had a broadly rounded top which the patient knew was a slide instead of a chop. (Fig. 1.)

It seems clear that an individual will adapt to the method of chewing which he feels is accomplishing the best results in the breakdown of food. If the patient is a “chopper” with his natural teeth, he will probably start as a chopper with dentures and then if he has the ability to move into lateral position, change to a “shear” or a “glide” if he can do so with better results.

In the nonmasticating category of denture movements, the lateral free movement of the mandible describes an upward arc, which changes to a horizontal line in the working range of flat occlusal surfaces and into an inverted V with cusp teeth. Without exception, all the patients preferred wearing the dentures with the flat tooth forms even though each recognized that the cusp teeth were slightly more efficient. The man wearing the steel insert teeth, on the other hand, felt that these teeth were more efficient.

This could lead to some interesting speculations and indicates to me that, while eating is a very pleasant pastime, the extracurricular activities of dentures are of extreme importance. People do bite and slide on their teeth, and the friction of the surfaces and inclines of the cusps produce movement of the bases on the tissue. Perhaps the easier this gliding can be done, the less disturbing it is to mouth comfort. I believe that wear facets are produced more quickly on teeth from bruxism than by chewing done at mealtime. If someone could build duplicate dentures and use one set only at meals and the other set the rest of the time, we could gain more valid information. Only a dentist or a patient under constant supervision could be used to make sure the right set was used at the right time. An institution might be the logical place to carry out such an experiment.

Can any definite conclusions and practical applications be made from what has been done? Certainly the fact that all patients who had had the dentures for some time preferred to wear the ones with flat teeth is a puzzling one. Each one felt that the cusp teeth were more efficient, except the patient with the steel insert teeth. This should not be interpreted to mean that everyone would prefer nonanatomic forms but these people did, and they felt more comfortable with them. In the masticating movements, a relatively narrow range of articulation is used, and the occlusal surfaces are padded with food while chewing. It would be logical to me to believe that the function of dentures between meals in the nonmasticating movements is extremely important. Here we have bare tooth surfaces grinding on one another with friction, as well as cusp inclines if they are present. As shown in the preliminary article, the free movements of the mandible follow an upward arc while it moves in an inverted V following cusp inclines. This would certainly indicate that the introduction of cusp heights will increase thrust on the denture bases in lateral grinding movements with nothing between the teeth. With the tension and stress of modern life, this could be a very significant factor in ridge resorption. The thin, high-strung nervous patient is usually one of our most difficult problems and chronic ridge soreness is a common symptom. Improvement of nutritional and other systemic disorders plus a noninterfering type of articulation is helpful.

We can say definitely that the patient’s evaluation of his efficiency with dentures is to some degree psychologic, based on actual performance versus his opinions. If a patient with normal tissues says he cannot chew well with a good set of dentures, the chances are that he is doing a better job than he thinks. Reducing the occlusal contact area and grinding escapeways will probably make him feel that he is penetrating his food better.

An adequate supply of saliva is an important factor in efficiency of teeth, in that it lubricates the bolus of food.
and facilitates its manipulation and positioning on the food table by the tongue and buccinator muscles.

We see that in actual chewing only a small range of movement is used in the actual occlusal contact area. The patient with the steel insert teeth varied the most, and used more width in the actual contact area. An accurate centric registration at the proper vertical dimension is of paramount importance for masticating stability with cusp teeth. However, it is in the nonmasticating activities of dentures that the refinement of articulation is of increasing importance for comfort and reduction of undue thrust, regardless of the type of posterior teeth used. Certainly, an adjustable articulator with the proper settings will aid in its attainment.

The patients in these tests showed that most of the flat teeth do a pretty good job of chewing, and these patients preferred them. They were a little less efficient, however. Where, then, shall we use cusp teeth or flat teeth? From a mechanical approach, it seems logical to me that where the ridges are quite flat, the bases will slide more easily than on the prominent, well-shaped ones. Also if the interridge distance is great at the selected vertical dimension, the increased leverage on the bases will cause them to tip more easily. In my opinion, flat teeth can be used to definite advantage in these situations, since there will be a maximum of vertical force and a minimum of horizontal force. Therefore, the greater the interridge space and the flatter the ridges, the more indication for flat posterior teeth. On the other hand, mouths with well-shaped ridges can take advantage of cusp teeth for increased penetrating ability and psychologic effect, without producing as much denture skid. A smooth articulation is important, and anteroposterior intercusping should be freed or eliminated to allow for some degree of settling.

The steel insert teeth, it seems to me, have a definite place in our choice. People with very heavy bites who break porcelain or wear resin teeth rapidly do very well with them. They can be used elsewhere, of course, but are of particular advantage in these cases.

We should select posterior teeth as we select impression materials. By evaluating the requirements and mouth conditions in each individual case, we can learn to utilize many forms of teeth to good advantage. All of the teeth that were tested performed well, and I believe we should make wider use of their possibilities.

REFERENCES

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