

Linear Occlusion

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Linear occlusion is an entirely new occlusal design. It is intriguing because of its simplicity and its remarkable success in practical usage. By incorporating an extremely effective chewing mechanism with linear stability in the occlusion, an entirely new combination of prosthetic advantages is achieved. Linear occlusion definitely provides a stabilizing effect on the denture bases during function.

Heretofore, occlusion for full dentures has been limited to three-dimensional (cusp) occlusion and two-dimensional (flat plane) occlusion. When the combined points of contact on the occluding surface form a flat plane, the tooth is two-dimensional. When any portion of the occluding surface is above another portion of the occluding surface, the tooth is three-dimensional.

All of the posterior tooth designs which have been available fall into either one of these categories.

Two-Dimensional: Fench, Halls inverted Cusp, Myerson & Sears, Tru-Byte Rational, Univac Bio-Mechanical.

Three-Dimensional: Criterion, Myerson's Synchronized, Pilkington-Turner. Tru-Byte Dentron, Tru-Byte Fournet, Tru-Byte Functional, Tru-Byte New Hue Diatoric, Tru-Byte 20 Degree, Tru-Byte 30 Degree, Tru-Byte 33 Degree. Univac Nuform, Univac NIC, Verident NIC.

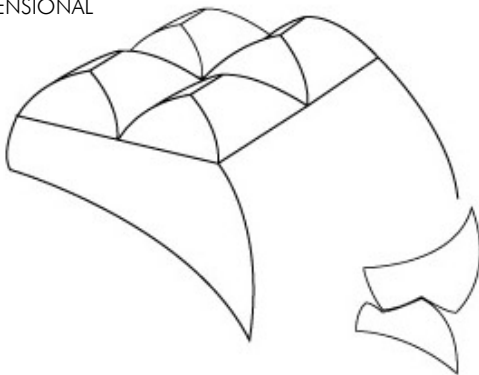
Linear occlusion allows us to complete the geometric classification of occlusion by providing a one-dimensional occlusal design. As such, it provides the practitioner with a valuable new tool to cope with prosthetic problems.

Geometric classification of occlusion is not a pure geometric interpretation of the entire bilateral occluding surfaces of posterior teeth. A geometric classification of occlusion describes the dimensional contact (one, two or three dimensional) between the occluding surfaces of any two opposing teeth.

1) Cusp Occlusion

In cusp occlusion the contact between the opposing surfaces of any two teeth occurs in three dimensions. These dimensions are the width of the occluding surface, the length of the occluding surface, and the depth of the occluding surface.

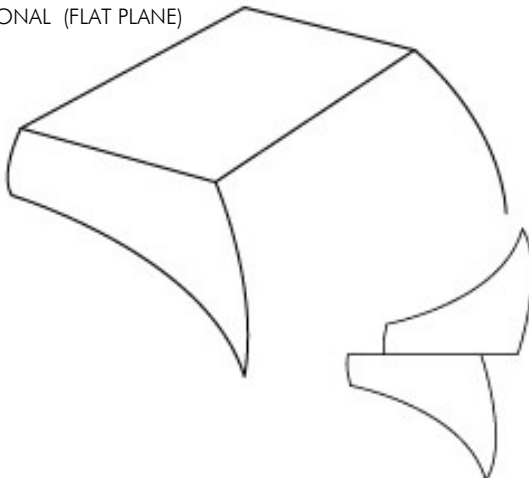
THREE DIMENSIONAL (CUSP)
Length
Width
Height



2) Flat Plane Occlusion

In flat plane occlusion the contact between two opposing posterior teeth occurs in two dimensions.

TWO DIMENSIONAL (FLAT PLANE)
Length
Width

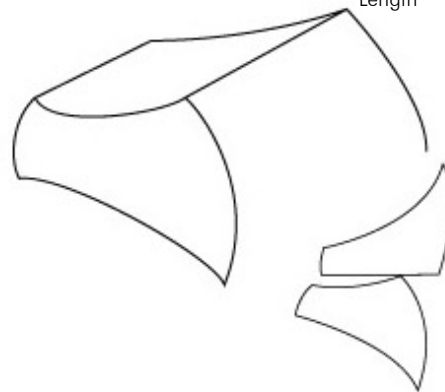


These dimensions are the width of the occluding surface and the length of the occluding surface.

3) Linear occlusion

Linear occlusion is a one-dimensional contact between two opposing posterior teeth. The contact occurs only in one dimension which is the length of the contacting blade (not surface). This blade, being always in the form of a straight line, geometrically constitutes "length" in occlusal contact without either "width" or "depth" of occlusal contacts.

ONE DIMENSIONAL (LINEAR)
Length

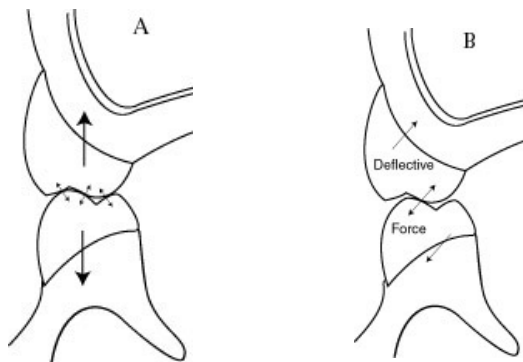


There is ample clinical evidence that one-dimensional occlusion has certain advantages over either two or three-dimensional occlusion because of the geometric simplicity of the occlusal contact. The reduction in the amount of occluding surface accomplished by one-dimensional occlusion likewise reduces the potential occlusal deflections which may occur with broader contacting surfaces.

Directions of Force

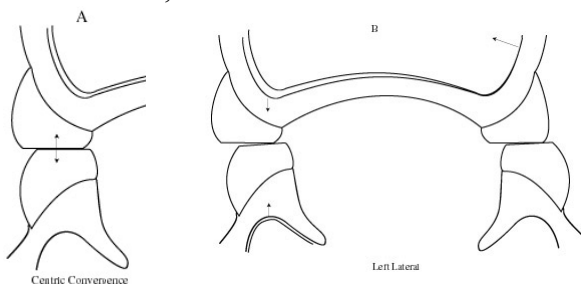
Directions of force developed in any kind of surface contact between opposing posterior teeth (two or

three-dimensional occlusion) necessarily change with any alteration in the relationship of these opposing occlusal surfaces, such as with lateral excursion of the mandible. Directions of force in three-dimensional occlusion can be determined by observing the slopes of the contacting inclined surfaces in Diagram A. However, if the relationship of these contacting surfaces suddenly changes, through lateral excursion of the mandible, the directions of force also change, as in Diagram B.

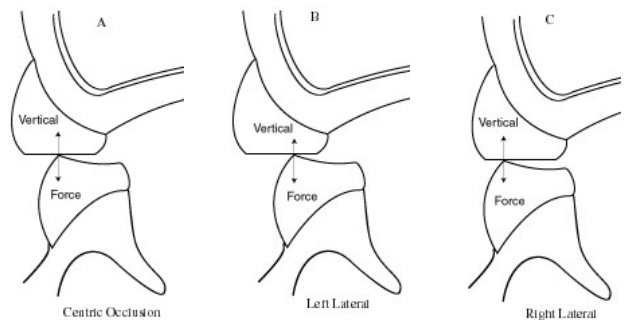


Likewise, in two-dimensional occlusion, the directions of force can be determined by observing the angle of the surface contact. Of course, in two-dimensional occlusion the surface contact is presumably occurring at a flat or level angle, Diagram A. However, the slightest change in relationship of these opposing surfaces, such as a lateral excursion of the mandible, produces a bilateral imbalance with an attendant tipping of the denture base in relationship to its original position on the tissue, Diagram B.

Whereas, in linear occlusion the



directions of force are vertical to the flat surface opposing the blade, as in Diagram A. Any change in the position of the linear contact against the upper surface, as in a lateral excursion of the mandible, would not appreciably change the direction of force, which still remains essentially vertical Diagram B. In the opposite excursion of the mandible, the blade still contacts a flat surface and the direction of force remains essentially vertical, Diagram C.

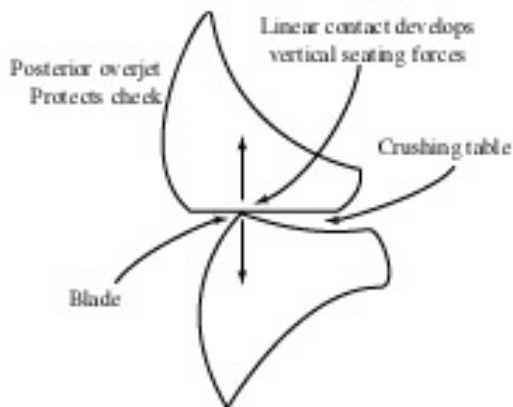


To a patient, chewing efficiency is apparently first related to the ease with which he can penetrate and cut the bolus of food. Next, chewing efficiency to a patient is related to the comminution of the bolus of food. Next, chewing efficiency to a patient is related to the comminution of the bolus after it is penetrated and cut.

Many methods of introducing easier penetrating and cutting power to the occlusion have been attempted in the form of cutter bars which occur in various shapes. If one studies the various types of cutter bars it becomes apparent that the simplicity of a straight line (one-dimensional) occlusal contact is not maintained. Therefore, it is doubted that the

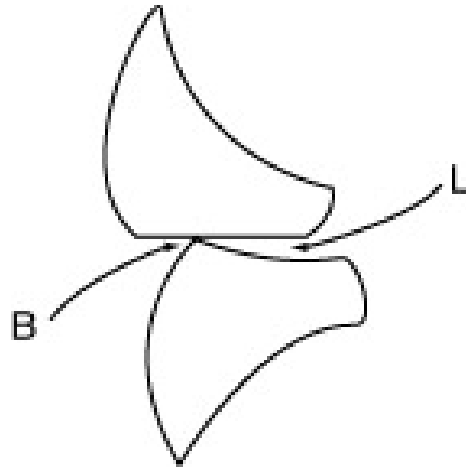
efficiency of a simple blade contact in the occlusion has been properly documented. One of the prerogatives every dentist has is to make his own comparison and personally document the practical difference between linear occlusion, whichever he has been using. The best way to do this is on an existing set of dentures which are at the present time less than satisfactory. The attached procedure should be followed.

The one-dimensional; occlusion at present in use (about 20,000 cases) includes a crushing surface lingual to the linear contact as shown in the diagram below:



This crushing surface, in order to maintain true linear contact between the occluding surfaces, never touches. Carbon paper will determine this when the dentures are seated at the delivery appointment. However, it can be seen that the person who sets up the teeth and finishes the dentures has control over the distance between the crushing surfaces lingual to the blade. As in a ball mill, or any crushing mechanism, the proximity of the crushing surfaces determines the fineness of the separated particles. For instance, in the ball mill where

gypsum is crushed by stainless steel balls, the size of the particles is determined by adjusting the proximity of the stainless steel balls. It is interesting to note that in the finest of particles the balls never quite touch. If one studies the diagram below, it becomes apparent that the space between the crushing surfaces varies greatly from the extreme lingual (L) to the blade contact (B). Apparently, from clinical experience, the separation of the crushing surfaces at "L" should be no more than a millimeter (.040").



improvement in comfort, stability and chewing as a result of one-dimensional occlusion. This seems sufficient to indicate an advantage over two-dimensional and three-dimensional occlusion. A very important aspect of this innovation is that it seems to provide the following:

- 1) Reduction of needless problems due to complexities of occlusal contacts and resultant deflections.
- 2) Simplification of prosthodontic procedure.
- 3) Reduced post-insertion adjustments with an attendant

- time-saving factor in both laboratory and operator.
- 4) A general increase in chewing efficiency, comfort and stability of full dentures.

Denture Techniques

Whatever denture techniques or procedures being use can be continued. For instance, impressions and relationships, the mounting and re-mounting of the dentures, etc, can be done according to present practice.

When the dentures are constructed with flat plane or cusp teeth, any kind of articulator can be used. However, with linear occlusion there is a definite requirement. Any articulator with an incisal guide pin, a flat incisal guide plate, and an adjustable condyle inclination can be used. The Hanau articulator is ideal for this, the exception being the extremely old Hanau with the cup type of incisal guidance. Centrimatic articulators are recommended because they already have a fixed 12 degree condylar inclination and a flat incisal guide plate.

Laboratory Procedures

When one-dimensional occlusion is used:

- 1) The lower anterior teeth may be set with as much horizontal overlap as necessary, but the vertical overlap should be zero. This is a requirement of linear occlusion. To have any interference in right or left lateral or protrusive (cusp rise) defeats the bilateral line contact necessary between the upper and

- lower dentures at all times. Protrusive balance is desirable.
- 2) All the lower teeth will be set on a flat occlusal plane. The anterior level of the occlusal plane will be the lower anterior teeth, and the posterior level of the occlusal plane will be approximately at the top of the retromolar pads.
 - 3) Technicians should set the lower posteriors with the buccal surfaces nearly straight up and down. This will bring the linguals of the first and second molars almost as high as the buccal blade on these teeth. The linguals of the bicuspid will not be as high because of the basic design. The bicuspid were designed to cut more than to crush; therefore, it is not expected that the occlusal surface lingual to the blade on these teeth will be used as much for crushing as will the first and second molars.
 - 4) The upper posteriors are set with the occlusal surfaces level and with the central fossa of the upper teeth against the blade of the lower posterior teeth. If the linguals of the lower molars and of the upper molars touch when the upper posteriors are set, it is okay.

Note: The separation between the linguals of the upper and lower posterior teeth is eventually achieved at the expense of the lower posteriors. After the teeth are completely waxed, the occlusal surface lingual the blade of the lower

posteriors is ground for proper clearance.

- 5) Following are the salient features of a one-dimensional occlusion in the set-up:
 1. All the lower teeth on a flat occlusal plane; this plane extending from the lower anteriors towards the top of the retromolar pads.
 2. The combined buccal blades of the lower posterior teeth should form a perfect straight blade. This blade should be perfectly straight to support one-dimensional contact against the opposing occlusion.
 3. The crushing table lingual to the buccal blade on the lowers should be adjusted to create an inter-occlusal crushing space of approximately one millimeter.
 4. Zero vertical overlap between the anterior teeth. It should be noted here that any interference in a protrusive movement requires a change in vertical to avoid this interference. A forced change in vertical dimension in this instance produces the same kind of a deflection of the denture base on the mucosa as would a cusp rise in lateral excursion of the mandible.
- 6) Cusp rise is removed from the upper occlusion before the dentures are delivered to the patient. This is why a flat incisal guide plate must be used on the articulator. It is best to

accomplish this after the dentures are deflasked and remounted on the articulator. If the laboratory (or the dentist) does not usually re-mount the dentures before delivering them to the dentist, the cusp rise would be removed in the wax-up. The laboratory procedure for removing cusp rise on the articulator is as follows:

1. Set the incisal guidance at zero degrees and the condylar inclination at 12 degrees. (The Centrimatic articulator automatically has these features;)
2. Adjust the upper occlusion until the pin touches in centric.
3. Remove any contact marks which appear on the crushing table of the lower posteriors. Never grind the lower blade itself.
4. Run the articulator through right and left lateral. Balance is automatically achieved by grinding away the interferences, revealed by the carbon paper on the upper teeth, which lift the pin off the incisal guidance plate. These must be removed to eliminate cusp rise.
5. Continue to relieve the upper occlusion through right and left lateral until the pin maintains contact with the incisal guide plate through all excursions. This automatically balances the occlusion!
6. If necessary, remove any interferences in protrusive by grinding the lower anteriors.

When switching from flat plane or cusp occlusion to linear occlusion, the set-up is the same as for a set-up of linear occlusion on new dentures.

Note: If the anterior teeth are locked or touch in centric after the dentures are mounted on the articulator, the technician should arbitrarily open the articulator to relieve this anterior interference. This arbitrary opening is possible only with linear occlusion. It should not be done with either cusp or flat plane teeth because neither of these can accommodate the slight change in centric occlusion which is affected by such a procedure.

Use the following technique for switching posteriors:

- 1) Carefully position the occlusion of the dentures into centric contact. Do not use a wax or plaster relationship for this purpose. Sticky was the teeth together preparatory for mounting.
- 2) Mount the dentures with the occlusal plane sloping up and back. If it is customary to use a face bow for mounting dentures, this is even better.
- 3) Set the teeth and cure. Either cold cure or heat cure is satisfactory. In the event cold cure is used, the articulator should be opened slightly to accommodate for the shrinkage which always occurs.

General Considerations

The author of this memorandum on technique has personally taught more than 500 dental technicians the use of one-dimensional occlusion in dentures. The greatest obstruction to learning the proper application of one-dimensional occlusion by the technician is habit. The

habits developed in full denture work by a good technician over a period of years are necessarily associated with either flat plane teeth or cusp teeth. With these two types of occlusion, there has been little need for precision placement of the individual teeth. For instance, the technician learns to set teeth very rapidly and to rationalize the set-up to this speed. If a lower molar is placed buccally or lingually a millimeter in relationship to the approximating teeth, it is not necessary to correct. Not so with linear occlusion. The very simplicity of this occlusion sometimes defeats precision performance by the technician. In looking at the occlusion, he over-simplifies it and fails to realize the geometric significance of a bilateral straight line contact in the occlusion. If one lower posterior is buccal or lingual even a half-millimeter to the intended straight line, a second dimension is immediately incorporated into the occlusion.

The slightest deviation from one-dimensional occlusion can cause postinsertion problems of soreness or looseness which the operator should immediately investigate and correct in the occlusion.

Linear Contact

There is no excuse for a laboratory technician not to understand why linear contact is so important and not to implement it in the set-up. However, the final control of this must be in the hands of the operator. This is ordinarily done when the finished dentures are delivered from the laboratory for insertion in the patient's mouth. The operator should take a lead pencil and mark the edge of the blade to check its accuracy; then, with carbon paper, the operator should be sure there is no other contact than the

blades when the patient slides from right to left. Protrusive balance is desirable, but not protrusive interference.

It should be apparent by now that linear occlusion is simply a bilateral linear contact between the dentures when they occlude in the mouth. This bilateral linear contact must be maintained in right and left lateral excursions of the mandible into the parafunctional occlusion relationships. In a protrusive excursion, a balancing contact between the anterior teeth is permissible. This excludes any protrusive interference which would bring about a change in vertical opening in end to end relationship of the anterior teeth. This requirement to maintain one-dimensional occlusion brings into focus the patient with a deep over-bite of the natural anterior teeth.

Vertical Dimension

Linear occlusion works better without an over-bite in artificial denture. However, in view of the clinical experience to date, patients with a deep over-bite can be included in linear occlusion.

It has been sufficiently demonstrated that patients with a deep over-bite can have vertical dimension increased to terminal phonetic closure. This vertical opening has been described in many ways. Silverman describes it as the closest speaking space. In any event, it is the vertical relationship of the anterior teeth at the spoken word "six." This vertical dimension is noted by having the patient stand and then count to ten loudly. At the moment the patient pronounces the word "six," the operator simply observes the vertical relationship of the anterior teeth and registers his centric relationship at this vertical. This can only be said of one-dimensional occlusion and should not be attempted

with either two or three-dimensional occlusion. This opening is usually sufficient that in setting the anterior teeth, the technician can achieve a protrusive balance of the anterior teeth, the technician can achieve a protrusive balance of the anterior teeth by sacrificing very little in the length of either the upper or the lower anteriors.