THE MEASURED VERTICAL DIMENSION AND DENTURE ADHESIVE POWDERS*

FRANK H. McKEVITT, D.D.S.

San Francisco, Calif.

The superlative for logical dental reasoning during the first half of the present century might be awarded to Dr. John Hunter for his views on the theory of dental foci of infections, and to Dr. Gysi a close second for his studies of the geometric movements of the mandible. However, it is not the intention of this paper to dwell on the work of either of these men, but to discuss in part a practical sequence of their combined achievements.

At the turn of the century the profession of dentistry was confronted with the problem of keeping dentures stable on their ridges. Springs, gum tragacanth, vacuum chambers, and Eureka suction cups were employed to supplement work done at the chair.

Hunter's statement obviously added to the number of these devices, but more particularly to the output of denture adhesive powders which were to become so universally employed. As a corollary, the relatively high cusps of Gysi's new and geometrically carved bicuspidts and molars contributed indirectly to the denture adhesive powder output because of the inability of dentists to properly articulate them. The use of high cusps should not be construed as the sole cause of the use of adhesives, but as one of many diverse contributing factors. In all probability the profession during the first half of the century gave no thought to the role denture adhesive powders play in prosthodontia or to what their growing use implied. Nor does it today. This cannot be said of the manufacturers of this product. To the producers it has become the big legitimate business it now is.

How the full impact of Hunter's edict affected the trend of dental thought of that day was reflected in the program of the newly organized National Society of Denture Prosthetists which met in Boston for the purpose of discussing "Geometry in Articulators;" "Esthetics and Art;" "Mouth Examination and Impression Making;" "Classification of Mouth Tissue Conditions and the Treatment Indicated;" "Technic;" and finally, "Business Methods and Education of Patients in Wearing Artificial Dentures." At the meeting Dr. Gysi was the rotation center around which the articulator discussion revolved; a revolution which has not as yet lost its momentum. From then on until today articulators seem to have absorbed the attention of prosthetists to the point of being made a major prosthetic issue to the exclusion of more important phases of the work. Actually the role of the articulator...
in the prosthetic scheme is a minor one. A simplex articulator should suffice for all but a small number of cases. Human errors in diagnosis and inaccuracies in technique at the chair are more conducive to denture failures and to the use of adhesives than any mechanical malfunction of articulators.

That midcentury prosthetic reasoning comparable with that of the earlier temperamental theory of tooth selection still prevails in the prosthodontic mind is manifest in present-day literature.

As with practically all technical achievements whose development has been spurred by actual necessity, prosthodontia is coming up the hard way and is still muddling through trial and error. It limps along from day to day, its shortcomings rather obvious to the patient, though perhaps not so obvious to the dentist.

Today the question arises: has prosthodontia consolidated the gains of Hunter, Gysi, and Leon Williams? The answer is an emphatic no. Evidence of this lack of uniform success can be found in daily journals and current magazines which advertise adhesive powders for the purpose of keeping full artificial dentures in position during speech and mastication. Answers to letters of inquiry addressed to adhesive powder manufacturers regarding the number of such plants in America and their approximate annual output were frank, revealing and interesting.

The replies submitted by the various manufacturers are duly acknowledged here and are in part as follows:

Years ago the common gums used in denture powders were tragacanth, arabic, and acacia. They were used singly and in combination.

The powders had several drawbacks—they were too mucilaginous and too soluble in contact with saliva; they seeped out, were ill-tasting, and were swallowed.

Gum karaya with small additions of acacia and arabic to prevent seepage is now the powder of choice.

Karaya is not water soluble and lasts longer. Denture powders have been described as adhesives which they are not in the mucilaginous sense. Their function is to establish a temporary peripheral seal for denture retention.

In 1939 thirty manufacturers were producing more than $2,500,000 worth of adhesives annually. From the same source we also learn there were 15,000,000 denture wearers in the United States. The powder users are grouped as follows:

1. Those who because of the peculiar shape of their mouths are unable to obtain dentures which afford much suction.
2. Nervous patients requiring additional assurance of complete comfort.
3. Those who cannot afford an accidental slip of their dentures, such as attorneys, actors, public speakers, etc.

The foregoing statement in a sense constitutes an indictment of the dental profession. The inescapable inference is that uniform success with a large number of dental restorations has not been achieved by the profession as a whole.

What is needed is a new concept of responsibility in a matter essential to the public welfare and a recognition that such conditions are intolerable when the problem is thrown into the laps of the powder manufacturers for solution.
In support of this statement we have seen new commercial enterprises develop and thrive for the purpose of supplementing our professional shortcomings.

We also have evidence of new improvements in types of denture adhesives by more recent entrants into this field, such as amazing new creams that lessen the constant fear of dropping, rocking, and chafing plates.

Add to the foregoing a questionnaire submitted by Dental Survey Publications asking what brand of denture adhesive do you recommend? No doubt the honest assumption of the publisher is that denture adhesives are here to stay; coming from the well-considered perspective of a businessman, he is probably correct in that assumption.

It is equally true that well constructed dentures do not require adhesives or any extraneous suction devices.

The foregoing are facts that imply failure and the relegation of ourselves to a secondary role, which some day may become a cold hard reality; for recognition we may be required to pass a specialty board for Dental Prosthesis. They raise the question, can we avoid this blundering which must be recognized and understood? Our professional policy must be derived from our strategic situation. From this objective we must not be turned back either by the complexities of the task or by weakness in ourselves. To achieve this we must initiate radical and standardized changes in teaching and in technique—the one course to success is a logical analysis of the various steps in denture construction.

It is not the purpose of this paper to set up a formula or a simple method encompassing a complex technical problem, but to break the problem into units for further examination and better understanding.

Full denture cases that come within the range of the prosthodontist may be divided into three groups. The first is of patients who are to become edentulous and for whom the mouth must be prepared for the reception of dentures. Those in the second group may have either an edentulous maxilla or mandible. In the third group they are completely edentulous.

**DIAGNOSIS**

Before construction begins, each case within this category should be subjected to diagnostic acumen of a high order, i.e., from a roentgenologic, study-cast, and surgical viewpoint, before it reaches the impression stage in order to obviate possible flaws and inaccuracies that compel the use of powder in the finished case.

The initial unit for investigation should begin with roentgenographic interpretation using films for the entire mouth which may disclose evidence of osteomalacic diseases that influence rapid atrophic changes and denture instability, root tips, impactions, cysts, and other forms of gross pathology impedimental to successful prostheses.

The second unit to consider should be study casts—edentulous and dentulous. Edentulous casts require critical examination. To the discerning diagnostician they reveal many forms of atrophy and hypertrophy of bone and soft tissue such as senile bone atrophy, sharp oblique ridges in the mandible, thin high and sharp
remnants of bone in both processes, soft tissue hypertrophies, tori, asymmetrical ridges, osteodystrophies, incompletely completed surgical ridge preparation, etc., any of which could undermine a finished denture and result in the use of adhesives. A cardinal prosthetic blunder is committed when pre-extraction casts are omitted of teeth about to be extracted. Detailed impressions of both jaws should be obtained. The brief time taken for this purpose will return important diagnostic and mechanical aids for the slight effort involved. The casts will disclose important aspects of the pre-existing order of the natural teeth and their anomalies if any be present. The size, shape, alignment, and arrangement of teeth are thus available for study away from the mouth. The most significant item they contain is a record of the vertical dimension, the technical use of which will be described in a succeeding step.

Surgery is the third preparatory step; it is pivotal and it is incumbent upon the surgeon to correctly interpret the x-ray films and the study casts. His objectives should be the removal of the teeth and pathologic tissue, and the adequate preparation of the ridges. He should have a due consideration of bone conservation and also for atrophic changes attending the loss of the teeth and alveolar process. Three millimeters of alveolar bone should be removed to allow for the thickness of the baseplate material, the pins, and ridgelaps of the artificial teeth. The maxillary papilla of the rugae should be conserved as a landmark or point of beginning from which the vertical is to be measured and recaptured.

At times, these factors are slighted and the preparation of the ridges is inadequate—routine x-ray rechecks and postextraction casts will disclose these inadequacies. Exodontia and prosthodontia are so entwined that any shortcomings of the former are more than likely to damage the plans of the latter.

**IMPRESSIONS**

Impression taking, usually regarded as the first step in denture construction, is actually its fourth. Opinion varies widely as to how impressions should be obtained. From standpoints of accuracy and economy of time prepared plaster is the ideal, as it does not overcompress the soft tissues. It should be noted here that a stiff plaster mix will overcompress the soft tissues.

Prepared plaster impression material, when set, is incapable of distortion. The maxillary impression when finished requires no further manipulation at the chair except relieving. As with any full impression technique, the mandible may at times require a snap impression and a cast over which to form a mandibular tray. With the use of plaster it often happens that simple methods succeed where complicated measures fail.

**JAW RELATIONS**

Recording centric relation is one of the most exacting tasks in denture construction. It is a step in which the most inaccuracies occur and contribute to denture failures. Its importance is not appreciated by dentists in general as it should be. Thousands of dentures are constructed annually that require adhesives
in which the vertical dimension was not properly secured. Establishing the vertical dimension is only one step in recording centric relation. It must be divided into its maxillary and mandibular components in order to establish the occlusal plane.

Failure to regard these vertical and horizontal lines as an integral entity will lead to clinical disaster. The length of the vertical cannot be varied more than one millimeter with impunity, nor can the division of the line by its occlusal plane, termed “Vertocclusion,” be slighted. Its exact location must be predetermined. The correct establishment of the occlusal plane is of much greater significance than can be appreciated at a glance because it insures that the force exercised in mastication at each closure of the mandible and repeated many times daily will be distributed in a manner which will be the least destructive to the tissues that support the dentures. It acquires a double significance when one reflects that artificial teeth set to an accurately integrated occlusal plane will minimize spot grinding, obviate the use of check bites, extra-oral records of the downward inclination of the condyle paths, and the more recent attempts to register these inclinations roentgenographically. Significant movements of the mandible are made, not away from the maxilla, but toward it.

When the jaws are freed from the controlling action of the cusps of the teeth, the mandible makes a universal excursion and returns on varying rotation axes until the cusps of the teeth again come into contact; obviously, any check bite or roentgenographic record of the degree of inclination of the downward path of the condyle has no practical value; the path of the lateral movement alone has value in the articulation of artificial teeth.9

Any impediment can be attributed to faulty articulation, an overlengthened vertical dimension, and its concomitant unbalanced occlusal plane. Almost every phase of prosthodontia has been investigated (with the possible exception of the unmeasured vertical dimension) in ineffectual attempts to solve the prosthodontic riddle. Measuring the vertical dimension and recapturing it with millimeter accuracy may keep our prosthetic thinking straight.

The interalveolar crest line derives its name from Gysi. This entity is now described as the “vertical.” The eruption of the mandibular and maxillary first molars determines the height of the vertical dimension and the location of the occlusal plane; the latter remains invariable throughout life. The length of the vertical, because of atrophic changes in both processes, varies in length from 10 to 28 millimeters. Regardless of alveolar bone atrophy when the teeth are present or following their loss, the original position of vertocclusion remains invariable.

The economic waste, loss of professional prestige, and a 20 percentage of denture “makeovers” must be given serious consideration, particularly when the vertical is so easily recorded and recaptured with millimeter accuracy.

In the edentulous state its point of beginning is the papilla of the maxillary rugae in the median line of the maxillae. It ends at a point on the mandibular ridge crest in the median line. It varies in length from 10 to 28 millimeters. According to Gysi, who stated at a time when the surgical preparation of the
ridges was not well understood as it is today, "It is rarely if ever practicable for prosthetists to make artificial dentures which restore the original height of the bite." His method of measuring the vertical is not clear when he further stated, "In all cases the height of the bite was tested by the facial expression and the ability to pronounce clearly. For some patients the height of the bite could not exceed ten millimeters." It is common practice today to do an alveolectomy to compensate for the thickness of the baseplates and ridge laps of the artificial teeth, in all cases where the vertical dimension is ten millimeters.

When the vertical dimension is to be restored following extractions of the teeth, one millimeter is the allowable variation from its original length. A practical method of recording and recapturing the vertical is by the use of pre-extraction casts. When these are omitted, its accurate recapture is, in most instances, irrevocably lost. It can be recovered from dentures about to be discarded, their long habitual use having fixed the dimension.

When these aids have been lost a hazardous attempt at its recapture can be made by placing a mark on the maxillary occlusion rim one millimeter above the rest line of the upper lip; a similar mark is made on the mandibular occlusion rim one millimeter below the rest line of the lower lip. These marks are used as points from which to establish an arbitrary interalveolar crest line or the vertical.

RECOVERING THE VERTICAL FROM PRE-EXTRACTION CASTS

The vertical dimension is recovered from the pre-extraction casts by placing one point of the compass on the ridge crest in the median line of the maxillary cast at the elevation of the papilla of the maxillary rugae, the other on the ridge crest of the mandibular cast in the median line for transfer to a millimeter gauge for recording.

RECAPTURING THE VERTOCCLUSAL PLANE WITH THE OCCLUSAL RIMS

The vertical actually consists of two parts—a maxillary and mandibular component. They should be divided accurately.

The vertical length in millimeters of the maxillary occlusal rim can be taken from a maxillary central incisor on the cast, from the original extracted incisor, its artificial substitute or from a mark drawn on the occlusion rim in the median line one millimeter above the lip line in repose. One beak of the caliper is placed inside the occlusion rim at the location of the papilla of the maxillary rugae in the median line. The other beak is placed outside on the labial surface of the occlusion rim at a point in the median line corresponding to the length of the central incisor to be used. With this point as a target, the occlusion rim is heated and paralleled anteroposteriorly with a line previously drawn on the face from the lower border of the external auditory meatus of the ear to the ala of the nose and laterally with an imaginary line drawn through the pupils of the eyes.

The dimension of the mandibular component is obtained by heating its occlusion rim and closing it against the maxillary component to a predetermined
vertical dimension taken in millimeters from the casts, using the location of the maxillary papilla as a point of beginning and the median line of the mandibular ridge crest as its ending point. When the vertical dimension and the occlusal planes have been established with fidelity, artificial teeth set to these dimensions will have occlusal clearance which is automatically re-established.

Accuracy in establishing the occlusal plane is obviously important when artificial teeth are to be set to it. A vertical biting force directed against the oblique surfaces of the teeth set against an incorrect occlusal plane will result in a horizontal thrust that tends to dislodge the dentures, accelerate ridge resorption, and invite the use of adhesives. The vertical dimension may be lost by the omission of pre-extraction casts, by lengthening its dimension for cosmetic effect, by relining, rebasing, or being totally oblivious to its existence.

Involvements pertaining to relining immediate dentures are serious enough to warrant discussion under another heading. Suffice it to say relining or rebasing immediate dentures lengthens the vertical dimension and overcompresses the soft tissues and bony ridges of the supporting structures, as well as those comprising the temporomandibular articulation.

The added impact of intermittent pressures resulting from closing the mouth many times daily traumatizes these highly vascularized tissues and induces a pressure atrophy.

A comparison of the prosthetic occlusal plane with the curve of Spee will be revelatory. The function of the curve of Spee is to maintain the occlusal surfaces of the teeth at right angles to the line of closure of the mandible.

When natural teeth are in good positions and condition, there is a nice balance and adjustment of their occlusal surfaces in functional movements, so fine that the loss of a mandibular third molar may affect the articulation and traumatize the mandibular lateral incisor on the opposite side. A hard, high, unyielding gold inlay or a high amalgam filling will likewise controvert the function of the curve.

The cumulative effect of the staggered loss of teeth will result in a progressive articular imbalance which may require splints for correction in cases of acute temporomandibular arthrosis. In hypo-ostotic cases involving natural teeth because of a combined bone and soft tissue calcium deficiency, a resulting lowering of the vertical dimension will induce subjective symptoms of articular crepitus, discomfort and pain common to this arthritic syndrome.

Returning to the prosthetic occlusal plane to complete the comparison, it can be said that the external pterygoids are the principal muscles in opening movements of the jaw. The masseter muscles come into action more prominently when the teeth are in approximation and it is desired to exercise the maximum crushing force. It should be obvious that a lengthening of the vertical from one to five or six millimeters more than the normal will result in a traumatic derangement of the articulation of the artificial teeth and will contribute to the temporomandibular arthrosis syndrome, particularly in cases where the natural teeth had been greatly worn and the musculature is heavy.
A further suggestion is, that artificial teeth should be arranged initially with the mandibular central incisor. This should in a measure, assure the proper location of the mandibular first molar in its place as a key to functional occlusion. To equalize and perfect the articulation the teeth at the “try in” stage should be caught in plaster and remounted on the articulator. When vertocclusion has been correctly secured this measure will minimize spot grinding.

REMARKS

At this midcentury period, the future, as it pertains to the use of denture adhesives, indicates their use will be continuous.

Atrophic changes in the tissues supporting dentures are accelerated by osteomalacic diseases which hasten the use of adhesives.

The vertical location of the combined occlusal plane and the vertical dimension, termed vertocclusion in this paper, is fixed by the eruption of the mandibular and maxillary first molars and remains invariable throughout life. Its vertical component only, varies, because of atrophic changes in the mandibular and maxillary processes when teeth are absent or present. When teeth are lost in these atrophied bone cases the vertical dimension should be recaptured from measurements taken from between the increased heights of the resorbed ridge crests at the median line of both processes. The integrity of vertocclusion and the vertical dimension, should be maintained.

Most technical blunders are made at the chair while vertocclusion is in the process of integration. No suitable instrument or caliper for the accurate measurement of the vertical dimension is available at dental supply depots.

The term, “registering centric,” lends ambiguity to any course taken toward its integration. This uncertainty ranges from biting into fickle wax, to recording it with precision.

To obviate this misleading term and to secure a clear development of centric it would be more explicit to transpose the word “registering” from “centric” to read, “registering the vertical.”

When the vertical dimension is referred to for descriptive purposes its length in millimeters should be included in its description.

The line of the occlusal plane should intersect the vertical at a predetermined point at a right angle to it. The two are actually one integrated unit, which should be designated vertocclusion.

The maxillary occlusion rim should conform to this plane and should be carefully equalized before its mandibular component is formed against it.

Care in establishing the vertocclusal plane will facilitate the recording of centric. Its horizontal and vertical location can then be oriented with pinpoint accuracy.

To hazard a guess as to the proper length of the vertical dimension and the exact location of centric tends toward excessive spot grinding and the consequent use of adhesives.
At the present time full denture prosthesis is not at its highest standard. It may be feasible to work out a simple system of standardized technique that will be acceptable to colleges—a system that will yield results beyond present-day accomplishments.

REFERENCES

1. Personal Communication from “Wernet,” “Fasteeth,” etc.

516 Sutter Street
San Francisco 2, Calif.