

The Gerber Articulator and System of Full Denture Construction

Part 1

The Condylator Articulator

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Introduction

Professor Gerber of the University of Zurich, Switzerland, has devised a system for constructing full dentures, which, although used widely on the Continent, is little known in this country. The Gerber system embodies the best features of established techniques to which have been added refinements resulting from Gerber's experience and research. The system is based on Professor Gerber's interpretation of mandibular movement and on his study of oral anatomy and occlusion. It embraces every phase of denture construction from the selection of the primary stock tray through to the method of finishing the processed dentures. Because he considered the adjustable articulators currently available unsatisfactory, he developed the **CONDYLATOR**[®] articulator which he claims, reproduces the important movements of the mandible more faithfully. Smooth gliding tooth contacts free from cuspal interferences are easily obtained with the articulator and particularly so when Gerber **CONDYLOFORM**[®] teeth are used. These are designed to enable the teeth to move during mastication in harmony with the temporomandibular joint. Fenn, Liddelow and Gimson (1961) and most other authorities stress the importance of arranging the artificial teeth so that (a) balance occlusion and (b) balanced articulation can be demonstrated in the articulator before the dentures are fitted into the patient's mouth. Dentures, which are made without balanced tooth contacts are usually unstable and can cause the underlying alveolar bone to resorb and so spoil the ridge form. This effect is greater in the case of the lower jaw because the

tissues on which the denture rest are of smaller surface area than the upper. Because of this the denture is less stable and more likely to move and cause bone resorption to produce the flat lower ridge problem, which is so difficult to solve.

The Gerber system will be described in two parts:

1. The Gerber Condylator articulator.
2. The Gerber System of full denture construction.

PART 1

The Condylator Articulator

If balanced articulation and occlusion are to be achieved with dentures, an articulator, which will reproduce mandibular movements with a degree of accuracy, must be used so that eccentric tooth contacts developed in the articulator will be reproduced in the mouth. The Gerber Condylator articulator is an uncomplicated adjustable articulator, which claims to do this simple means. (Fig. 1.) (See cover picture.)

The Condylator dates from 1950 when it appeared in Switzerland in an average condylar path form called the **SIMPLEX**. From this time the design has undergone detailed development, including the introduction of a companion instrument, the **INDIVIDUAL**, which has an adjustable sagittal condylar path angle. From its inception the articulator had a simple three-dimensional condylar guidance mechanism, an important design innovation, which allows the incisal guidance table to be dispensed with as a mandibular movement guide. This design concept is at variance with the established two axis designs of Gysi,

Hanau, Dentatus and other popular adjustable articulators.

The work of Bennett (1908) show that the working side condyle (condyle on the side to which the mandible moves) did not simply rotate against its intercapsular disc but did in fact move slightly outward and downwards during lateral mandibular movement. This discovery led Bennett to the important conclusion that condylar movement is three-dimensional and as a consequence, *no stable axis of rotation can be found during lateral movement of the mandible*. This conclusion of Bennett's forms the basis of Gerber's concept of mandibular behaviour and to reproduce it in his articulator Gerber has designed a "temporomandibular joint" which allows the artificial condylar heads to move three-dimensionally rather than around the two fixed axes described by Gysi and more latterly by Posselt (1968).

The Condylator's "Temporomandibular Joint" Mechanism

The natural condyle head is represented by a condylar body, which has a bi-conical profile, copied from the roof shaped sliding surfaces of natural condyles. (Fig. 2.)

It may be seen from Fig. 3 that if, as Bennett suggested, the working side condyle moves slightly outwards whilst the balancing side condyle is moving forwards and inwards, then this outward movement of the working side condyle will be accompanied by a downward movement due to the guidance offered to the condyle head by the coronal shape of the glenoid fossa. In more recent years, investigators have been able to describe this movement in greater detail, so that our understanding of it has progressed.

Isaacson (1958), for example, describes the Bennett movement as an outward and downward component in a more complicated condylar movement, which can also have a forward movement.



Fig. 2

The Condylator's bi-conical representation of the natural condyle head. It is claimed that this more natural shape is able to reproduce the Bennett movement more faithfully.

Gerber 's research confirms this and to the outward and downward Bennett movement described he adds the forward movement, which he claims is guided by the posterior half of the glenoid fossa. (Fig. 4.)

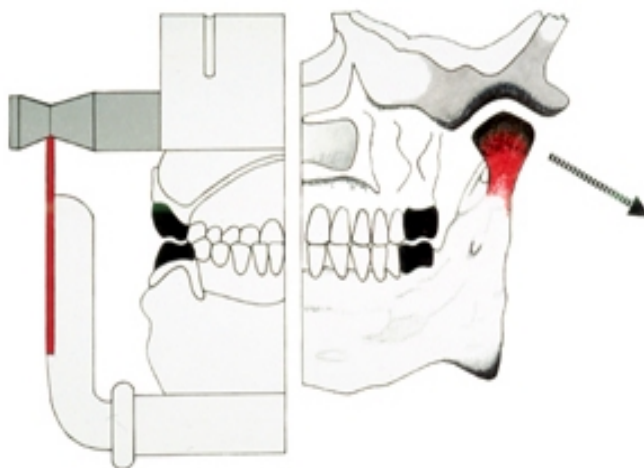


Fig. 3

The Bennett movement is not only outwards but is also downwards, due to the guidance of the coronal shape of the glenoid fossae. The Condylator is able to reproduce this movement.

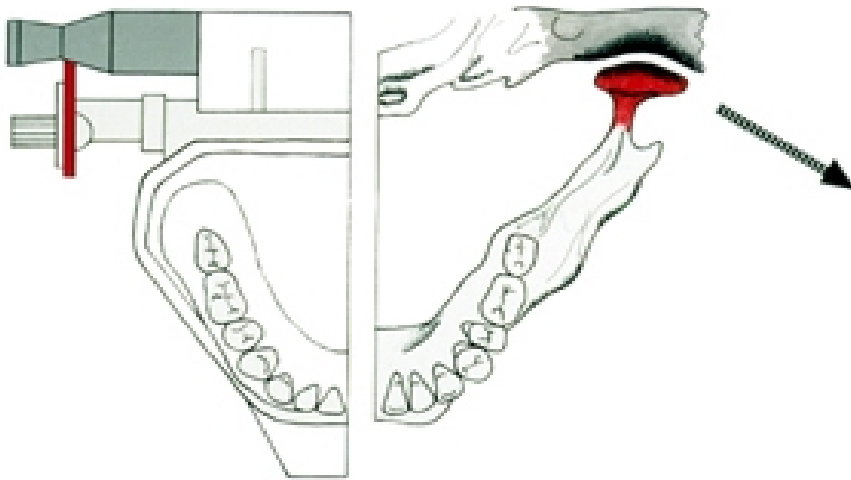


Fig. 4
A Forward movement of the condyle head is produced during the Bennett movement by the guidance of the posterior half of the glenoid fossae. The Condylator is able to reproduce this movement.

The working side condyle, therefore, is capable of a range of activity within the envelope of movement *outward and downward to outward and forward*. Gerber does not suggest that all natural condyles perform all these excursions during the Bennett movement. The Condylator's temporomandibular joint mechanism is capable of reproducing a natural envelope of three-dimensional movement in which a patient's own individual condylar movement paths can be accommodated.

In natural temporomandibular joints the articular surfaces, articular ligaments and muscles act together to contain the condyles to a field of movement, which is duplicated in the Condylator by a "condylar aperture" which restrains its bi-conical condyle to a similar natural field of movement. Lateral movements of the bi-conical head within its condylar aperture are guided in the three-dimensional way described by the combined guidance of (i) the almost perpendicular edge of a controlling lock which enters the aperture to provide a "centric stop" on the condylar track, and (ii) by the upper, lower and anterior borders of the aperture. (Fig. 5.)

The mechanism allows a three-dimensional range of movement at extreme or border mandibular movements and at the more important smaller inter-border movements. Craddock (1956) noted in this connection

that "balanced lateral movements of only 2mm from centric in the molar region almost doubles the chewing efficiency of dentures".

When the natural condyles have been correctly positioned in the glenoid fossae, following the registration of centric occlusion, it is still possible for them to perform small retrusive movements (Payne (1969)). This is allowed for in the condylar mechanism by withdrawing the "centric stop" from the condylar aperture to reveal a curved extension to the condylar track which copies the shape of the glenoid fossa. These retral movements are made during the swallowing of saliva and in grinding movements (Gerber (1959)). The Dentatus and some other articulators have provision for retral movement from centric but this is usually a "less natural" straight-line extension of the condylar track. In protrusion the condylar path of the articulator rises from the lowest support point of the inter condylar axis and ascends via a short circular segment to the selected condylar angle. (Fig. 6.)

Gerber's research led him to suspect that many adjustable articulators in current use did not move in the way that the published literature said they did and that they could not provide a close enough approximation of natural mandibular movements: so that the working and balancing tooth contacts seen in the articulator during setting-up

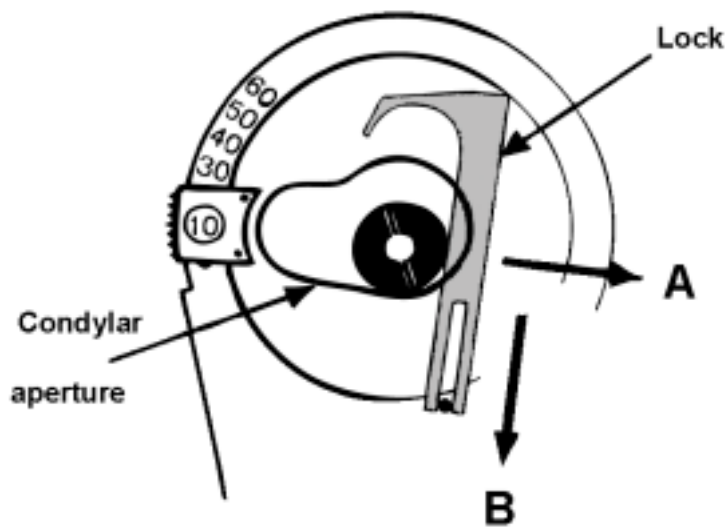
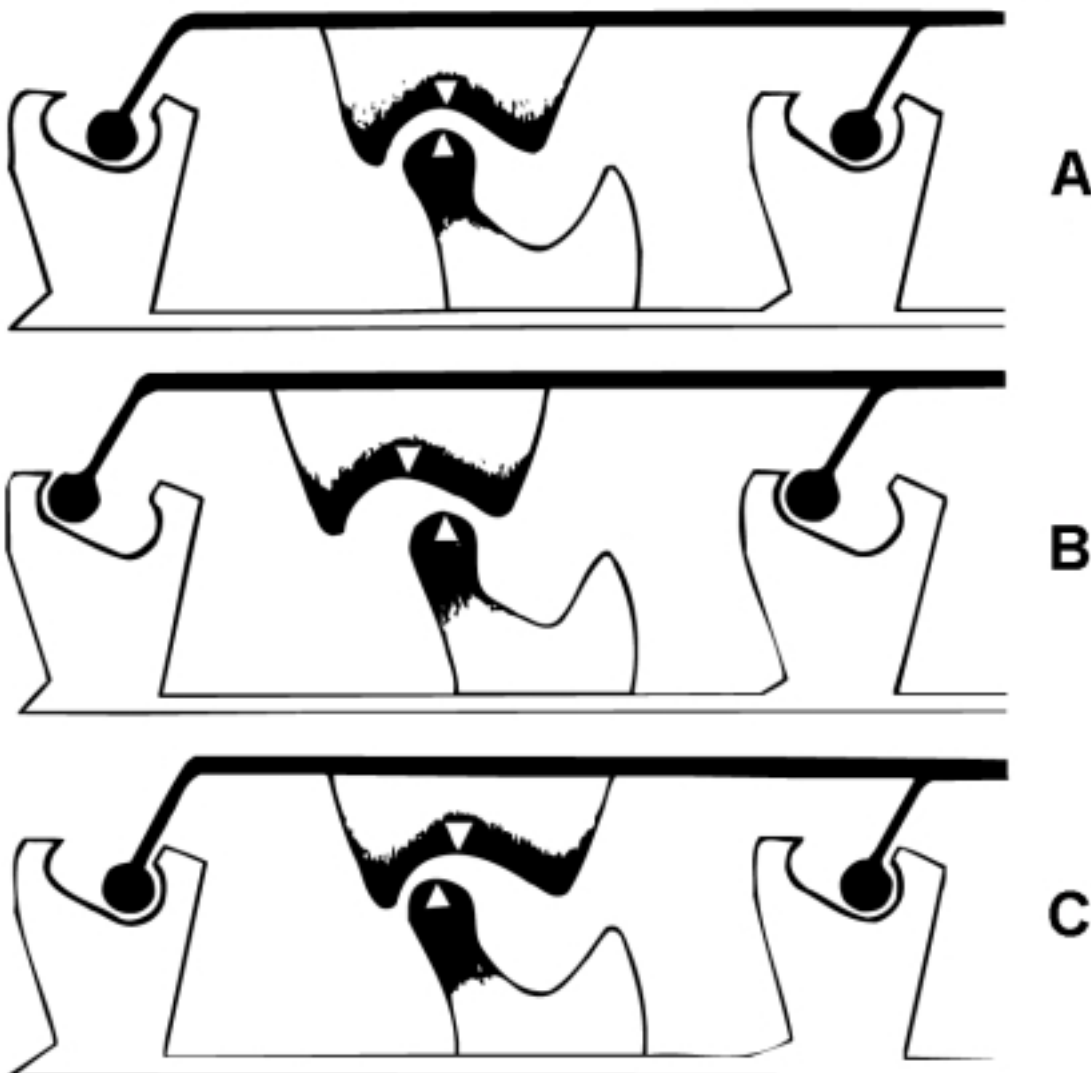


Fig. 5
 Detail of the “condylar aperture” showing the moving lock mechanism. When the lock is moved to A, three-dimensional condylar movements are possible in protrusive lateral and retrusive jaw movements. When moved to position B only hinge movements are possible.

Fig. 6
 The “condylar apertures” duplication of:

- A. Centric.
- B. Protrusive condylar activity.
- C. Retrusion from centric condylar activity.



may not be reproduced in the mouth. It is difficult for a dentist to check for balanced occlusion and articulation when fitting dentures into a patient's mouth. His observations have to be made from outside the mouth with the lingual cusps hidden from view and further, he cannot see the unseating inter-cuspal forces acting on the denture which are concealed by a resilient mucosa. Weinberg (1963) is of the opinion that mucosa mobility is so successful in accommodating the occlusal disharmonies produced on Dentatus-Gysi Hanau type articulators as to just allow them to meet the minimum standards of efficiency for full denture work. They are not suitable, he suggests, for reconstructing hard and unyielding natural tooth surfaces in bite rehabilitation, partial denture and crown and bridge work. Gerber considers that Bennett's moving axis theory is crucial for proper mandibular guidance and on this point he is at variance with the established theory of Gysi, who claimed to be able to trace the centre of all lateral mandibular movements to static axes situated behind the working side condyle. The Bennett/Gerber departure from this theory is that the rotation centres are constantly changing with the amount of lateral mandibular movement and are three-dimensional.

Articulators with distally placed joints in their "correct" anatomical position (according to Gysi) have been designed in which the fixed axes of rotation lie considerably behind a rod indicating the inter-condylar axis. The example shown is Gysi Simplex. (Fig. 7.)

The design has now been abandoned in favour of having the hinge axis in the inter-condylar axis. This new design makes it possible for the vertical dimension to be altered without repeating the registration of vertical dimension.

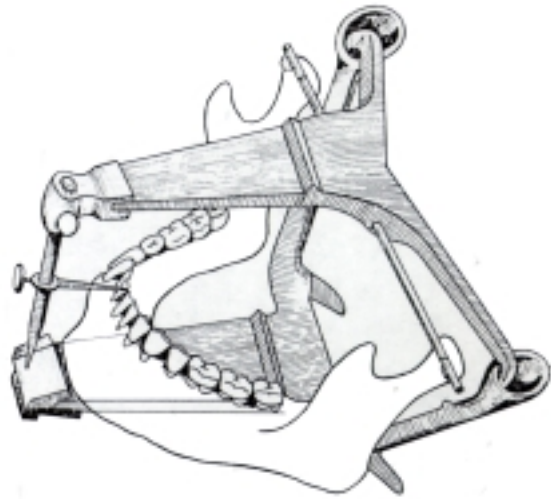


Fig. 7

The Gysi Simplex articulator with the axes of rotation in their "true anatomical position" (according to Gysi).

The Gerber Articulator Test

Gerber (1950) showed in an articulator test how the movements of two axis articulators were always "too flat" and so could not generate movements which would give balanced occlusion and articulation in the mouth, *particularly on the working side*.

In 1955 Gysi confirmed Gerber's results following a similar test of his own articulators. He found that his Trubite articulator adjusted to 0 deg. and then, 5, 10, and finally 30 deg. of incisal guidance "give really extensive faults in the angulation of the facets in protrusion and in the cusp groove angle in the molar and premolar area". Later Gysi suggested that his articulator be fitted with a double faced or V-shaped incisal guidance plate with inclines of 15 deg. to correct the faults revealed by Gerber's test. This revision of incisal guidance was partly successful in the anterior region, but was unsatisfactory in the molar and premolar areas of the articulator where the influence of condylar guidance predominates.

The Cusp Groove Angle

Finn, Liddelow and Gimson (1961) describe balanced occlusion as the arrangement of the artificial teeth so that

as many as possible are in contact in any lateral or protrusive position. Balanced articulation is that arrangement of teeth so that they maintain an even sliding contact during the final masticating movements without causing any cuspal interference. The production of this smooth interworking of the cusp inclines in the articulator depends on the accuracy with which the cusp slopes are made parallel with the articulator's reproduction of mandibular movements. Fig. 8A shows the familiar arrangement of the first molar cusp inclines to obtain working and balancing cusp contacts.

If continuous smooth sliding contact is to be maintained between the cusp inclines when the mandible is moving in the direction indicated by the arrow, then the mandibular path must be parallel to path X (Drawing 8B). Equally when the

working side is on the left the path is Y. The total of these paths, i.e. a left and right mandibular movement, is X and Y and where these lines meet a "cusp groove angle" is formed. (Drawings 8C and 8D.) The character of the cusp groove is the determining factor for proper cuspal relations on the working side (side to which the mandible is moving). Weinberg (1959) agrees with Gerber that simple adjustable articulators such as the Hanau are capable only of working side condylar *rotation* with a lateral shift at zero degrees inclination and therefore the discrepancies between the cusp groove angle produced by the articulator and that produced by the patient's own condylar guidance will result in a loss of balance on the working side and the production of cuspal interference and denture instability.

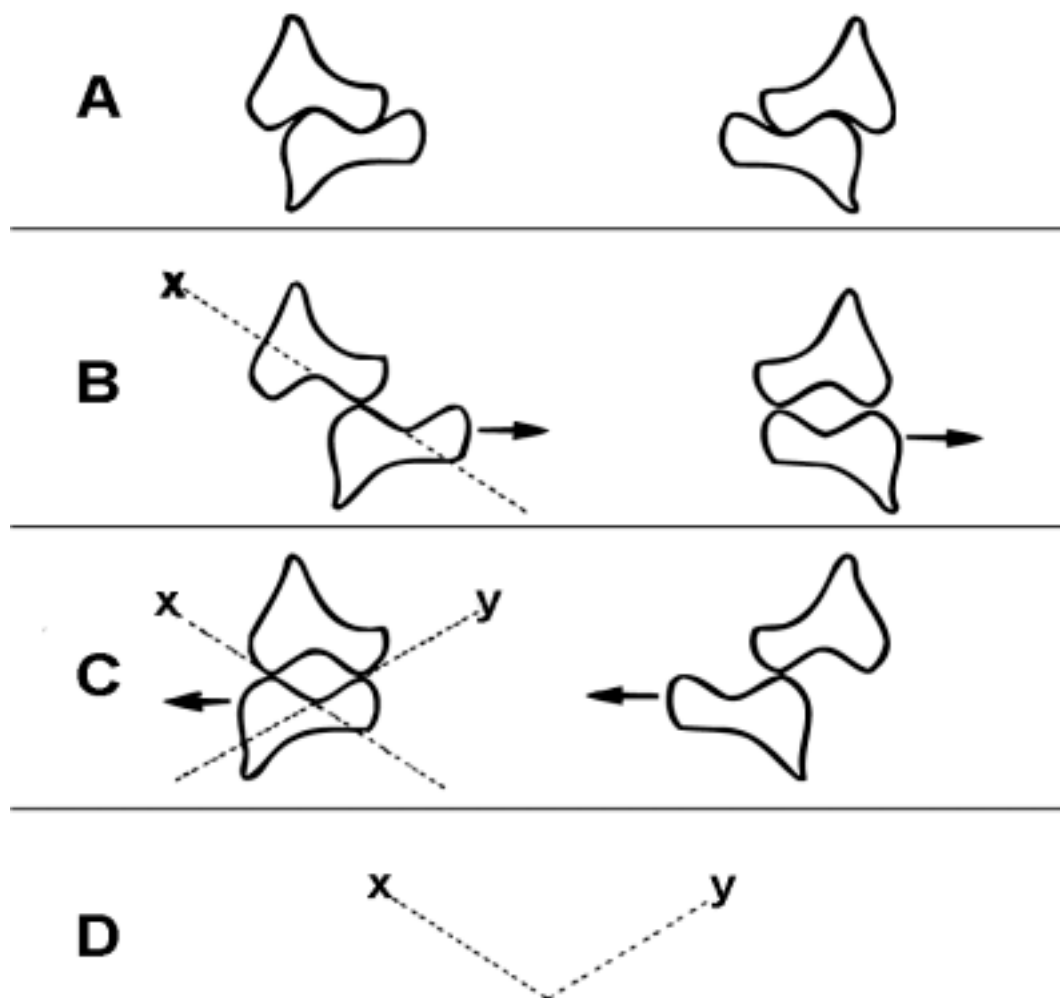


Fig. 8

The arrangement of the cusp inclines to give anatomical articulation during working and balancing jaw movements.

The Gerber Articulator Test

Two steel knives in saw tooth form are prepared, having teeth, which approximate in size and form to the palatal cusps of the upper molar, premolar and canine teeth. A precise anatomical representation is not necessary. The knives are mounted on the maxillary frame of the articulator to be tested, together with a flat wax block on the mandibular frame. Each articulator is then given the same sagittal condylar angle, Bennett movement (when fitted) and incisal guidance angles. The articulator is then gently closed to allow the knives to cut into the surface of the wax, while at the same time the upper frame of the instrument is moved through every possible excursion. The knives cut a clear pattern in wax. (Fig. 9.)



Fig. 9

An articulator undergoing mandibular movement analysis. Note the characteristic herringbone pattern cut into the wax by the upper metal “teeth”.

The examination of this performance pattern is made easier if plaster is poured into the depressions to make a convenient three-dimensional performance cast. The cast may be sawn through at any mandibular excursion and the cross section viewed “end on” to study

the behaviour of any particular tooth (Fig. 10A).

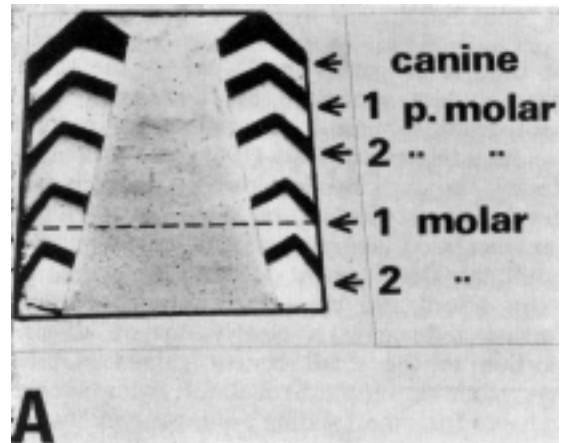


Fig. 10A

Shows plan view of entire un-sectioned plaster performance cast.

Using this technique, four popular adjustable articulators, including the Condylator and one average condylar angle machine, were tested. The performance casts were sectioned to show the performance of the articulator at approximately the first molar on the working side (Fig. 10B.) Fig. 11 shows the results of the test.

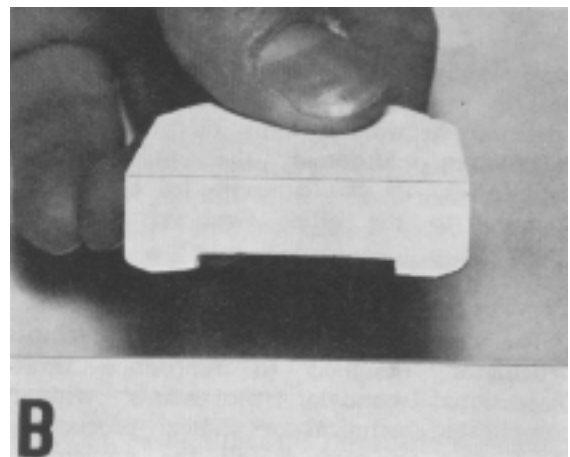


Fig. 10B





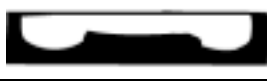


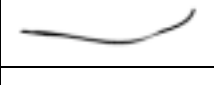

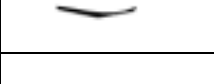


Performance cast sawn through to show the path of movement generated by the articulator at the first molar on the working side. Note the roof shaped cusp groove angle produced.

Summary of Results

Gerber concluded from his original test of Hanau and Gysi articulators that they lacked efficient condylar guidance on the working side. The same observation applies to Dentatus, Gibling and Ash Freeplane articulators. The error demonstrated was a flat and/or distorted cusp groove angle, which, if balanced articulation and occlusion are to be obtained in the articulator, would dictate the use of flatter bucco-lingual cusp inclines than would be necessary in the mouth. Those who use a two-axis articulator regularly will be familiar with the need for extensive bucco-lingual cusp reduction while at the same time preserving the protrusive cusp inclines. This error is a product of the two-axis theory and cannot be corrected by altering incisal guidance.

Even if the connection between the cusp groove angle and natural mandibular movement is disputed and

one dismisses the claim of the Condylator in this respect, an interesting question that this articulator test poses is that although the articulators had identical incisal guidance and condylar inclination settings (except for Ash Freeplane, where the condylar and incisal guidance are fixed) they nevertheless had different performance characteristics. This variation cannot be explained by constructional errors or by a lack of precision. The question then is which most closely approximates natural jaw movements for this can be the only criterion of articulator superiority. If the cusp groove angle is accepted as evidence of proper lateral mandibular activity, then the Condylator alone gave a satisfactory performance in that it was able to produce a well-defined cusp groove angle on the working side. Of the remaining articulators, although the Gibling had deficiencies, it would seem to be slightly superior to the other two axis machines tested.

						A	B
ARTICULATOR	TYPE	BENNETT MOVEMENT	INCISAL GUIDANCE	CONDYLAR GUIDANCE	CUSP GROOVE ANGLE PRODUCED	CUSP GROOVE ENLARGMENT	
1	DENTATUS	ARLS 15° X	15°	30°			
2	DENTATUS	ARLS 15°	15°	30°			
3	DENTATUS	ARL 15° X	15° + 10° X	30°			
4	GABLING	--	15°	30°			
5	ASH FREEPLANE	--	10°	30°			
6	CONDYLATOR	FIXED '3D'	15°	30°			

X Recommended settings DENTATUS HANDBOOK (1962)

Fig. 11

The table shows photographs of the sectioned performance casts showing the performance of the articulator tested at the first molar on the working side (column A) and an enlargement of the cusp groove angle produced (column B). Compare column B with Fig. 8D.

Conclusions and Summary

The Condylator is a simple, easy to use articulator, designed to reproduce three-dimensional condylar movements without complicated technical or clinical procedures. It is able to perform all the movements described by Bennett. In the past much technical discussion has been focused on articulator adjustability with merit being given for the range and quality of control. Many technicians and practitioners have been deceived by thoughts of the "automatic" excellence, which would attend the use of one of the more complicated and more "anatomical" machines. Highly adjustable articulators have been developed to meet this demand, which are able to reproduce almost every registerable eccentricity of the temporomandibular joint. The major problem with such an articulator, apart from the amount of time it consumes in its use, is the highly questionable accuracy of the complicated pantographic records the articulator requires for its adjustment. Watt (1968). In articulator design, as in other fields of research and development, the law of diminishing returns for increased complexity applies. A critical point of development is reached when the extra effort and complexity needed to gain further refinement is clearly out of all proportion to the small benefit gained. Gerber has made a simple articulator, with average values for the sliding components, which produce the Bennett movement, which is able to reproduce the important movements of a "fully adjustable" articulator.

When a patient wearing full dentures maintains occlusal contact between his dentures and makes lateral and protrusive movements, there are only two factors, which control how his mandible moves, the condylar guidance and the occlusal surfaces of the teeth. These two factors are given prominence in the Gerber system of full denture construction. He uses natural three-dimensional condylar guidance, coupled

with complimentary occlusal surfaces to guide the mandible. Gerber's views are "in articulators with joints formed according to anatomical principles and with a range of movement limited to that found in nature, the vertical rod and incisal guidance table is only necessary for maintaining the vertical dimension during the setting-up of the teeth in centric and the grinding-in of the finished dentures".

Most adjustable articulators in use today are direct descendants from the instruments Gysi, Hanau and others developed just after the turn of the century. Many detailed changes have been made over the years to refine their design and the precision of their construction is unquestioned, but they remain two axis instruments. The Gerber Condylator is a departure from this theory. It has Bennett inspired three-dimensional condylar guidance, including retral movements without incisal guidance. It is perhaps the first of a second generation of articulators.

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