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Evolution of Articulators- Research and Review

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ABSTRACT

One of the aims of prosthodontics is to reestablish teeth in concordance with temporomandibular joints. Articulator is a gadget that permits an administrator to create a restoration that will be physiologically and psychologically effective. The objective of this article was to depict the evolution of articulators as the years progressed. The online data was searched for the terms articulators, history, and early articulators. The alternative of "related articles" was likewise used. In this review we present the evolution of the articulators from the past to the present.

Keywords: Articulators; Temporo-Mandibular Joints; Evolution; History

INTRODUCTION

Articulators are mechanical devices that represent maxilla, mandible and temporomandibular joints (TMJs). Their main task is to provide a frame where it is possible to relate, in the three planes of space, maxillary cast with mandibular cast relative to the hinge axis of the patient and of the instrument [1]. An articulator can be defined as following: “It is a mechanical instrument that represents temporomandibular joints and jaws, to that maxillary and mandibular casts may be attached to simulate some or all mandibular movements” [2].

Early articulators were based on individual theories of occlusion. However, normal variations in mandibular movement between patients, and even variable movement of the joints in one patient required to design adjustable articulators. The challenge for the dentist is to choose an articulator that is suitable for specific purpose. This requires an understanding of the instrument, as well as a grasp of the treatment objectives for the given patient [3]. Very little is known about the origin of dental articulators. There are two early documented facts: 1) Phillip Pfaff was the first to describe wax impression procedure and a method of creating plaster casts; and 2) Jean Baptiste Gariot was the first one to describe a method for mounting casts and conserving their relationship with plaster index (“plaster articulator”). However, it must be recognized that

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because Gariot never claimed the procedure as an innovation, it was not associated to him. Even though "plaster articulators" were the first to be used for conserving the relations of casts, sometime before 1840, mechanical hinge articulators have become a new and widely used device for this purpose [4]. More sophisticated articulating devices advanced as more knowledge about anatomy, mandibular movement, and mechanical principles was gained.

Various articles in dental literature relating to articulators deal with the theory and progress of articulating devices, directions for use, descriptions of shortages and approaches for overcoming them, thorough mechanical analyses of the devices, and several systems of classification [5]. The aim of this article was to describe the evolution of articulators.

MATERIAL AND METHOD

An online search was done with the search terms articulators. Other related articles were also searched. Over the years some articulators have been modified, some have not been accepted by the profession and many are no longer in use [6]. In this review the history of articulators, beginning with the 18th century, when the evidence of the first articulator appeared to till date is defined.

1. Plaster Articulator

Phillip Pfaff, dentist to the court of Frederick the Great, King of Prussia, first defined his method of conserving the relationship of the casts, the plaster articulator in 1756 (Figure 1) [4]. It has of a plaster extension on the distal portion of the mandibular cast, that was grooved to help as a guide for plaster extension of the maxillary cast. This was called as 'slab articulator' [5].

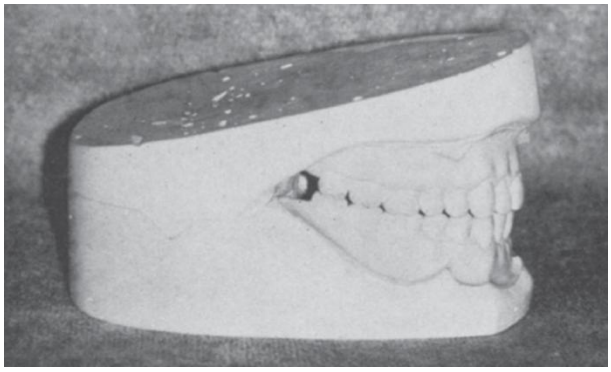

Figure 1. Plaster Articulator [5]

2. Barn Door Hinge

In 1805, Jean Baptiste Gariot defined his method of creating plaster casts and extending them posteriorly to giving an indexing mechanism for conserving the relationship of the casts [4]. The barn door hinges (Figure 2), designed by J.B.Gariot, and had an anterior vertical stop. It recognized centric relation record and replicated this position reliably [5].

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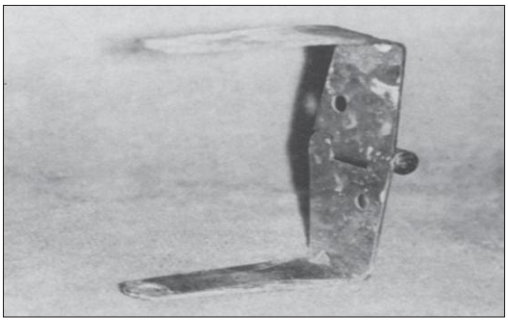

Figure 2. Barn Door Hinge [5]

3. Hovarth and Ladmore Articulators

The first available reference to the original mechanical hinge articulators is perhaps Fairhurst's discussion of Hovarth's articulator and Ladmore's articulator in the 1830s. Fairhurst defined these and other early examples as devices entailing of two wooden or metal blocks or slabs hinged together with a simple hinge. These articulators and others of that time must surely have resembled that is now commonly referred to as the "barn door hinge" [7].

4. Thomas W. Evan's Articulator

One of the initial mechanical hinge articulators demonstrated and discussed in some detail in the texts is credited to Thomas W Evans. In his textbook, Chapin A Harris defined the T W Evans articulator as a "very simple instrument by means of that the extension of the plaster back of the plates and wax is rendered unnecessary." He emphasized that the most important feature was that vertical dimension could be conserved or altered as obligatory. It is not known if Thomas Evans patented his Articulator. According to House, the records of the US patent office before 1870 may be unfinished. In same year, the Commissioner of Patents entirely reorganized the system of keeping records and delivering patent letters. Also, onetime between 1840, when the first patents were delivered, and 1870, a fire demolished many of the new patent records [7].

5. The First US Articulator Patent – Cameron's Articulator

The first US patent for articulator was allotted to James Cameron on April 30, 1840. Cameron's articulator was distinctive in its departure in design from other hinge-type devices (Figure 3). There was enclosure of the anterior- posterior and vertical adjustment features [7].

Figure 3. Cameron's Articulator [7]

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6. The Second US Articulator Patent – Even's Articulator

The second articulator to be patented was that of Daniel T. Even (Figure 4). He first attempted to record mandibular movement and documented the forward and lateral movement of the mandible. He called it the "Dentist's Guide". It was unsuccessful because it was inconvenient and difficult to use.[8]

Figure 4. Even's Articulator [8]

7. "Fixed Condylar Guide Articulators" and the Next Advancement

The original Evens Articulator, with the horizontal condylar path feature, can be classified commonly as a''Fixed Condylar Guide'' instrument, and is the first of this type. Two other early patented examples were the Starr (1868), and the Antes- Lewis (1895, 1900). The most famous articulator in this category was the Bonwill (1858). All of these articulators expected some reception by the profession. Certainly, the Bonwill was common for many years. But none signified a further invention in principle. It was not until almost 50 years after the Evens was patented that Richmond S. Hayes would include the next important advancement into an articulator, the downward and forward condylar path, when he delivered a patent for his ''fixed condylar guide'' instrument in 1889 [8].

8. The First "Adjustable Condylar Guide" Articulator

William E. Walker of Pass Christian, MS obtained 2 patents for articulators with adaptable condylar guides (Figure 5). The earliest version of his articulator, constructed in about 1895, had fixed condylar guides. Although the second model, featured adjustable condylar controls, they could not be set individually. The third model of the Walker articulator was the first to include individually adjustable condylar guides as well as adjustable rotation centers for lateral movement. Walker patented these last 2 models sequentially, calling them "Walker's Physiological Articulators". [9].

Figure 5. Walker Articulator [9]

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9. The appearance and early use of the Incisal-Pin and Guide [10]

In the 1840s, some form of "*vertical stop*" was common component of mechanical articulators. Clearly, some early inventors documented the importance of preserving vertical relationship of the casts in the articulator.

10. The First Articulators Patented with an Incisal- Pin and Guide Assembly

C.E. Luce, got the first patent for an articulator with an incisal-pin and guide assembly on November 28, 1911. Luce also described downward and forward movements of condyles (1889). Luce's articulator was the first "scribing" type. (Figure 6).

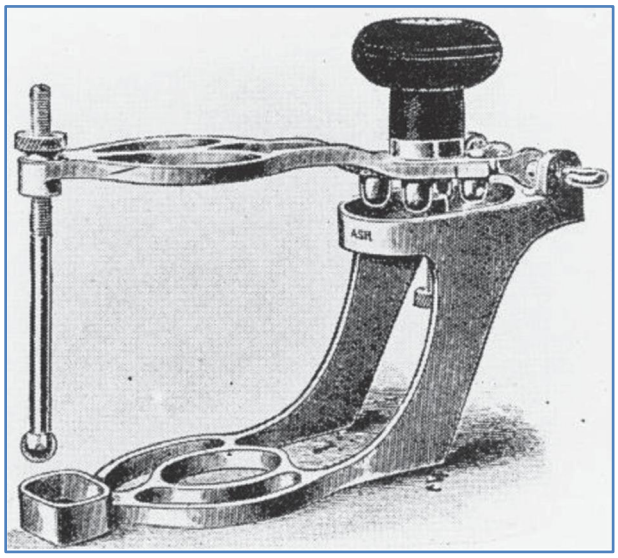

Figure 6. Luce Articulator [10]

Alfred Gysi received a patent for his "*Adaptable*" articulator in October 1912 (Figure 7). This was Gysi's first US articulator patent. Although the "*Adaptable*" was extremely progressive for the time, it had only fixed, 45-degree incisal guide table.

Ray W. Burch of Hart, MI got the fourth patent issued for an articulator with incisal pin, in December 1913. Burch was the first to use the innovation of converting maxillary and mandibular facebows into an articulator. The facebow devices were linked by condylar slot assemblies and were attuned while being tatty by the patient.

After the Burch articulator, George B. Snow patented the *"Acme*" articulator in November 1915, that was Snow's third articulator patent and the first with incisal- pin and guide. David M. Shaw of Eltham, England, patented an articulator in February 1916. In November 1916, Rupert E. Hall received his first patent for an articulator, nicknamed "*Alligator*". The "*Alligator*" was the first articulator to include an incisal guide table with adjustable lateral wings. On Hall's second articulator (March 1917), a revised version of the "*Alligator*," the incisal pin was intended to function within a 45-degree cup.

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Figure 7. Gysi's Adaptable Instrument [10]

11. Hall's "Dental Occluding Frame": The First Patented Gothic Arch Incisal Guide Table

Rupert Hall's third articulator patent, "*Dental Occluding Frame*" (April 1917), (Figure 8). It was an arcon instrument that featured adjustable, curved condylar paths, including settings for the Balkwill- Bennett angle, and a mechanism for adjusting the intercondylar distance. Also included horizontal incisal table with adjustable lateral wings, anew feature - a triangular guiding edge on each lateral wing for the "gothic arch" tracing.

Figure 8. Hall's Occluding Instrument [10]

12. Maxillomandibular Instrument

George Monson in 1918, based on the spherical theory designed this. According to this theory, that advanced from the concepts of Monson and a German anatomist Graf von Spee, the mandibular teeth move over the maxillary teeth as over the surface of a sphere. The average radius of the sphere is 4 inches, but the Monson instrument has set screws that can vary the instrument's radius (Figure 9) [5].

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Figure 9. Maxillomandibular Instrument [5]

13. Stephen Articulator

Stephen articulator, developed in 1921, similar to the Gariot hinge articulator from 1805, except that it has a fixed condylar inclination and allows for an arbitrary lateral movement. A posterior set screw holds the upper and lower members of the articulator at fixed vertical dimension [5].

14. The Hanau Model C Articulator and the Hanau Model M Kinoscope

Rudolph L. Hanau, developed a research model called the Hanau Model C articulator. In 1923, he developed another research instrument, the Hanau Model M Kinoscope articulator (Figure 10). It has double condylar posts on each side. The inner posts serve two purposes- (1) they act as the horizontal condylar guides and (2) they are variable rotation centers when the posts are moved inward or outward. The Bennett angle is adjusted by rotating an eccentric cone located on the outer posts against the intercondylar axis [5].

Figure 10. Hanau Model M Kinescope

15. Homer Relator

Homer Relator was introduced in 1923 by Joseph Homer. It was based on a principle that plastic material rather than mechanical guides is used to preserve articulator positions. Three cups in the lower member filled with plastic material (usually modeling compound), capture the record and guide the tripoded upper member into the recorded positions. [5]

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16. Wadsworth Articulator

In the Wadsworth articulator, developed in 1924, the casts were mounted with a facebow and the Wadsworth T-attachment determined the third point of reference. A divider was used to measure the distance from the median incisal point to the condyle center on one side. This arc length was defined first from the condyle and then from the median incisal point to the flag located on the instrument's upper member. The intersection of these arcs was located on the rotational center for the measured side. The center was used to design a spherical plane of occlusion. It had an adjustable intercondylar distance as well. This measurement was determined by using the distance between the facebow condyle pointers minus 0.75 inch skin-condyle distance on each side. The condylar paths of the instrument were slightly curved [5].

17. The Hanau Model H110

The Hanau Model H110 was introduced by Hanau in 1926 and was designed primarily for complete denture and to encompass mechanical averages of many previous concepts. It has individual condylar guidance adjustments in both sagittal and horinzontal planes[5]. Rather than using lateral positional records, the lateral setting was calculated using the formula, given at the base of the articulator:

L = H/8 +12, where H = Horizontal condylar angle.

18. The Hanau Model H110 Modified

It was designed in 1927, and introduced the incisal guide table. The original incisal guide cup with its fixed curvature could be moved only as a unit, and it did not have calibrations for resetting. The improved table appeared on Hanau articulators from 1927 to 1972 and allowed for adjustments in three dimensions through considerable range [5].

19. The Hagman Balancer

Developed in 1920s by H. C. Hagman, the Hagman Balancer opens and closes on a hinge that is in the center of the upright support but requires no facebow or interocclusal records for mounting. It was also based on spherical theory of occlusion. Mandibular teeth are constructed to the curve of Spee using a balanced occlusal guide, and maxillary teeth are constructed to fit with mandibular teeth [5].

20. Phillips Student Articulator

The Phillips Student articulator (Model C), or the Panto- graphic articulator, was developed by George P. Phillips in 1926 (Figure 11). The Phillips graphic recorder was de- signed to trace in one step the Gothic arch (needlepoint) tracing and the inclinations of glenoid fossa. The articulator could replicate mechanically the movements of the graphic recorder through the use of two vertical pins that follow horizontal inclination of glenoid fossa, and two horizontal pins that retraced needle point tracing [5].

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Figure 11. Phillip's Student Articulator [5]

21. Stanbery Tripod Instrument

Developed in 1929 by C. J. Stansbery, this articulator was designed without a hinge to facilitate the reproduction of any positional relationship. The articulator replicates positions, not movements. Interocclusal positional records of centric, protrusive, right lateral and left lateral positions are used to set three individual turrets and slots of the tripod, with the slots forming straight line to the centric position [5].

22. House Articulator

The House articulator was developed by M. M. House in early 1930s. The Needle-House intraoral chew-in or other positional records were used to set the House articulator. The intercondylar centers of rotation varied without moving the lateral posts that support the condylar elements, with the help of hooks that could slide along the intercondylar bar. The incisal guide table could control horizontal and vertical movement. Lateral plates in the guide table created a mechanical function as a curved incisal pin [5].

23. Precision Coordinator

The Precision Coordinator was developed by W. H. Terrell in the early 1930s. It is an arcon type of articulator that has curvilinear condylar guides. Twin parabolic cams control vertical and horizontal anterior guidance. The incisal pin is curved to allow for changes in the vertical dimension. There is also freedom of movement in centric relation [5].

24. The Hanau Crown and Bridge Articulator

The Hanau Crown and Bridge articulator 29-0 was manufactured by the Hanau Engineering Co from 1934 to 1971. A posterior pin-and-cam guidance mechanism can be set to simulate working and balancing side excursions of 15 degrees. The mechanism can be set to L for restorations in patient's left quadrant, R for right quadrant, or Anterior restorations or for equalizing right and left excursions. Its protrusive movements were up to 30 degrees. [5].

25. The Philips Occlusoscope

The Philips Occlusoscope articulator was developed by George P. Phillips in 1938. The maxillary cast on the Philips Occlusoscope articulator was mounted with the use of a facebow. The articulator could be adjusted by either intraoral or extraoral records. The lower member had

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two adjustable units that represent the two temporomandibular joints. It did not have an adjustable incisal guide. The incisal pin rested on a flat plane because Philips believed that an incisal guide pin serves only to prevent closure and should not serve as a third tempomandibular joint [5].

26. The Modified Stephen Articulator

The Stephen articulator (Figure 12), as modified in 1940, is a simple hinge joint articulator that has fixed condylar path of 30 degrees. It is similar in design to the 1921 model, except that the upper and lower mounting arms on this model are longer. An adjustable setscrew in the posterior region holds the upper and lower members in the fixed vertical position [1].

Figure 12. Modified Stephen Articulator [1]

27. The Stephen Articulator Model P

The additional features of the Stephen articulator Model P are incisal pin and vertical height adjustment. Another version of this articulator was manufactured to include a fixed 10 degree incisal guidance [11].

28. The Fournet Articulator

The Fournet articulator (Figure 13) was developed around 1940 and distributed by the Dentists' Supply Co. of New York. The Fournet articulator is one-dimension articulator that has no lateral movement. The maxillary cast is positioned horizontally by (11) the two maxillary central incisors, that are oriented aesthetically and rest on Spee curve template anteriorly, and (12) the Cook mounting jig, that fits into the depth of the hamular notch and orients the casts posteriorly [11].

Figure 13. The Fournet Articulator [11]

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29. The Johnson-Oglesby Articulators

The Johnson-Oglesby articulator was developed around 1950. It is small, nonadjustable, flexible articulator. The Johnson-Oglesby instrument had limited use, and restorations produced using it sometimes required major adjustments intraorally [11].

30. The Coble Articulator

The Coble articulator was developed around 1950. by Lucian G. Coble. The Coble articulator maintains centric relation and vertical dimension but does not allow functional movements. It is a hinge articulator in that the maxillary cast is mounted with a mounting jig that corresponds to the occlusal plane. The mandibular cast is positioned with an interocclusal record [11].

31. The Galetti Articulator

The Galetti articulator (Figure 14) was first manufactured about 1950 in Italy. In this articulator, each cast was held mechanically without plaster by two fixed posts anteriorly and one adjustable post posteriorly to each member. The upper member was adjustable by an extendable arm and a universal ball-and- socket joint to achieve the desired relationship of the maxillary to the mandibular cast, that permitted rapid cast mounting. This articulator had fixed condylar path and a vertical stop that was in the posterior region. It did not accept a face-bow [11].

Figure 14. The Galetti Articulator [11]

32. The Pankey-Mann Articulator

The Pankey-Mann articulator (Figure 15) was developed in 1955 by Lindsey De Pankey and Arvin W. Mann. This articulator consists of a base that holds a platform for the mandibular cast and a vertical post containing two movable assemblies. The first assembly was made up of a horizontal rod that supports the face bow frame and also has centers of rotation for measuring and cutting calibres. A second movable assembly hold the mounted maxillary cast. By using the Pankey-Mann face bow to mount the mandibular cast, and cutting dividers to establish an occlusal plane in the mandibular teeth based on the spherical theory, the entire occlusal plane was engineered before tooth preparation is initiated [11].

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33. The Stuart Articulator

The Stuart articulator (Figure 16) was developed by Charles E. Stuart in 1955. It was a fully adjustable articulator. The movable outer cam and sphere on each side controlled all condylar movements except the angle and timing of the Bennett movement, that were controlled by the inner cam and sphere. The articulator settings were programmed using pantographic tracings from the patient [11].

34. The Hanau Model H2 Series

The Hanau Model 96 H2 came out in 1958. The principal feature of this articulator was an increased distance between the upper and lower members from 95 mm to approximately 110 mm. In addition, the orbital indicator was added to the upper member. The H2-XPR, that is one of the models of the H2 series, was introduced in 1958. It had features identical to those of other models in this series, but in addition, it had extendable condylar shafts and retrusive-protrusive adjustment in the condylar element.

Some other models of the H2 series are:

Model H2-O, with orbital indicator attachment; Model H2-X, with extendable condylar shafts;

Model H2-PR, with calibrated adjustments to protrude or retrude condylar balls up to 3 mm.

An adaptation of the Hanau Model H110 articulator, that uses a 0.75 inch Lucite shim to increase the condylar post height, was defined by Elinchbaugh. He also defined the fabrication of a 0.75 inch Lucite orbital point guide plane that provided an anterior point of reference level with the condylar axis.

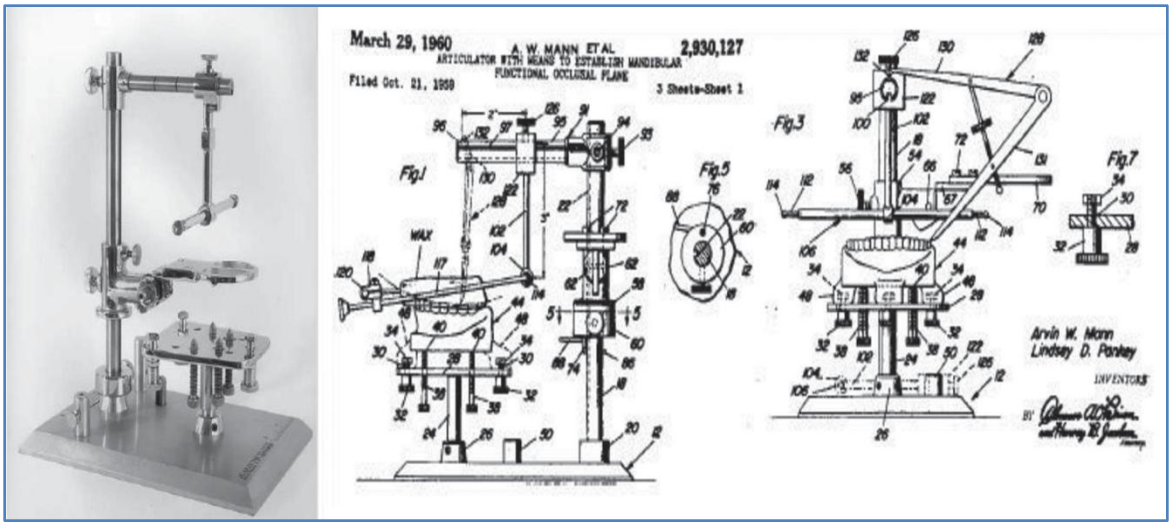

Figure 15. The Pankey-Mann Articulator

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Figure 16. The Stuart Articulator

Figure 17. the Dentatus ARL Articulator

35. The Dentatus ARL Articulator

The Dentatus ARL articulator (Figure 17) was first manufactured by A.B.Dentatus of Stockholm, Sweden in 1958. It was a semiadjustable, shaft type articulator with a straight condylar path and a fixed intercondylar distance. In mechanical principle and design it was similar to the Hanau H2 articulator. The Dentatus ARL was a rigid, durable instrument with a curved incisal guide pin. Extendable condylar shafts enabled receiving a hinge axis face-bow. The Bennett movement was calculated from the Hanau's formula, and rotating the condylar post up to 40 degrees regulated it. As with the Hanau articulators, the size of Bennett movement was controllable, but not the timing or direction [11].

36. The Improved New Simplex Articulator

The Improved New Simplex Articulator (Figure 18) was distributed by the Dentists' Supply Co. of New York in 1960. This is an updated version of the Gysi Simplex articulator. It used average movements. The condylar inclination was 30 degrees, with a Bennett movement of 7.5 degrees. The incisal guide table was adjustable from 0 to 30 degrees to accommodate various amounts of vertical overlap of the teeth for each patient. A mounting jig, that doubles as an occlusal plane table, was used for arbitrarily mounting the maxillary cast [11].

37. The Verticulator

The Verticulator was developed by William Windish in 1960. The Verticulator consisted of two rigid members that separate and close only linearly in vertical dimension. It had a positive stop that locked in its closed position. Another model was introduced in 1962, that was able to accept full arch casts [11].

38. The Ney Articulator

The Ney articulator (Figure 19) was designed by Anthony J. De Pietro in 1962. It is an arcon instrument with no locking device between the upper and lower members for centric position. The condylar elements can be set to varying intercondylar distances. When the metal condylar elements do not follow or duplicate pantographic tracings, more precise duplication is possible

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with custom ground plastic inserts. A plastic incisal guide table or a metal incisal guide table that has a provision for creating a region of freedom centric position can be used [11].

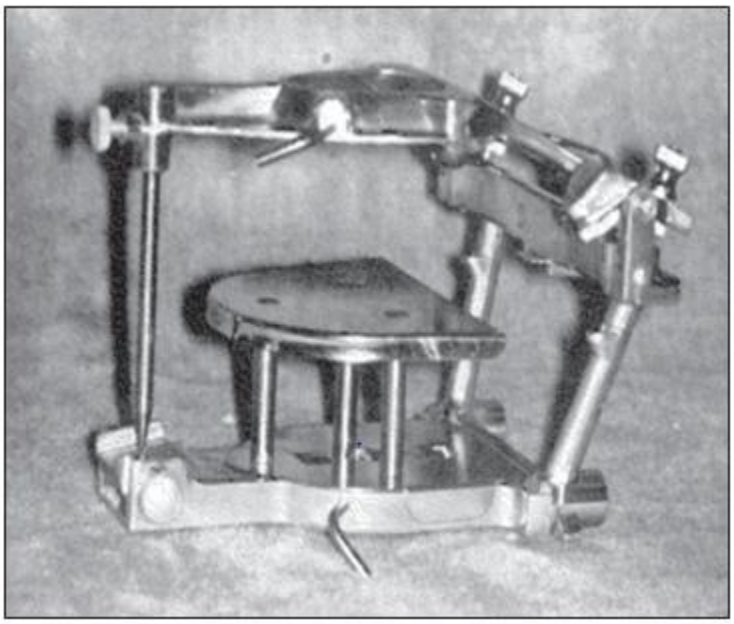

Figure 18. The Improved New Simplex Articulator [11]

Figure 19. The Ney Articulator [11]

39. The Hanau Model 130-21 Articulator

The Hanau University Series or Model 130-21 articulator was designed to be a split-axis instrument. It had a central locking device and a mechanism to keep upper and lower members together. The condylar paths and Bennett guide paths were straight. The Bennett guide paths that are located near midline did not allow for immediate side shift. It would accept all positional records but could not duplicate pantographic tracings. The incisal guide pin was designed to compensate for changes in vertical dimension. It was self tripoding in an inverted position [11].

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40. The Whip-Mix Articulator

The Whip–Mix articulator was developed by Charles E. Stuart in 1964. This was a semi adjustable arcon articulator that had three intercondylar adjustments: small, medium and large. These were selected by means of the accompanying Quick Mount face-bow that uses the external auditory meatus as a posterior landmark. This face-bow had a nasion anterior guide for establishing an anterior point of reference for maxillary cast positioning. The condylar element of the Whip-Mix articulator was adjustable about the vertical and horizontal axis but not the sagittal axis; hence it could not be set to all positional records. The condylar and Bennett guide paths were straight. There was no centric position-locking device, and the upper and lower members could not be attached mechanically [11].

41. The Simulator

The Simulator (Figure 9) was developed by Ernest R. Granger in 1968. It was a fully adjustable articulator that could be set from pantographic tracings, positional re- cords and other tracings. There were curved condylar paths, but the unique feature of this articulator was the condylar path that rotates inwardly, a broken axis and a mechanical timing element that combine to replicate mechanically the Bennett movement and Fischer's angle. The Simulator had condylar path locks that could be re- leased so that the upper member could be separated from the lower member. The incisal guide pin was curved [11].

42. The Denar Model D4A Articulator

The Denar Model D4A articulator was developed by Niles Guichet in 1963. This articulator was programmed from tracings made with a pneumatically controlled pantograph of the same company, the Denar Corp of Anaheim, California. It was a fully adjustable instrument. It had a definite centric lock and had accommodations to hold the casts in an open position. The curved incisal pin assembly could rest on a mechanical or plastic incisal guide table [1].

43. The Dentatus ARO Articulator

The Dentatus ARO articulator was manufactured by A.B. Dentatus in 1971. It had all the features of Dentatus ARL plus the unique feature of a movable arm that holds the mandibular cast. The universal joint and the locking device that attaches the movable arm to the base allowed repositioning of the mandibular cast without remounting. The gauge block was used to center the lower member to the upper member, but once the mandibular cast has been repositioned, the articulator or casts could not be inter- changed without the aid of centric relation records [11].

44. The Panadent Articulators

The Panadent System is the latest approach to dental instrumentation. The Panadent System was based on the premise that it was possible to classify individual condylar movements into groups based on the amount of precurrent side shift. The Panadent articulator was introduced in 1978. The current models were introduced in 1983. The major modification in the latest models was the Dynalink Panalock mechanical latch. This mechanism keeps the up- per and lower articular frames joined together, yet permits an opening movement of 180 degrees [11].

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Recent Advances

45. SAM

The company was founded in 1971 by Heinz Mack, a practicing dentist, in Munich, Germany. Their anatomically correct and skull related articulator system became known and identified as SAM (School Articulator Munich). These are basically arcon type of articulators. SAM developed a wide variety of articulator models, including SAM SE, SAM 2P, SAM 2PX and SAM 3. These articulators provide accurate functional simulation of mandibular movements [12, 13].

46. The Artex Articulator

This articulator was developed by *GIRRBACH DENTAL GMBH* Company and was listed in the FDA on 24th May, 1995. The ARTEX CN, that was the base model, is a non-arcon type average value articulator. The ARTEX CT is partially adjustable average-value articulator in non-Arcon design. Then came the ARTEX CP, that was partially adjustable average-value articulator with super smooth condyle track guide in Arcon design. The latest model was the ARTEX CR, that was fully adjustable average-value articulator in Arcon design. [14].

47. The Protar Articulator

Developed by the KaVo Company during the beginning of this century, the PROTAR articulators (Figure 10) offer good precision, they are cost effective and provide superior handling. Four models are available- the PROTAR, the PROTAR 3, the PROTAR 5, the PROTAR 7, and the latest model are the PROTAR 9. The PROTAR is 6.4” H x 6.6” W x 8” D and weighs 2.5 lbs. The Protar 3 has an upper member with curved sagittal and pre-set condylar guidance paths, a 45° horizontal condylar inclination, and a 15° fixed Bennett angle. The PROTAR 5 has an upper member identical to the one in the Protar 3 with the exception that it has an adjustable Bennett angle and an adjustable horizontal condylar inclination. The PROTAR 9 has an upper member identical to that of the Protar 7 with adjustable protrusion, distraction, and retrusion [15].

48. The Virtual Articulators

The latest breakthrough in the world of articulators was the introduction of the VIRTUAL articulators in 2003. This system not only simulates the temporo-mandibular joint movements in the modelling software by viewing it on the computer screen, but is also the only system that allows the dental technician to take the measurements of his/her own articulator, to scan it and to add these data to the software database. The articulator dimensions are faithfully saved in the software so as to be able to virtually articulate the models.

CONCLUSION

Articulators are devices that effort to replicate the range of movement of the jaw. The first instrument designs tried to duplicate anatomic relations or replicate functional movements of the anatomy. Additional refined articulating devices advanced as more was learned about anatomy, mandibular movements, and mechanical principles. Nevertheless, the objective was always same: to produce or replicate occlusal relations extraorally. No matter how modest or complicated an articulator may be, if the operator does not use it correctly or if it does not have the features for the basic purpose for that is used, the results will be disappointing.

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