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## Review Article

# Clinical relevance of Bennett's contribution – An overview

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### ABSTRACT

**Purpose:** Bennett movement has been extensively discussed in the literature, yet the clinical relevance of Bennett's contribution in the field of Prosthodontics and restorative dentistry remains unclear.

**Materials and Methods:** An electronic search of articles in PubMed database for relevant literature published between 1958 until present day was meticulously scrutinized with the following search terms: lateral movements or immediate mandibular lateral translation or mandibular side shift or Bennett side shift or Bennett movement.

**Results:** After conducting an extensive and in-depth review of the literature, the authors were unable to conclusively find the clinical relevance of Bennett movement. Moreover, the logical sequence could not be negated fully. For the beginners in the profession, it is desirable to incorporate this for intellectual and logical satisfaction until new research proves otherwise.

**Conclusion:** The Bennett movement have little or no clinical impact in a restorative occlusal scheme.

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## 1. Introduction

In 1908 Norman G. Bennett<sup>1</sup> published an eminent and classic article entitled 'A contribution to the study of the movements of the mandible'. In those days, it was believed that a fixed centre of rotation existed outside the condylar perimeter while making opening and closing movements.<sup>1</sup> The main objective of Bennett was to determine the validity of this belief. He made an extensive device with which two incandescent battery powered glow lamps were attached to a wire frame work which was fixed to his mandibular teeth. One lamp was fixed immediately opposite the right condyle, while the other was fixed opposite the sulcus below the lower lip (symphysis). The head was maintained in a fixed position. The images of the bulbs were focused by

means of biconvex lenses on a paper struck to the wall, and the different positions were plotted. Using the Reuleaux method of locating the instantaneous centers of rotation, he analysed his results and definitely established that no single fixed center of rotation existed, but that the center of rotation is constantly shifting. In other words during the right lateral movement of the mandible there should be an observable shifting of the right condyle outwards and slightly downwards. This has been designated in literature as the Bennett movement. Based on the tracings, Bennett concluded that a right lateral movement caused the working condyle to move laterally downward. Since a rotational movement is recorded as an arc unless the light is oriented directly over the rotational axis, this method of recording mandibular movements may provide data of questionable validity. Preiskel has observed that the phenomenon of mandibular lateral translation had been described previously

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by Bell in 1833 and Balkwill in 1866, however Bennett's name has been linked to it possibly because of the endorsement of the listeners he received at the odontological section of the Royal Society of Medicine on 27<sup>th</sup> April 1908.

Bennett movement was very much celebrated in the later years, though Bennett never had that as a primary intention. In extreme lateral movements with teeth in continuous occlusion, the working side condyles undergo an outward shift and this can be possibly a common occurrence during mastication. Towards the end of the presentation, Bennett was not at all convinced that the ideal natural articulator is a necessity for practical prosthetic dentistry. In constructing artificial dentures, we are concerned only with the smallest degrees of openings and with lateral movements with the teeth in occlusion. This accounts for a small movement of rotation and translation, combined with some lateral freedom of the correct kind, would probably be sufficient, if there were a scientific method of fixing the plane of occlusion in relation to the condyles when the normal occlusion has been lost. If Bennett was alive today, he would have wondered at the quantum of sophistication, the present day Prosthodontist has achieved, from the smallest spark he has dropped for the future thinking professionals. From an undefined articulator with frugal potentialities about which Bennett has mentioned, we have passed through different grades of adjustability of articulators and which culminated into even virtual possibilities.

## 2. Defined Bennett Movement

“The bodily lateral movement or lateral shift of the mandible resulting from the movements of the condyles along the lateral inclines of the mandibular fossae in lateral jaw movements.”<sup>1</sup> Bennett movement is considered as an important determinant of occlusion. Bennett movement is usually recorded with a pantograph - an instrument for recording and measuring the degree and direction of the border movements of the mandible. Bennett movement is divided into immediate and progressive side shift. Immediate side shift represents the mandibular side shift in which the orbiting (non-working) condyle moves straight medially in the two dimensional graphic tracings. Progressive side shift represents the mandibular side shift occurring at a rate or amount directly proportional to the forward movement of the orbiting condyle; it is essentially a straight line. Mandible is a singular bone and the side shift should be present throughout its body. On the working condyle, the immediate shift may not be manifested as prominently as in the non-working side tracings. Even in the original experiment of Bennett, this was not clearly noticed possibly due to the limitation of the experiment. Working side condyle predominantly makes a rotational movement around a vertical axis. The sum of immediate and progressive side shift equals the total Bennett movement.

Preiskel<sup>2</sup> used ultrasonic probe to find out the range of immediate side shift after evaluating 27 individuals. He has observed the side shift as  $1.04 \pm 0.71$  mm. The working side condyle rotated around the vertical axis as follows:  $1.9 \pm 1.36^\circ$ . Most of the future studies centered round Bennett angle because it was evident graphically.

## 3. Landa Questions Bennett

For a long time, Bennett was unquestionably accepted may be because of the limitations of conceptual understanding. Later Landa undertook detailed experiments. He examined 175 skulls and could get convinced of the presence of Bennett movement only in three specimens. He made an observation that when the mandibular condyle rotates around its vertical axis on the working side, the lateral pole becomes more conspicuous. Landa is of opinion that this is interpreted as Bennett movement. Landa<sup>3,4</sup> further studied the condyles by dissecting the temporomandibular joint of cadavers. In some dissections the superior aspect of the condyle was exposed, while in others the lateral aspect was exposed. Observations and measurements were made using custom made instruments and Bennett movement could not be established convincingly. On radiographic evaluation of the Bennett movement, Landa expresses much reservation since it was difficult to compare the positions of mandible both in centric and working positions through tracings because of limitation in the radiographic facilities available during Landa's time. Bennett perceived that ‘considerable movement of the condyle outwards away from its articular surface and slightly downwards’ could not be established in comparative radiographic tracings made by Landa. It is logically difficult to prove the existence of lateral shift of condyles in lateral view radiographs. Landa subjected himself to Cinefluorographic evaluation but could not get satisfactory evidence for the Bennett's movement. Probably it may be due to the limitation of the view selected and the technique used.

In contrast, Issacson<sup>5</sup> did a clinical study on the Bennett movement using 26 patients, with a gnathograph. The gnathograph was developed by the Gnathological Society of California for the purpose of accurately recording excursive mandibular movements. Issacson concluded that all the patients had Bennett movement in at least one condyle. It is a rarity to find a patient without Bennett movement.

## 4. Radiographic Evaluation

It is interesting to note that, even though advancements in CT has happened, the measurement of lateral side shift of the working side condyle during the lateral excursions were not precisely determined. Fanucci's<sup>6</sup> evaluation using 64 slice CT scanner is measuring the Bennett angle and comparing it with that obtained from the articulator. The lateral movement of the whole mandible which is designated

as Bennett movement is estimated to be no greater than 2 to 3 mm. Goldenberg<sup>7</sup> has related the loss of occlusion with the lateral side shift and has found no correlation between side shift and occlusal contact. The side shift measured by Goldenberg ranges between 0.3 and 0.4mm. Lundeen et al.<sup>8</sup> have found the average Bennett shift as about 0.75mm.<sup>9</sup>

### 5. Physiology of Bennett Movement

Sicher (1954)<sup>10,11</sup> explained the Bennett movement to illustrate the principle of split-second timing of muscle action. He stated that in a right lateral movement, the left lateral pterygoid muscle is the prime mover while the posterior bundles of the right temporal muscle contract in order to hold the right condyle in place so that the mandible can rotate around it. Furthermore, the contraction of the retracting fibers of the right temporal muscle occurs after an initial swing of the entire mandible laterally and anteriorly to avoid strain in the capsule that would be caused by a rotation of the resting condyle in situ. This time lag between contraction of the left lateral pterygoid muscle and the right temporal muscle is responsible for the Bennett movement.

### 6. How Bennett Movement is Integrated in Semiadjustable Articulator

The semi adjustable articulator should have facilities to make both immediate and progressive side shifts. Condylar element allows a central axis to slide through. The sliding will be equivalent to the immediate side shift and it will be evident on the working side. On the non-working side the condylar housing can be rotated (0 to 30<sup>0</sup>) to incorporate the progressive side shift. On the working side both immediate and progressive side shifts will be seen as sliding of the axis. When the non-working side condylar housing is rotated, the condylar element presses on the shoulder present in the central axis and that causes sliding of the axis equivalent to progressive side shift. In the articulator, both the immediate and progressive shifts cannot be distinguished but it is carefully integrated; on the working side only axis-condylar element sliding is visible for both immediate and progressive side shifts whereas on the non-working side sliding of the axis along with translation of the condylar element occurs.<sup>12</sup>

### 7. Clinical Importance of Bennett Side Shift

Bennett side shift had many synonyms like side shift, immediate side shift and Bennett shift but in the recent literature, this phenomenon is popularly described as immediate mandibular lateral translation (IMLT). Clinical research into IMLT has been very limited. A few authors have stated that there is no clinical significance whereas some others have argued that IMLT must be recorded and accounted for in the fabrication of all dental restorations.<sup>8</sup> Tupac recommended the use of

assisted mandibular movements for recording mandibular movements and programming the articulators.<sup>13</sup> The argument against this recommendation has been that assisted or forced border movements are not reproducible without external guidance and therefore are artificial and of no clinical relevance. Others demonstrated that the clutch angle and the location of the recording table relative to the terminal hinge axis altered IMLT recordings.<sup>14</sup> No specific harmful or beneficial clinical effects for patients in incorporating IMLT has been reported, other than the passing reference that if not incorporated it would alter cuspal pathways in restored occlusal anatomy. Adverse clinical outcomes such as extensive occlusal adjustments, compromised occlusion or harm to temporomandibular joint have also not been reported. Current scientific evidence does not support the need to include IMLT as a factor when prosthodontic or restorative treatment is planned and executed.<sup>15</sup>

### 8. Conclusion

1. Bennett movement and its expression, to a greater extent depend on the experience of the operator in assisting the patient during the clinical procedural execution. Inducing Bennett movement has a pronounced effect on the immediate side shift component than it has on the progressive side shift component. Operator assistance has a significant effect on older individuals.
2. Immediate mandibular lateral translation (IMLT) does not enjoy a clear cut support of evidence to be included as an important factor in the planning and execution of prosthodontic or restorative treatment. Still the terminology creates much confusion to the students and in the later stages of their professional life they do not find much clinical relevance. The effect of IMLT on the occlusal scheme would be in the width of the central fossa and the ridge and groove direction on the molar teeth. There is no evidence of adverse clinical events as a result of not including IMLT in a restorative occlusal scheme. In this context it is justifiable to question the necessity of attempting both to record immediate mandibular lateral translation on the average patient and reproduce it on an articulator.
3. Hanau's formula even though it is difficult to explain, it is a good option for the novice prosthodontist to incorporate the IMLT in the clinical instrumentation. If the horizontal angle is found out from a protrusive record, Bennett angle can be incorporated simply by the formula without making any further tracing and records.
4. Like most muscle controlled movements, each subject will have an individual pattern of condylar movement. Apparently, temporomandibular joint does not produce any discernible guidance, but contacts

of the opposing teeth produced significant effects on condylar movement.

5. There is a lacuna in identifying the mandibular movements using advanced radiographic techniques presently available. Now there is no scope for relying on crude experiments or on mathematical deductions. Future research should be moved in this direction.

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## 10. Conflict of Interest


None declared.


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