

# Integrating the Theories of Occlusion and Demystifying the Curve of Wilson and the Curve of Spee – From a Prosthodontic Standpoint- A Review

Janani S

<sup>1</sup>Assistant Professor, Department of Prosthodontics Vinayaka Missions Sankarachariyar Dental College, Sankari Main Road, Ariyanoor, Salem, Affiliated to Vinayaka Missions Research Foundation, Salem

**How to cite this article:** Janani S. Integrating the Theories of Occlusion and Demystifying the Curve of Wilson and the Curve of Spee – From a Prosthodontic Standpoint- A Review. Indian Journal of Contemporary Dentistry / Vol 14 No. 1, January - June 2026

## Abstract

**Purpose:** This article aims at a comprehensive review of the fundamental occlusal curves, Curve of Wilson and Curve of Spee from an anatomical, theoretical, and clinical perspective. To bridge the gap between historical concepts and contemporary prosthodontics, it revisits Bonwill's theory, Hall's conical theory, and Monson's spherical theory to understand the depth of anatomic and functional correlations for current clinical implications.

**Methodology:** The methodology included a structured literature search that included historical and recent articles. The inclusion criteria consisted of original articles of Monson and Wilson, peer-reviewed articles and textbooks pertaining to the topic.

**Results:** The original concepts were thoroughly analyzed, and conclusions were drawn based on geometric interpretations. The article then introduces an integrative occlusal model grounded in premolar anatomy, proposing a unified occlusal model. This re-evaluation has led to the introduction of the concept of 'Sphere of Wilson,' that takes into consideration, the maxillary first premolars as critical determinants of the mediolateral curve that is convex upwards and forms a segment of a sphere that aligns with functions of the orofacial complex.

**Conclusion:** This article encourages the development of an occlusal model as a dynamic concept that represents mandibular movements, centric and eccentric movements and its biomechanical interpretation. By correlating historical theories with contemporary anatomical and biomechanical insights, the article not only clarifies prevailing misconceptions but also sets the framework for further research. The article concludes with an emphasis on the role of visual three-dimensional dynamic mandibular movements and anatomical relevance in redefining the occlusal concepts.

**Keywords:** Occlusion; Bonwill's theory; Monson's spherical theory; Hall's conical theory Curve of Wilson; Curve of Spee; Curve of Monson; Integral occlusal model

---

**Corresponding Author:** Janani S, Assistant Professor, Department of Prosthodontics Vinayaka Missions Sankarachariyar Dental College, Sankari Main Road, Ariyanoor, Salem, Affiliated to Vinayaka Missions Research Foundation, Salem

**E-mail:** drjanani2024@gmail.com

**Submission:** Feb 7, 2026

**Revision:** March 18, 2026

**Published date:** May 1, 2026

---

## Introduction

In an era where cutting-edge sciences such as quantum physics are being applied in dentistry, prosthodontics is on the verge of a significant transformation. The advances in three-dimensional (3D) imaging and spatial visualization technologies now offer unprecedented opportunities to model and analyze the geometric complexities of mandibular movements. These tools have the potential to revolutionize diagnosis, treatment planning, and prosthetic fabrication, ultimately improving patient outcomes. However, to fully leverage these advancements, it is imperative to revisit the fundamental principles that have historically guided prosthodontic practice. The foundational work by Monson, Wilson, and other pioneers remains critical in understanding the complex anatomy and biomechanics of occlusion. Their concepts of occlusal curves and mandibular movements, such as the Curve of Wilson, Curve of Monson and the Curve of Spee provide essential geometric frameworks that form the basis of contemporary prosthodontics.

Despite the emergence of new technologies, many clinical misconceptions and inconsistencies persist regarding these occlusal theories and their significance.

This article aims to integrate the theories of occlusion and demystify the often-misunderstood Curve of Wilson and the Curve of Spee. By harmonizing anatomical facts with advanced prosthodontic concepts, this article aims to provide a clear, unified framework that supports both theoretical understanding and practical application of occlusal dynamics in contemporary prosthodontics.

## Methodology

This narrative review aims to integrate classical and contemporary theories of occlusion namely Bonwill's Triangle, Monson's Sphere, and Hall's Conical Theory through a conceptual framework grounded in premolar anatomy and three-dimensional mandibular dynamics. A structured literature search was conducted using databases

such as PubMed, Scopus, Google Scholar, and Web of Science. The search terms included "Bonwill triangle," "Monson sphere," "Hall conical theory," "Curve of Wilson," "Curve of Spee," "Occlusion theories," and "Mandibular dynamics." Both historical and recent sources from the year 1858 to 2007 were included to trace the evolution of these theories.

The inclusion criteria consists of peer-reviewed articles, textbooks, and authoritative prosthodontic reviews that elaborated on the geometric, anatomical, and clinical interpretations of occlusal curves. Articles lacking scholarly depth or clinical relevance were excluded. Randomized control clinical trials and case series were not included. The key conceptual elements were extracted from the selected sources, charted, and comparatively analyzed. The synthesis was interpretative and integrative rather than statistical, aiming to reformulate occlusal theory in prosthodontics. The methodological approach emphasized anatomical consistency, functional traceability, and biomechanical feasibility. This approach allowed for the formulation of a unified prosthodontic framework that respects historical concepts while addressing gaps in their anatomical correlations and clinical applications.

## Bonwill's Geometrical and Mechanical Laws of Articulation

In the words of Bonwill himself "One point of very great importance, has not been laid down in general or special anatomy, peculiar tripod arrangement of lower jaw, forming an equilateral triangle. From the center of one condyloid process to the other, the average distance is four inches, and from the same center of the condylar process to the point where the lower central incisors touch the cutting edge is also four inches".<sup>1</sup> The jaw forms a perfect triangle for the purpose of bringing into contact the largest amount of grinding surface of the premolars and molars and at the same time to have all the incisors come into action during these lateral movements. He goes on to quote that "The study of no other part of the human body will give one clearer idea of infinite wisdom."

From this it must be understood that Bonwill's theory does not conform itself to the equilateral triangle, but indeed a larger part of the Sphere of Monson, incorporating the mediolateral curves that includes the Curve of Monson and the Curve of Wilson as more emphasis is given for the lateral mandibular movements.<sup>2</sup> As he rightly said mandibular movements are complex and dynamic involving the orbital path of Curve of Spee, Spherical curve of Monson and Wilson.<sup>3</sup> The temporomandibular joint and the actions of the muscles of mastication make it even more complex so that we must identify the muscle vector actions, considering the magnitude and direction of each vector. Forming the basis of understanding mandibular movements lies. The planes and axes along which the mandible moves forms the understanding of mandibular movements.<sup>4</sup>

On observing the sagittal side of the mandible, it is observed that the frontal plane is tilted slightly backwards, and the transverse plane intersects the frontal plane, that forms the true transverse hinge axis. From this axis, starts the rotation of the condyle during protrusive and lateral movements.<sup>5</sup> This inclined frontal and transverse planes forms the foundation of biomechanical mandibular movements. Now if the arc of the mandibular opening is traced backward, it forms a component of the Sphere of Monson.

Compensatory curves are incorporated into the complete denture to achieve balanced occlusion. These are artificial counterparts to the Curve of Spee and Curve of Wilson present in the natural dentition, wherein the Antero-posterior curve corresponds to the Curve of Spee, and the Medio-Lateral curve corresponds to the Curve of Wilson.<sup>6</sup>

### **The Curve of Wilson**

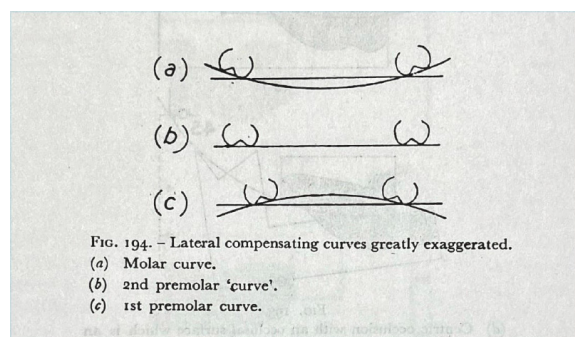
The Glossary of Prosthodontic terms 9th edition states that Curve of Wilson: 1. eponym for the mediolateral curve; in the theory that occlusion should be spherical, the curvature of the cusps as projected on the frontal plane expressed in both arches; the curve in the mandibular arch being concave and the one in the maxillary arch being convex.<sup>7</sup>

There is a wide misconception in the literature regarding the Curve of Wilson. In the textbook Wilson GH, A Manual of Dental Prosthetics, there are references to the mediolateral curve, but exactly who coined the term Curve of Wilson remains a mystery. Okeson and Dawson have stated that the maxillary teeth are buccally inclined, and the mandibular teeth are lingually inclined and thereby the Curve of Wilson is concave in the lower and convex in the upper and further goes on to add that in occlusion both the curves could merge.<sup>8,9</sup> It is geometrically impossible as they can only intersect and cannot merge, so it is important to correlate the principles of teeth setting and compensatory curves for better understanding and evaluation of the same. Let us consider the principles of teeth setting from Fenn, Clinical Dental Prosthetics.<sup>10</sup>

In the case of mandibular first molar the teeth are inclined to the lingual and mesial, in mandibular first premolar the lingual cusp is below the horizontal plane and the buccal cusp is 2mm above it, which conforms to the mediolateral curve being concave in the mandibular arch.

In case of maxillary first molar the teeth are inclined to the buccal and distal, so if a curve must be incorporated connecting the cusp tips, it will be concave as in the case of maxillary molar and not convex and that is where the misconception has occurred.

In case of the maxillary first premolar, the buccal cusp contacts the horizontal plane, but the lingual cusp is 1-2 mm above. So, the convexity of The Curve of Wilson naturally conforms only to the maxillary first premolar. It is erroneous that many studies have conducted to evaluate The Curve of Wilson in the maxillary molar, and these misconceptions in literature must be clarified for further authentication in teaching and research. It could be hypothetically proposed that there is a Sphere of Wilson which would be the downward compartment for the Sphere of Monson that encompasses the dynamic mandibular movements. Figure 1: Curve of Wilson



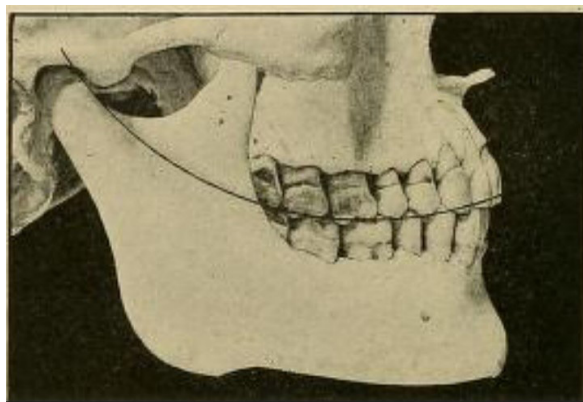
**Figure 1: Curve of Wilson**

Source: Fenn, Clinical Dental prosthetics, 1989

### The Curve of Spee

"The Curve of Spee is an imaginary one and is described as a segment of the circle which begins the incisal edges of the lower incisors, passes over the crest of the buccal cusps of the lower premolars and molars, and ends in the anterior border of the condyloid process."<sup>11</sup>

It is important to note that the Curve of Spee originally arises from the incisal edges of the lower incisors, whereas in the current literature, it is misinterpreted as starting from the cusp tip of the canine, this misconception makes it difficult to understand the curve as a segment of the Sphere of Monson. The end of the curve is also no exception, as it is misinterpreted as ending in the anterior border of the ramus of the mandible whereas it ends at the anterior border of the condyloid process.<sup>12</sup> Figure 2: Curve of Spee

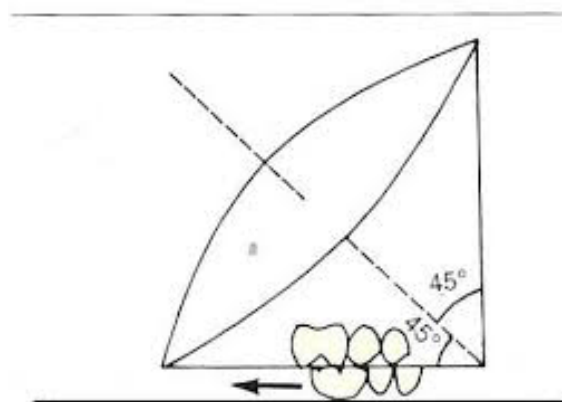


**Figure 2: Curve of Spee**

Source: A Manual of Dental Prosthetics Wilson G.H 1920

### Hall's Conical Theory of Occlusion

In 1915, Rupert E. Hall introduced the Conical Theory of Occlusion, proposing that mandibular movements could be conceptualized as occurring over the surface of a cone. Specifically, he suggested that the lower teeth move over the upper teeth as if traversing a conical surface with a generating angle of 45 degrees, and the cone's central axis also inclined at 45 degrees to the occlusal plane.<sup>13,14</sup> This geometric model aimed to replicate the natural paths of mandibular motion, facilitating balanced occlusion in prosthodontic applications. To functionalize his theory, Hall developed the Hall Articulator, an instrument designed to simulate mandibular movements based on the conical model.<sup>15</sup> This articulator was notable for being the first to feature an incisal guide table with adjustable lateral wings, allowing for more precise replication of mandibular dynamics. While Hall's Conical theory provided a geometric perspective on occlusion, it was eventually overshadowed by more comprehensive models, such as Monson's Spherical Theory. Nonetheless, Hall's work represents a significant step in the evolution of occlusal theories, emphasizing the importance of geometric considerations in understanding mandibular movements. Figure 3: Hall's Conical theory



**Figure 3: Hall's Conical theory**

Source: Babita Yeshwante A Classification Of Articulators- A Review Article International Journal of Dental and Health Sciences Volume 04, Issue 03

### Monson's Spherical Theory of Occlusion

Dr. George S. Monson introduced his spherical theory of occlusion in 1918, published in "Dental Cosmos". He proposed that the occlusal surfaces of teeth conform to a segment of a sphere with a radius of approximately 4 inches (10.16 cm), with the center located near the glabella. This anatomical center roughly corresponds to the mid-cranial region.<sup>16</sup>

Monson's theory was an evolution of earlier geometric models, notably integrating Bonwill's Triangle and Hall's Conical Theory into a more harmonious, spherical arrangement. The mandibular teeth, according to this model, articulate against the maxillary teeth such that their occlusal surfaces follow the curvature of this sphere. This ensures balanced contact during all excursive mandibular movements. The theory gained importance in the

early 20th century for its capacity to simplify the complex biomechanical interactions of occlusion, and it laid the foundation for the design of Monson's articulator.

Despite its utility, Monson's theory is limited by its geometric idealism as anatomical variation often deviates from the assumption of a uniform spherical radius. Additionally, the theory's static nature does not accommodate the dynamic, neuromuscular, and adaptive mechanisms of the stomatognathic system. Nevertheless, Monson's model retains educational and conceptual value, especially in understanding the Curve of Wilson and Curve of Spee as complementary segments of the sphere of Monson. Its principles continue to influence the arrangement of posterior teeth and the development of occlusal schemes in prosthodontics. Figure 4: Curve of Monson

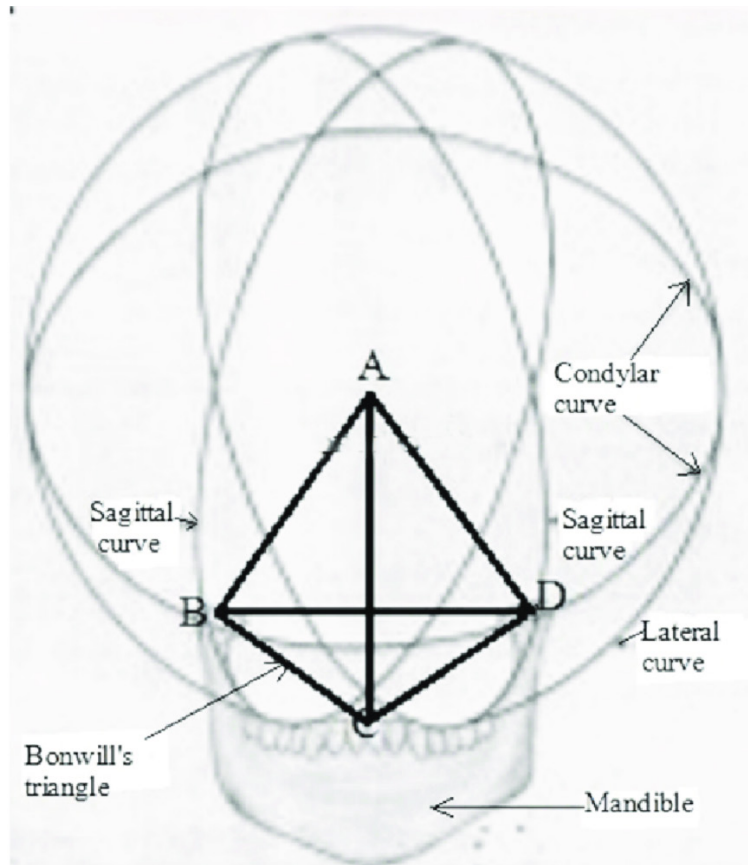


Figure 4: Curve of Monson

Source: Loto AO. Dental occlusion: A newly proposed tetrahedral theory of occlusion. *Edorium J Dent* 2017; 4:26-35

## Results

### Integral Occlusal Model for Prosthodontic Acceptance- Towards a Unified Spatial Model of Occlusion

The challenge in prosthodontics today lies not in the absence of theoretical models, but in the fragmented, often compartmentalized understanding of them. Bonwill's triangle, Monson's spherical theory, the Curve of Wilson, and the Curve of Spee have each provided critical geometric insights into mandibular movement and occlusal function.<sup>17</sup> However, their clinical utility has been diluted by false interpretations and isolated teaching. A truly integral occlusal model must integrate these theories within a unified spatial framework.

Bonwill's triangle forms an equal 4-inch distance between the condyles and from the condyle to the mandibular central incisor establishing a basal geometric orientation. When extended vertically, this triangle becomes a dynamic pyramid, with the condyles forming the posterior base and the incisal point as the anterior apex. This structure, when viewed in motion, aligns with Posselt's envelope and becomes a spatial orientation for mandibular dynamics. Monson's spherical theory, with its imaginary 8-inch radius sphere centered near the glabella, adds a third-dimensional curvature that complements Bonwill's triangular base. Meanwhile, the Curve of Wilson, represented by the mediolateral inclination of posterior teeth, completes the triplanar understanding of occlusion, particularly when visualized in harmony with the inclined frontal plane.

The Curve of Spee, often misunderstood as a mere sagittal arching of posterior teeth, in fact holds kinetic importance in protrusive movements.<sup>18</sup> Fenn's principles of teeth setting, which emphasize both esthetic harmony and functional occlusion, further validate these curves as more than just geometrical constructs. An integral occlusal model, therefore, must treat these curves not as separate entities but as parts of an interconnected spatial matrix. The interplay of condylar guidance, incisal

guidance, and cusp inclines must be assessed dynamically, not statically. In this model, mandibular movement is not just rotational or translatory but pyramidal guided by both anatomical boundaries and muscular vectors.<sup>19</sup> The vertical axis through the symphyseal region becomes a reference for mediolateral balance, while the hinge axis migrates with each Bennet shift. Such a unified model has profound clinical implications as it can guide the occlusal rehabilitation of worn dentition, inform implant occlusion protocols, and refine complete denture prosthodontics for enhanced balance and function. As we enter an age of digital articulators and virtual occlusion, anchoring innovation to this anatomical-geometric foundation is essential. This integral model aims to bridge the classical and the contemporary, offering a prosthodontic blueprint that is both theoretically sound and clinically viable.

## Discussion

The evolution of occlusal theories reflects not only the advancement of prosthodontics but also the struggle to reconcile static anatomical references with dynamic mandibular movements. The integral model proposed uniting Bonwill's triangle, Monson's sphere, the Curve of Wilson, and the Curve of Spee demands more precision in diagnosis and treatment planning.

Historically, these individual theories have often been taught in isolation, Bonwill as a geometric basis, Monson as a philosophical ideal, Spee and Wilson as textbook curves rather than functional determinants.<sup>20</sup> This approach has led to confusion among students and oversimplification in practice. However, when interpreted together, these models are not merely theoretical constructions but complementary components of a spatially coherent system. Bonwill's triangle forms the horizontal plane; Monson's sphere incorporates the Curve of Spee that outlines the sagittal trajectory of mandibular motion; and the Curve of Wilson in relation to maxillary first premolar ensures mediolateral balanced occlusion.<sup>21</sup>

The current digital revolution in prosthodontics with its virtual articulators, 3D printed occlusal

schemes, and AI-generated tooth morphologies demands precision not just in measurement but in theoretical foundation. Our proposed model, rooted in time-tested anatomical truths and enhanced by modern interpretation, serves to bridge the fragmented understanding of occlusion into a unified, three-dimensional matrix that can guide diagnosis, design, and rehabilitation.

The integrative occlusal model proposed in this article offers a geometrically and anatomically grounded reinterpretation of the Curve of Wilson and Curve of Spee, building upon the foundational theories of Bonwill, Hall, and Monson.<sup>22</sup> While historical models have provided valuable insights into mandibular movement, many have lacked an anatomically detailed emphasis on the premolar region, often the fulcrum of occlusal balance in both natural dentition and prosthodontic rehabilitation. By focusing on the premolars as pivotal elements, this model presents an updated perspective with greater clinical relevance.

In contemporary prosthodontic practice, the demand for predictable treatment outcomes underscores the need for models that are both biomechanically coherent and didactically intuitive. The current model addresses this by synthesizing occlusal curves with three-dimensional mandibular dynamics, while maintaining reference to anatomical constants such as the symphyseal axis and condylar geometry.

Furthermore, the model holds promise for integration into digital workflows. As virtual articulators become more prevalent, the translation of anatomically grounded theories into software algorithms will be critical. The geometric clarity of the integral model makes it a suitable candidate for incorporation into digital design platforms, potentially aiding in the generation of occlusal surfaces that harmonize functionally with mandibular movement trajectories. Finally, the pedagogical utility of this model cannot be overstated. It offers postgraduates and clinicians an opportunity to bridge the gap between historical occlusal theory and modern clinical expectations, fostering a deeper

understanding of how form, function, and geometry coalesce in occlusion.

The future of occlusion lies not in discarding the past, but in illuminating it with a unified perspective. The clinical success of prosthodontic intervention depends not only on the materials or mechanics employed, but on the theoretical clarity that precedes it. This paves way for the integration of traditional occlusal concepts with the tools of contemporary dentistry promising a new phase of precision-guided prosthodontics.

## Conclusion

The field of prosthodontics stands at a crucial point of intersection between classical prosthodontic theory and modern digital planning. As this article has sought to illustrate, a fragmented understanding of occlusal curves and theories undermines both clinical effectiveness and educational clarity. By integrating the spatial geometry of Bonwill's triangle, the curvature of Monson's sphere, and the functional relevance of the Spee and Wilson curves, we propose a unified model that honors the historical roots of occlusion.

This approach not only aids in more precise prosthodontic rehabilitation but also provides a scaffold for rethinking occlusal concepts in the age of digital dentistry. It offers a coherent, three-dimensional understanding of mandibular functions that enhances theoretical understanding and clinical implementation. Furthermore, it encourages advanced research in occlusal biomechanics, digital simulation, and occlusal design protocols. In conclusion, the integration of historical occlusal theories into a unified, spatially valid, and clinically relevant framework is not just an academic exercise. It is a necessary evolution that bridges centuries of prosthetic and anatomic literature with the precision demands of modern-day prosthodontics. The integration of theories of occlusion paves the way for biomechanical understanding of the concepts of occlusion and application of the same in clinical practice.

**Source of Funding:** None.

**Conflict of Interest:** None

## References

1. Bonwill GH. The geometry of the human jaw. *Dental Cosmos*. 1858; 1:913-925.
2. Christensen GJ. The Bonwill triangle and its clinical applications. *Journal of Prosthodontics*. 2001;10(2): 87-92.
3. Christensen GJ. Bonwill's triangle revisited. *Journal of Prosthodontics*. 2005;14(5):293-298
4. Carr AB, Brown DT. *McCracken's Removable Partial Prosthodontics*. 13th ed. St. Louis: Elsevier; 2016.
5. Wright RF. The effect of occlusal curvature on condylar guidance. *Journal of Prosthodontics*. 1997;6(4): 290-296.
6. Ash MM Jr, Nelson SJ. *Wheeler's Dental Anatomy, Physiology, and Occlusion*. 9th ed. Philadelphia: Saunders; 2003.
7. Orig, George H. Wilson, dentist, Ohio, U.S. A., 1855-1922 Wilson GH. *A manual of dental prosthetics*. Philadelphia Lea & Febiger, 1911:22-37
8. Dawson PE. *Functional Occlusion: From TMJ to Smile Design*. 1st ed. St. Louis: Mosby; 2007.
9. Okeson JP. *Management of Temporomandibular Disorders and Occlusion*. 8th ed. St. Louis: Elsevier; 2013.
10. Fenn, H.R.B, K.P Liddelow, A.P.Gimson, *Clinical Dental Prosthetics*. Second edition, 1989
11. Wilson G.H *A Manual of Dental Prosthetics*. 1854- 1908
12. Weinberg LA. The curve of Spee: Its nature and significance. *Journal of Prosthetic Dentistry*. 1971;25(2):171-181.
13. Hall RE: The Hall articulator, in Ottolengui R (ed): *Transactions of the Panama-Pacific Dental Congress*, Vol. II. San Francisco, CA, Panama-Pacific Dental Congress, 1915, 520-521
14. Hall RW. The conical theory of occlusion. *Journal of Prosthetic Dentistry*. 1950;1(1):25-30.
15. Edgar N. Starcke, DDS, *The History of Articulators: A Critical Review of Articulators Based on Geometric Theories of Mandibular Movement*, Part II: Rupert Hall's Conical Theory. *Journal of Prosthodontics*, Vol 11, No 3 (September), 2002: 211-222
16. Monson G. The sphere of Monson and its relation to occlusion. *Journal of the American Dental Association*. 1918;5(2):175-179.
17. Murray GM, Landtwing N. The kinematics of the mandible. *Journal of Dental Research*. 1990;69(5): 1477-1482.
18. Lundeen HC. The curve of Spee and curve of Wilson: Their role in occlusion. *The Journal of Prosthetic Dentistry*. 1964;14(3):345-353.
19. Granger ML. The biomechanics of mandibular movement. *Journal of Oral Rehabilitation*. 1996;23(5):303-310.
20. Kelly J, Lundeen HC. The significance of occlusal curves in prosthodontics. *Journal of Prosthetic Dentistry*. 1981;46(5):523-528.
21. Tanne K, McNeill C, Sakuda M. Mandibular movement and function. *Journal of Prosthetic Dentistry*. 1991;66(1):12-20.
22. Watanabe T, Ohtsuka M. Clinical relevance of Bonwill's triangle. *Japanese Journal of Prosthodontics*. 1993;37(2):97-102.