

Occlusal Plane Analyzers – A Review

¹Dr P.K.Monika, Postgraduate student, Department of prosthodontics, Lenora institute of dental sciences, NTR University, Andhra Pradesh.

²Dr B.L.Rao, Professor & Head, Department of prosthodontics, Lenora institute of dental sciences, NTR University, Andhra Pradesh

³Dr T.S.V. Satyanarayana, Reader, Department of prosthodontics, Lenora institute of dental sciences, NTR University, Andhra Pradesh.

⁴Dr Pratyusha, Senior Lecturer, Department of prosthodontics, Lenora institute of dental sciences, NTR University, Andhra Pradesh.

⁵Dr Jibi Joseph, Postgraduate student, Department of prosthodontics, Lenora institute of dental sciences, NTR University, Andhra Pradesh.

⁶Dr P.S.H.L.Parvathi , Postgraduate student, Department of prosthodontics, Lenora institute of dental sciences, NTR University, Andhra Pradesh.

Corresponding Author: Dr P.K.Monika, Postgraduate student, Department of prosthodontics, Lenora institute of dental sciences, NTR University, Andhra Pradesh.

Citation of this Article: Dr P.K.Monika, Dr B.L.Rao, Dr T.S.V. Satyanarayana, Dr Pratyusha, Dr Jibi Joseph, Dr P.S.H.L.Parvathi , “Occlusal Plane Analyzers – A Review”, IJDSIR- September - 2020, Vol. – 3, Issue - 5, P. No. 564 – 571.

Copyright: © 2020, Dr P.K.Monika, et al. This is an open access journal and article distributed under the terms of the creative commons attribution noncommercial License. Which allows others to remix, tweak, and build upon the work non commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

Type of Publication: Review Article

Conflicts of Interest: Nil

Abstract

Aim: This study was aimed to review the role of Occlusal Plane Analyzers (OPA's) in Prosthodontics, and mainly it's role in Fixed Prosthodontics.

Methodology: A systematic literature search was performed electronically and also hand-searched with the terms of Occlusal Plane Analyzers (OPA's), OPA's in Prosthodontics, Broadrick’s Occlusal Plane Analyzer (BOPA). The search was restricted to full-text articles published in the English language. The search was carried

out through Medline via Pubmed, Wiley online library, Ebscohost, Science Direct as well as the Google Scholar for articles published from 1990 to 2019. A total of 34 articles were found. Finally, a total of 20 articles were found relevant to the topic. Articles selected were critically appraised to evaluate their quality.

Results: Different articles described the role of Occlusal Plane Analyzers (OPA's) in Prosthodontics, and mainly it's role in Fixed Prosthodontics. The literature search

revealed 8 articles in PMC and 8 in Google search. Additional 4 articles were identified by hand search.

Conclusion: Occlusal Plane analyzers are an immense aid when treating cases that need Full Mouth Rehabilitation because assessing the occlusal plane is the first step towards a functionally and esthetically satisfactory result, thereby directly influencing the patient's quality of life.

Keywords: BOPA, Broadrick Occlusal Plane Analyzer, Occlusion, occlusal plane, occlusal plane analyzer.

Introduction

The term plane is usually associated with a flat surface. But with the occlusal plane, this is not true. According to the GPT, the term plane refers to a three-point flat surface, while the term occlusal plane refers to the average plane formed by the incisal and occlusal surface of teeth; generally, this is not a plane but rather the planar mean of the curvature of these surfaces.[1]

The determination of the occlusal plane in particular in Fixed prosthodontics plays an important role in the functional and esthetic recovery of the patient, in particular when restoring or rebuilding most of the posterior teeth is necessary. Posterior teeth positions are defined by 2 curves, an antero posterior curve, referred to as the curve of Spee (The Curve of Spee/von Spee's curve/Spee's curvature is defined as the curvature of the mandibular occlusal plane beginning at the tip of the lower incisors and following the buccal cusps of the posterior teeth, continuing to the terminal molar). The mediolateral curve referred to as the curve of Wilson (The Curve of Wilson is the mediolateral curve that contacts the buccal and lingual cusp tips on each side of the arch. It results from an inward inclination of the lower posterior teeth, making the lingual cusps lower than the buccal cusps on mandibular arch).[2,3]

Direct analysis of natural teeth through selective grinding and indirect analysis of facebow-mounted casts with properly set condylar pathways, and indirect analysis using the Pankey-Mann-Schuyler (PMS) approach using the Broadrick occlusal plane analyzer (BOPA) are 3 most widely used methods of determining a suitable occlusion plane. When restoration of all or most of the posterior teeth is needed, the PMS technique using BOPA offers an easy and useful method in determining the preliminary occlusal plane in the diagnostic casts[4].

The cusp tips of the posterior teeth are located by using Occlusal Plane Analyzers(OPA). It can also demonstrate how much significant reduction of tooth or addition of porcelain is necessary to idealize the occlusal plane.[4] This review paper aims to introduce and use this technique in clinically relevant situations to the reader with different types of occlusal plane analyzers and to establish the correct curve of spee for the occlusal plane.

Material and Methodology

PubMed/Medline were the electronic resources used to review the biomedical literature, using the following keywords:

BOPA, Broadrick Occlusal Plane Analyzer, Occlusion, occlusal plane, occlusal plane analyzer. The search was restricted to full text articles published in English language. A total of 34 articles were found relevant to the article. After first-level screening articles were selected for the review on the basis of title and abstract. . Then, full texts of selected articles were studied and relevant articles were selected to be included in this review. A total of 20 articles were found relevant to the topic, with publication dates ranging from 1990 to 2019. Articles selected were critically assessed to evaluate their quality.

Types of Occlusal Plane Analyzers

3 types of occlusal plane analyzers are named as follows:

1. **BOPA** (Broadrick Occlusal Plane Analyzer)

2. COPA (Customized Occlusal Plane Analyzer)

3. SOPA (Simplified Occlusal Plane Analyzer)

BOPA (Broadrick Occlusal Plane Analyzer)

Dr Lawson Broadrick developed an instrument in 1963 to guide the most effective position and orientation of the posterior occlusal plane. Its goal was to allow the curve of Spee to be rebuilt in harmony with incisal and condylar guidance[5].

The Broadrick Flag enables the arrangement of the Curve of Spee to be in perfect harmony with the anterior condylar

guidance, which enables absolute posterior mandibular disocclusion of the tooth during protrusion[6]. This results in the esthetic role of the mandibular incisors and their proper functioning[6]. The flag-like component of Broadrick's Occlusal Plane Analyzer is attached superiorly to the upper member of an articulator. The method employs the Monson spherical theory of occlusion principle in order to construct the occlusal plane.

Monson suggested that a three-dimensional sphere be part of the Anteroposterior curve, the centre of rotation of which is located in the Glabella region. The radius of this curve, as proposed by Monson, is approximately 4 "(10.4 cm)[4].

The Broadrick's Occlusal Plane Analyzer comprises of a [7] (Fig.1):

1. Card Index.
2. Bow Compass with graphite leads with an extra centre point and needlepoint.
3. Scribing knife.
4. Plastic Record cards.

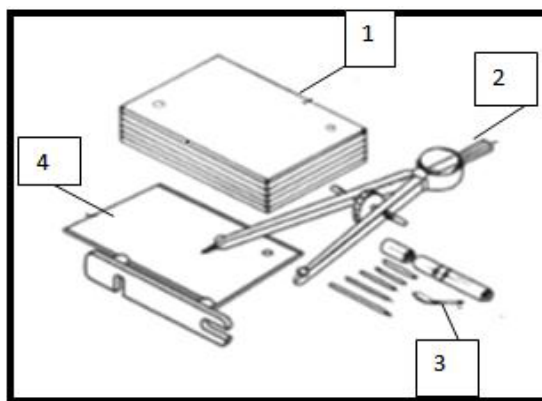


Fig 1: Parts of BOPA

The maxillary cast is mounted with a Facebow transmission and the mandibular cast is directly mounted in centric relation.

The upper member of the articulator is mounted on a split-cast accessory mounting plate. This split cast can be removed rapidly and replaced correctly during the survey. It also offers a visual guide for adjusting the articulator to protrusive and lateral interocclusion records.

A step-by-step procedure to use this instrument is as follows: [7]

1. On the upper member of the articulator, the card index is placed. (Fig. 2)

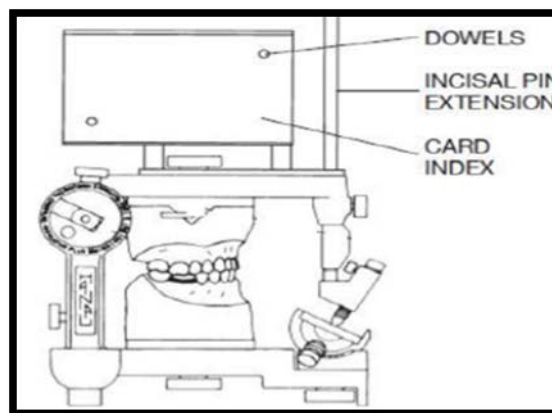


Fig 2: Preparation of the Analyzer

2. Press a plastic record card over the dowels on the right side of the card index. The cards are matte-finished on both sides, thus accepts ink or pencil markings

readily. One can also use a sheet of blank paper to record the markings.

3. A lead piece is inserted onto the compass (like a standard pencil) and is calibrated to a selected radius (such as 4 inches).
4. The compass centre point is adjusted to the Anterior survey point (A.S.P.), usually the disto-incisal point of the canines. If the canine cusp is attrited or worn, the A.S.P. will be at the incisal edge. The point on the cuspid is marked and not changed after selection.
5. A long 3-inch arc is applied to the plastic record card with the centre of the compass positioned to the A.S.P. The occlusal plane survey centre (O.P.S.C) will eventually be located at some point on the arc. (Fig. 3)

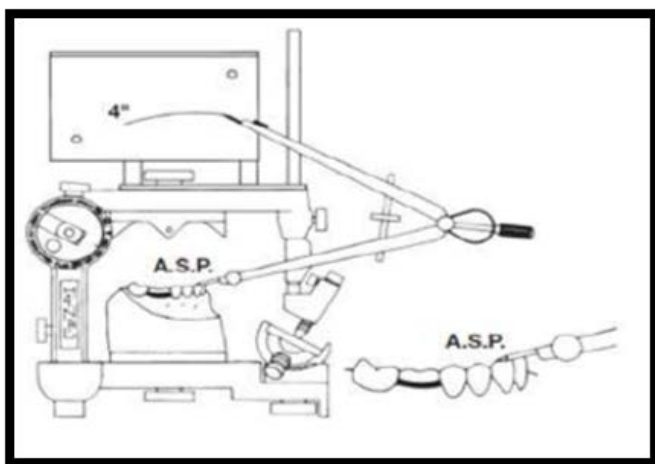


Fig 3: Selection of A.S.P

6. The middle point of the compass is set on the P.S.P and an arc is drawn to cross the arc from the A.S.P. (Fig 4.)

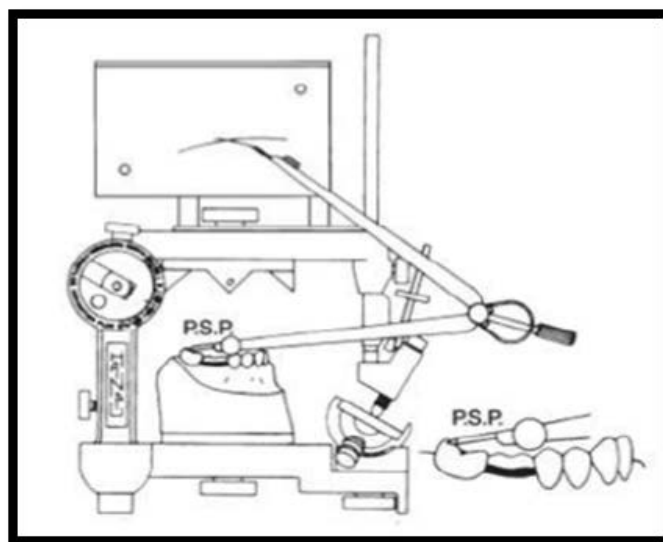


Fig 4: Determination of P.S.P

7. At the distobuccal cusp of the last lower molar, the posterior survey point (P.S.P) is selected. When the lower molar is missing, the upper cast is replaced and a soft modelling compound is placed across the ridge, closing the articulator until the incisal pin in a centric relation contacts the incisal guide. The impression compound is chilled and the excess is sculpted out, which allows only the compound contacting into the upper fossae, simulating the lower buccal cusp. On the modelling compound, the posterior survey point (P.S.P) will be chosen after removing the upper cast. The anterior border of the condyle would be an alternative P.S.P, represented by the most anterior point of the condylar element on the articulator.

Consistently, the author suggests that the condylar portion be used as a posterior survey point (P.S.P) in a tilted, attrited or mesially drifted molar. (Fig.5)

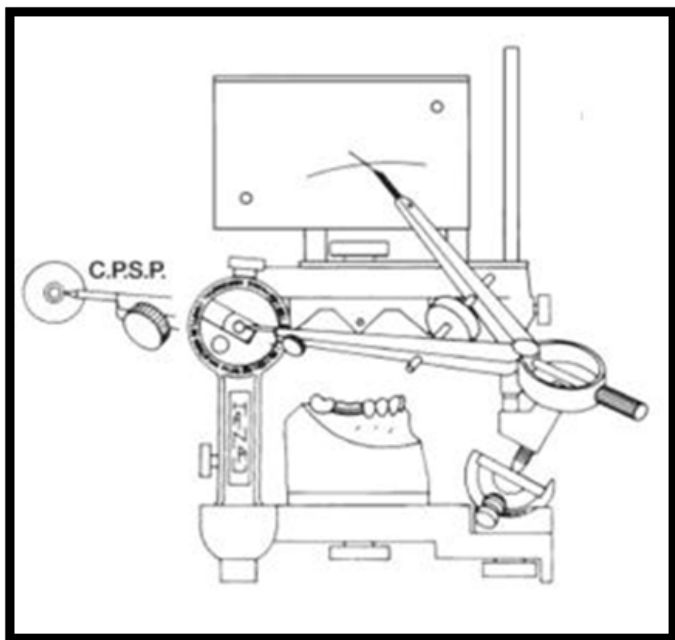


Fig 5: Modification in Determination of P.S.P

8. In the intersection of the Plastic Record Card arc, position the central point of the Bow Compass, always set to its 4 "radius(initial occlusal plane survey centre).
9. The needlepoint is then swept over the lower posterior teeth's occlusal surfaces to see if the arc correlates to the actual occlusal line. This occlusal plane survey centre (O.P.S.C) is shifted on the long arc on the plastic record card, the A.S.P line, until the most acceptable plane of occlusion and line is found. (Fig. 6)

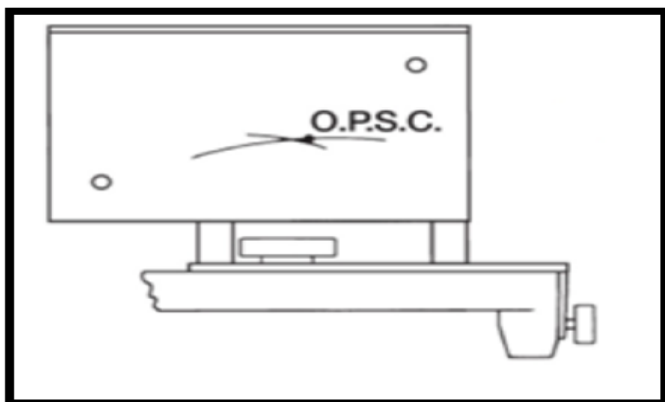


Fig 6: Occlusal Plane Survey Line

10. When the line and the plane of occlusion need to be raised at the distal end, the centre point is shifted anteriorly to the arc intersection. The point would be shifted at the posterior of the intersection to the lower the line and the plane of occlusion.
11. Following repeated trials and re-trials, the best survey centre will be identified and labelled for subsequent movements, creating the most appropriate line of occlusions and planes.
12. The scribing knife is used to position the plaster, compound or wax during an occlusal plane correction in the compass for scribing and cutting.

The Broadrick occlusal plane analyzer(BOPA) has only been adapted to a few articular systems as it is an expensive instrument which limits its use universally.[4],[5] Some of the articular systems that use Broadrick occlusal plane analyzer is the Denar Anamark Fossae and all models of the Hanau articulators.[4] As not many articular systems support the flag and also for the manufactures of the semi-adjustable articulators who do not provide with such flag, a custom made Broadrick flag could be used.[4] The flag could be constructed with the use of clear acrylic resin with several modifications to the semi-adjustable articulator.[4]

COPA (Customized Occlusal Plane Analyzer)

If one uses a custom made BOPA, then it is possible to substitute a clear acrylic sheet 2 mm thick and 4 inches * 4 inches in dimensions.

A custom flag was made using a 2 mm thick clear acrylic resin sheet attached to the upper articulator member which fits into a slot of the same size within a clear acrylic resin frame. To receive the markings, a sheet of blank paper was placed on both sides of the flag.

The maxillary cast was removed from the articulator, and the flag was attached on top of the upper member of the articulator (Fig. 7).

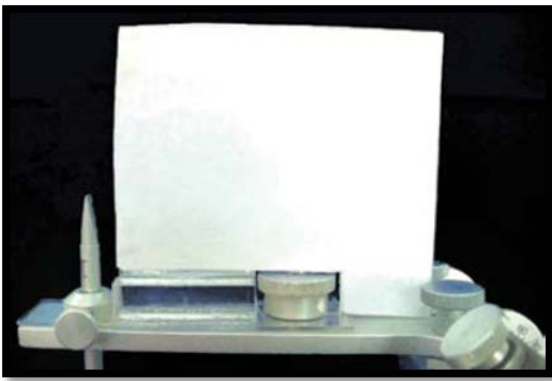


Figure 7

Fabrication of customized occlusal plane analyzer:

Materials Used:

- Semi-adjustable articulator
- Baseplate wax
- Metal sleeves with slots
- Clear acrylic sheet (2mm thick, 4X4 inch)
- Clear self-cure acrylic resin
- A4 gum stick paper
- Paper holding pins
- Compass

Fabrication Method

For any form of the semi-adjustable articulator, this is the simplest method for making highly useful BOPA.

- Two wax indices were adapted on the upper member of the semi-adjustable articulator, one on either side of the upper mounting plate attachment screw. (Fig 8).
- The wax indices were carefully removed from the upper jaw member of the semi-adjustable articulator and duplicated to form clear self-cure acrylic resin attachment blocks.
- Clear self-curing acrylic resin attachment blocks are made with metal sleeves attached to them and they are designed to match the articulator's upper jaw member.
- A clear acrylic sheet with a cyanoacrylate adhesive is adhered to in the centre of the metal sleeve, with the acrylic indices attached and the metal sleeve adapted over it.

- A paper with a gum stick of the same size is pasted over the transparent acrylic sheet.
- The flag is attached to the articulator's upper jaw member with the help of acrylic indexes and paper holding pins (Fig 9).

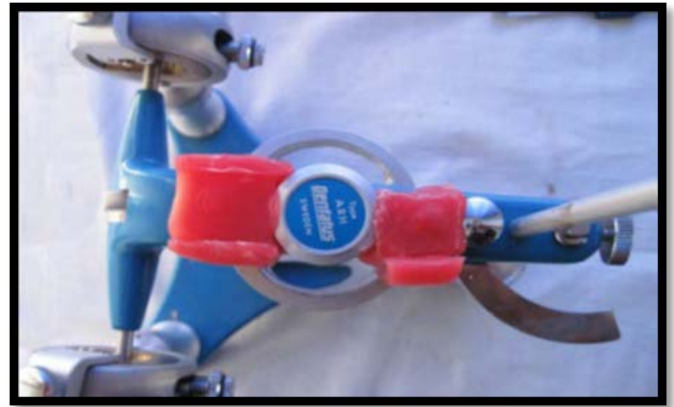


Figure 8



Figure 9

This simple modified(Custom-made) occlusal plane analyzer allows the clinician to use an occlusal plane analyzer with a commonly used semi-adjustable articulator when there is no such device available.

Simplified Occlusal Plane Analyzer (SOPA)

In this, Each flag has two sides (patient's right and left) and space for patient information such as name, date and other data. The graph is in millimetre increments.[8](Fig 10)

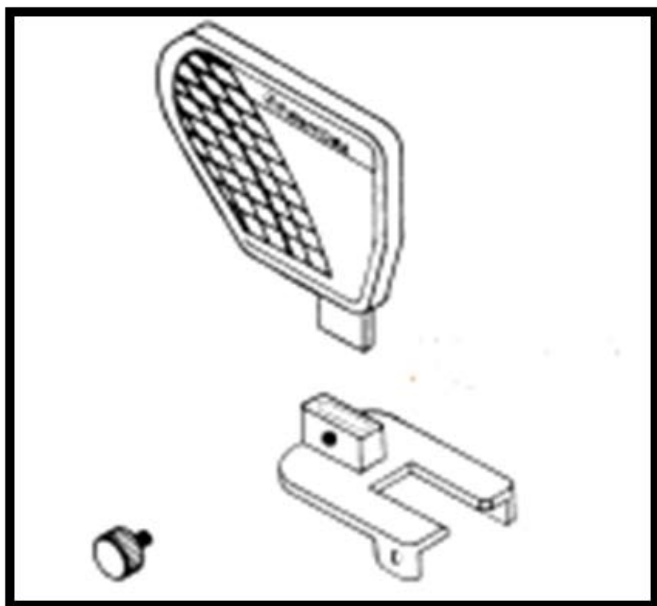


Figure 10

The compass has a standard radius of 4". This setting is standard for evaluating the final cusp tip heights on an ideal lower occlusal plane. This automatically establishes the position for the compass point in correct relation to the condyle. (Fig 11)

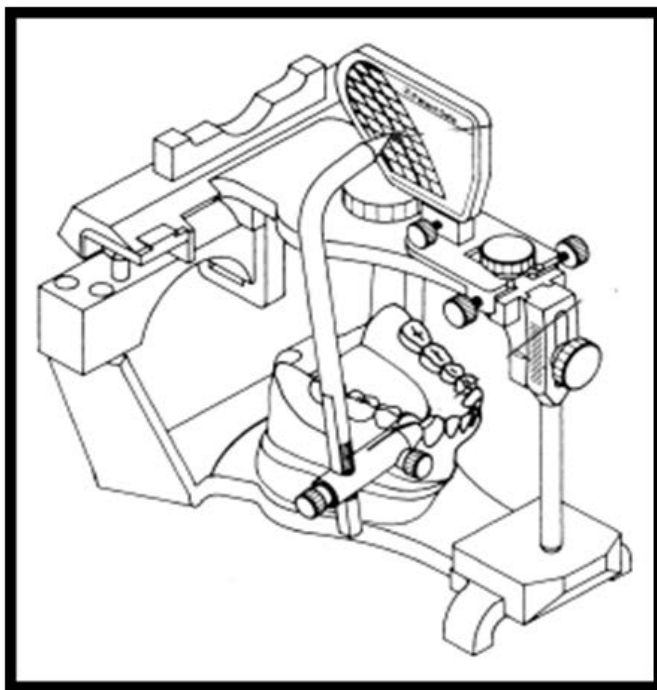


Figure 11

The difference between BOPA and SOPA is the standard radius of 4" compass in SOPA and the flag is different from the graph in millimetres.

Discussion

In 1963 Dr Lawson Broadrick developed an instrument to direct the direction and orientation of the posterior occlusal plane. Its goal was to enable the rehabilitation of the curve of spee in accordance with incisal and condylar guidance[5].

The Broadrick flag is a helpful tool in prosthodontics and restorative dentistry since it marks the centre of the Spee curve's most probable location. This position should, however, not be considered static or unalterable.

The occlusal plane design places considerable demand on the esthetics and function. Compromise can be accomplished by altering the length of the radius of the curve. The choice of a range of 4-inch can appear arbitrary. The radius may differ slightly depending on the person's skeletal and dental morphology. For class II skeletal ratio, a 3.75-inch radius may be indicated, while a 5-inch radius for a skeletal class III ratio may be indicated.[9]

In order to achieve the same effect, the centre of the curve may also be varied. The centre should always lie along the long arc drawn from the anterior survey point, but it can be moved in the anterior or posterior direction from the intersection of that arc with that drawn from the posterior survey point. This alteration will not affect the position of the anterior survey point, an important fact when the position of the mandibular anterior teeth is esthetically and clinically suitable. Therefore with a little experience and training, this aids the clinician for the definitive restorations as well as a guide for the actual tooth preparations.[4,10]

The Broadrick occlusal plane analyzer(BOPA) has only been adapted to a few articular systems, which leads to the

development of Customized Occlusal Plane Analyzer(COPA). Simplified Occlusal Plane Analyzer(SOPA) is used only with the Denar Articulator system and the difference between BOPA and SOPA is the standard radius of 4" compass in SOPA and the flag is different from the graph in millimetres.

Conclusion

The use of Occlusal Plane Analyzers aids the clinician in the development of an initial mandibular occlusal plane in diagnostic casts, and later, as an integral part of both the contours of the definitive restorations as well as a guide for the actual tooth preparations.

This is a huge help when treating cases requiring Full Mouth Rehabilitations as determining the occlusal plane is the first step towards a functionally and esthetically acceptable outcome, thus directly affecting the quality of life of the patient.

With a little experience and training, dentists can make Broadrick flag an integral part of their practice.

References

1. The Glossary of Prosthodontic Terms, 9th Edition.
2. Dawson PE. Evaluation, diagnosis and treatment of occlusal problems. 2nd ed. St Louis: Elsevier; 1989. p. 85, 373-81.
3. The glossary of prosthodontic terms. 8th ed. J Prosthet Dent 2005;94:10-92.
4. Bedia SV, Dange SP, Khalikar AN. Determination of the occlusal plane using a custom-made occlusal plane analyzer: A clinical report, Journal of Prosthetic Dentistry. 2007; 98(5):348-352.
5. Chaturvedi S, Verma AK, Ali M, Shah M. Full Mouth Rehabilitation using a custom-made Broadrick flag: A case report, International Journal of Case reports and images. 2012; 3(5):41-44.
6. S.Manvi, S.Miglani, C.L. Rajeswari, G. Srivatsa and S. Arora, Occlusal Plane Determination using Custom

Made Broadrick Occlusal Plane Analyser: A case-control study, International Scholarly Research Network Dentistry, 2012,373870.

7. W.M Corporation, Restorative oral health U.S.A, Whip- Mix Corporation-West, 2012.
8. W.M Corporation, Restorative oral health U.S.A, Whip- Mix Corporation- West, 2008.
9. Lynch CD, McConnell RJ. Prosthodontic management of the curve of Spee: Use of the Broadrick flag. J Prosthet Dent 2002;87:593-7.
10. B.W. Small, "Occlusal plane analysis using the Broadrick flag," General Dentistry, vol. 53, no. 4, pp. 250–252, 2005.