ejpmr, 2020,7(11), 739-750

SJIF Impact Factor 6.222

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Review Article

ISSN 2394-3211

EJPMR

PRE-EXTRACTION RECORDS ARE RELIABLE TOOL FOR COMPLETE DENTURE FABRICATION: AN OVERVIEW

Dr. Samarth Kumar Agarwal*[1], Dr. Romil Singhal[2], Dr. Kumari Kalpana[3], Dr. Prakhar Khurana[4]

[1,2]Professor, Department of Prosthodontics and Crown & Bridge, Kothiwal Dental College and Research Centre.
[3,4]Post-Graduate Student, Department of Prosthodontics and Crown & Bridge, Kothiwal Dental College and Research Centre.

***Corresponding Author: Dr. Samarth Kumar Agarwal**

Professor, Department of Prosthodontics and Crown & Bridge, Kothiwal Dental College and Research Centre.

Article Received on 22/09/2020 **Article Revised on 12/10/2020** **Article Accepted on 02/11/2020**

ABSTRACT

Pre-extraction records provide important clinical data for the continuing treatment of the complete denture patient. These data reveal the progressive changes which occur when natural teeth are extracted. Many methods of recording pre-extraction data have been advocated. Dentists use arbitrary methods while determining the vertical dimension of occlusion and arranging the maxillary anterior teeth. Though there are many advances in techniques and materials employed in the field of prosthodontics for recording vertical dimension at occlusion; still, there is no accurate method for assessing vertical dimension of occlusion in edentulous patients and henceforth difficulty is faced by clinician during denture fabrication. Prosthodontists who do not make use of pre-extraction records and consider the natural findings of the patient while denture fabrication lack the scientific component in denture fabrication, translating into compromised patient's satisfaction. Every denture should be characterized according to existing state rather than performing a pearl like arrangement of artificial teeth. Pre-extraction records provide a useful guide while fabricating denture and it should be preferred over arbitrary methods which are commonly used. Therefore, pre-extraction records serve as a reliable tool during denture fabrication.

KEYWORDS: Diagnostic cast, radiograph, photograph, Sorenson profile.

INTRODUCTION

Esthetics is an important dimension in dental practice and is related to individuals' preferences, culture, sociodemographic factors, and perceived dental treatments.[1] Denture construction for the edentulous patient is challenging for the dentist in terms of combining esthetics with function and comfort. The best guideline in this respect comes from Hardy, who said, ''make the teeth look like natural teeth''. As the complete denture replaces the entire dentition and associated oro-facial structures, patients often request to retain natural shape, size, shade, teeth-alignment, overlap, diastema, rotations, significant differences in incisal edges or any other unique dental feature in their dentition. Further, greater percentage of patient satisfaction has been observed when the patient is involved during the esthetic decisions of denture making, and greater the esthetics, more successful is the overall denture.[2] For the success of Complete dentures establishing the vertical dimension of occlusion (VDO)[3,4], recording centric relation, and arranging the maxillary anterior teeth in their proper position are important. Dentists may use arbitrary methods in determining VDO[5-10] and arranging the maxillary anterior teeth[4], and some dentists have difficulty in recording centric relation. Authors have recommended the use of pre-extraction records (PERs) to overcome these problems.[12-30]

The most common pre-extraction records include

- Pre-extraction diagnostic casts (PEDCs),[13-18]
- Photographs[28,29]
- Radiographs[30]
- Instruments
- Measurements (between tattoo points,[25] of the closest speaking space,[26] and of the physiological rest position[27]),

The information access from pre-extraction archive help to compensate for progressive changes and help to establish vertical dimensions, serving a guide as a starting point for teeth-rearrangement.[32] Some authors like Smith have also emphasized that pre-extraction records should be used in the prosthodontic curriculum. Silverman stated that "the greater the number of pre-extraction records available to the dentist, the greater the chance of success".[32]

'Natural Dentition Archival (NDA)'' is conceptualized on generating pre-extraction records by the age of 25–34

years which can be utilized later (when needed in future) to fabricate the denture better, by incorporating near natural dental characteristics in it and ensure greater patient acceptability. Preparing a diagnostic cast, facial profile photograph, photograph of anterior teeth in occlusion and recording tooth shade are steps, which can be recommended for NDA.[31] The purpose of this article is to review pre-extraction records that have been proposed and used to reproduce the anterior esthetics, determining vertical dimension of occlusion, in recording centric relation, and in arranging the maxillary anterior teeth for a completely edentulous patient.

DETERMINING VERTICAL DIMENSION OF OCCLUSION WITH PRE-EXTRACTION RECORDS

Vertical dimension of occlusion of edentulous patient can be determined using pre-extraction diagnostic casts. Heintz and Peters[12] used pre-extraction diagnostic casts to record the position of the maxillary and mandibular teeth and the maxillomandibular relationship, as existed before the teeth were extracted, by incorporating a stone replica of the natural teeth in their original relationship in occlusion rims of the edentulous stone casts.

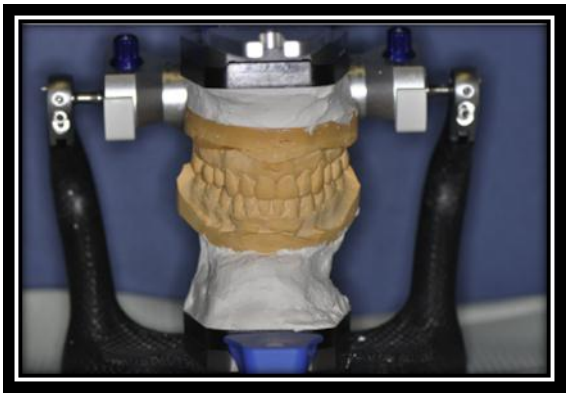


Fig 1: Pre extraction diagnostic cast.

A technique for making occlusion rims that provide a definite guide for the arrangement of the teeth for dentures was described. Impressions for maxillary and mandibular pre-extraction casts were made in an irreversible hydrocolloid material. On the edentulous maxillary and mandibular definitive stone cast a layer of aluminium foil was adapted. The edentulous definitive stone casts were placed into the irreversible hydrocolloid impressions. After the stone was set, the stone teeth were removed from the irreversible hydrocolloid impressions and attached, using sticky wax, to their original position on the edentulous definitive stone cast.

If changes were desired, these occlusion rims served as a basis for comparison and for evaluation of the proposed changes. The gingival line and labial tissue contours could be reproduced accurately. The procedure maintains the same jaw relations as existed before the teeth were removed. If enough teeth were present when the pre-extraction records were made, the occlusal facets on the teeth was used to adjust the articulator guidance. The method necessitated additional procedures and was time consuming.

Quinn et al[13] used pre extraction dental casts to make maxillary and mandibular record bases and wax occlusion rims, also to record patient's maxillomandibular relationship, and made wax flanges for the dentate areas of the pre extraction diagnostic casts. Duplicating flask was used with reversible or irreversible hydrocolloid impression material for this purpose. The replica of wax bases were used for making the definitive impression, the resultant stone casts and the replica wax bases and the wax teeth were mounted in an articulator in maximal intercuspation, and the artificial teeth were arranged with the impression material in place. This method was also time consuming as it required additional procedures.

A simple procedure which did not require additional armamentarium was proposed by Bissasu,[14] where the vertical dimension of occlusion of edentulous patient was determined by measuring the distance between the centre of incisive papilla and the incisal edges of the maxillary central incisors and between the anterior attachment of the lingual frenum and the incisal edges of the mandibular central incisors, on the pre extraction diagnostic casts, and then adjusting the maxillary and mandibular wax occlusion rims, anteriorly, to correspond with these measurements.

Fig 2: Mandibular cast with pencil marks. Arrows indicate anterior attachment of the lingual frenum and incisal edge of mandibular incisor.

Mathema[33] also concluded that per extraction record can be used to determine vertical dimension for occlusion by measuring the distance between anterior attachment of lingual frenum and incisal edge of mandibular central incisors, this acts as the guide to prepare the mandibular occlusal rim. The distance between the incisive papilla and incisal edges of maxillary central incisors on a pre extraction cast is then used to orient the level of maxillary plane and this can be used to prepare the maxillary occlusal rim.

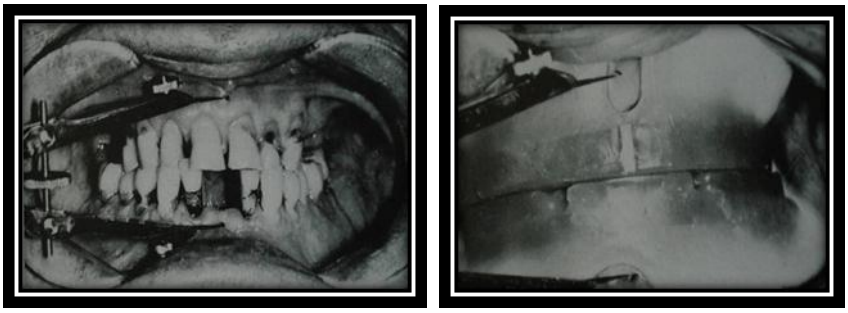


Fig 3: A) The lips are retracted so that the frenums are stretched, a fine inedible dot is placed so that its margin is at the most occlusal part of attachment of both upper & lower frenum.
B) The same distance is verified with the occlusal rims in place while establishing vertical jaw relations

Dakometer is the most common instrument advocated for use in determining vertical dimension of occlusion.[15-18] This instrument records both the vertical dimension of occlusion and the position of the maxillary anterior teeth. This instrument is placed on patient's face while the patient is closing into maximal intercuspation. With the instrument in position, the edge of the instrument moved to engage the incisal edges of maxillary central incisors.

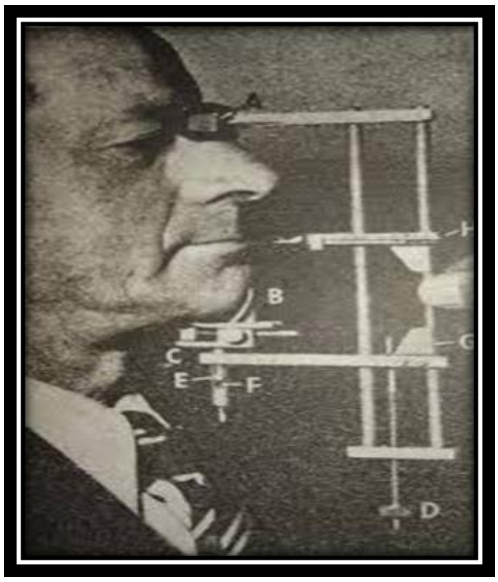


Fig 4: Dakometer.

The measurements were recorded and used after the patient had the remaining teeth extracted. Various authors suggested the use of a profile template[19-21] and described several methods to fabricate it. The profile template recorded facial contour in the mid-sagittal plane before the extraction of the natural teeth and served as a guide for determining the vertical dimension of occlusion and arranging the maxillary anterior teeth. To ensure proper facial contour is re-established or not it is placed against the edentulous patient's face. When the template is placed on the face, the skin gets displaced; therefore, errors may incorporate.[18] Willis[22] recommended the use of the Willis gauge for measuring the vertical height from the under surface of the chin to the base of the nose. This method introduced inaccuracies because it depended on the operator applying the exact same degree of pressure when the instrument contacted the skin of the face.

Fig 5: Details of facial description described by Willis.

The use of the Sorenson scale, Smith[24] recommended. In the depression at the bridge of the nose, nasion locator of this instrument was placed and the chin seat was raised until it lightly contacted the most inferior, as well as the most anterior, part of the chin. Even though instrument was simple, the result was not always accurate because the chin seat of the instrument was placed on an area, covered with soft tissue.

Orofacial device was used by Aboul-Ela and Razek[24] to record the vertical dimension of occlusion. The upper portion of the device extended between the orbital point and the external auditory meatus to form the Frankfort plane. The lower part of the device was placed against the inferior border of the mandible and pressed gently against the mandible. This part of the device formed the mandibular plane. Angle was noted which was formed by the junction of Frankfort and the mandibular plane. After the extraction of the teeth, during recording of the vertical dimension of occlusion of the edentulous patient, the wax occlusion rims were reduced or increased until the previously recorded angle was duplicated, thus restoring the vertical dimension of occlusion.

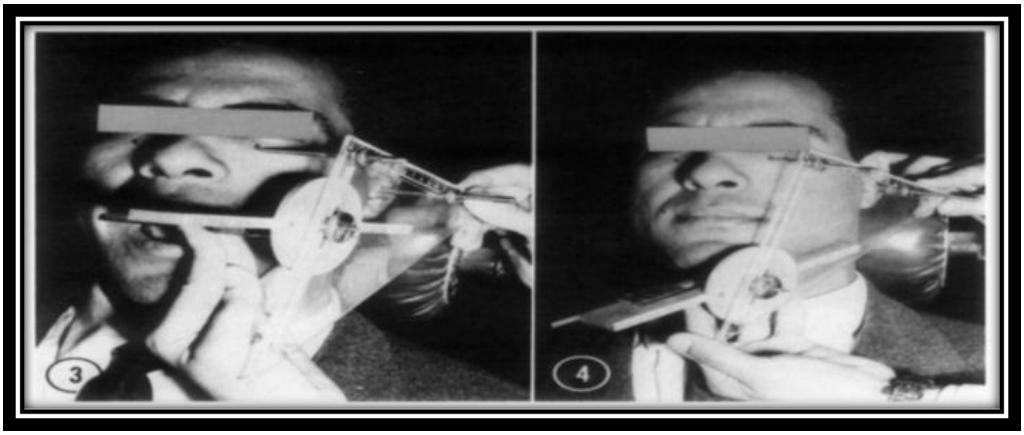


Fig 7: A) The orofacial device is used to record the occlusal plane.
B) The orofacial device is used to record the occlusal vertical dimension.

A soft lead wire may be adapted carefully to pre-extraction profiles, and this contour transferred to cardboard. The resultant cutout is stored until after the extractions. When the dentist estimates the vertical dimension using the trial plated, the cardboard cutout is placed against the profile in order to see whether the proper facial contour has been reestablished. The method is fraught with too many errors and is not in common use today.[25]

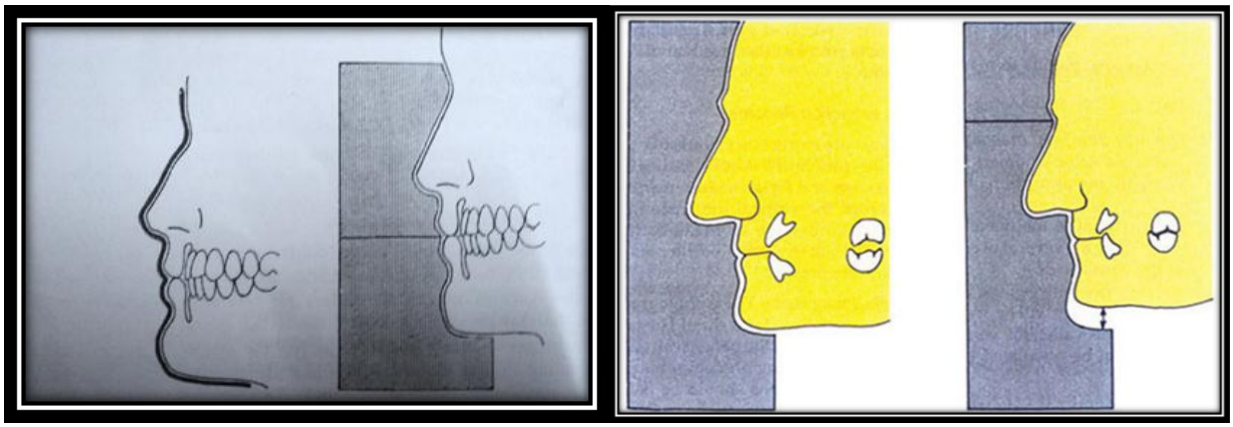


Fig 8: The above picture showing contoured wire being adapted according to facial profile and followed by replicating it in cardboard template.

Merkeley[41] advocated complete standardized pre-extraction method in which he said that to extract all the teeth without having first a record of the facial contours, tooth size, color and arrangement etc is criminal. He used a 16 gauge galvanized iron wire and embedded it in Balsa wood 8-9 inches long and 1/8 inches thick.

Kolodney, Akerly and Rudd[3] advocated that the dentures patient has been wearing can be measured and the measurements can be correlated with observations of the patients face to determine the amount of change required. These measurements are made between the borders of the maxillary and mandibular dentures by means of boley gauge.

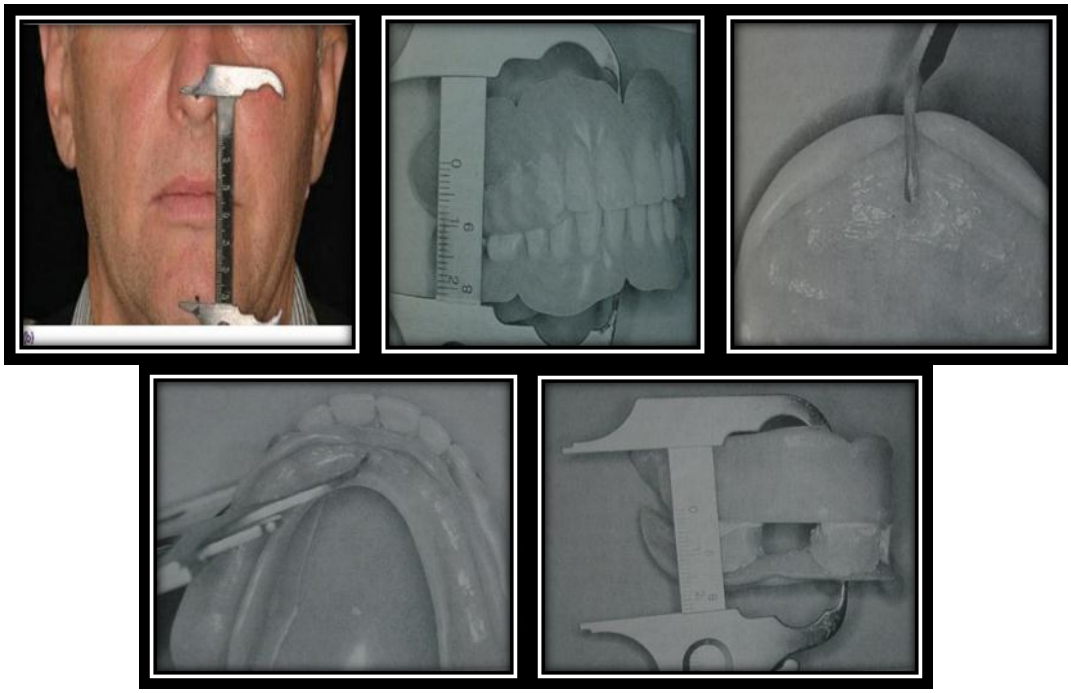


Fig 9: Measuring the dimension of former dentures with the help of boleys gauge.

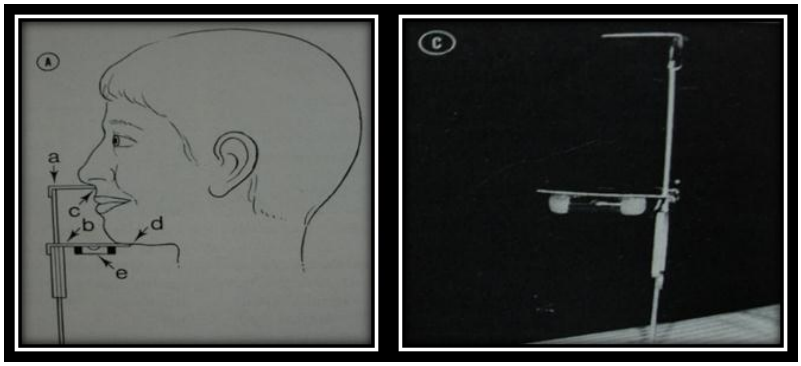


Fig 10: Measuring patients dimension using modified boleys gauge by Michael, Taylor and William.

Morikawa et al[42] advocated to modify the conventional gauges and have devised two kinds of improved gauges. One is the KOM gauge, which has an additional reference arm that is placed on the forehead of the patient. The other gauge uses an eyeglass frame for accurate setting and stable support and is named the TOM gauge. The validity of this gauge was evaluated by testing the reproducibility of the records. The TOM gauge showed excellent reproducibility of the record compared with the conventional gauges. The TOM gauge can be expected to significantly reduce the risk of errors in measuring the vertical dimension of occlusion especially in complete denture fabrication.

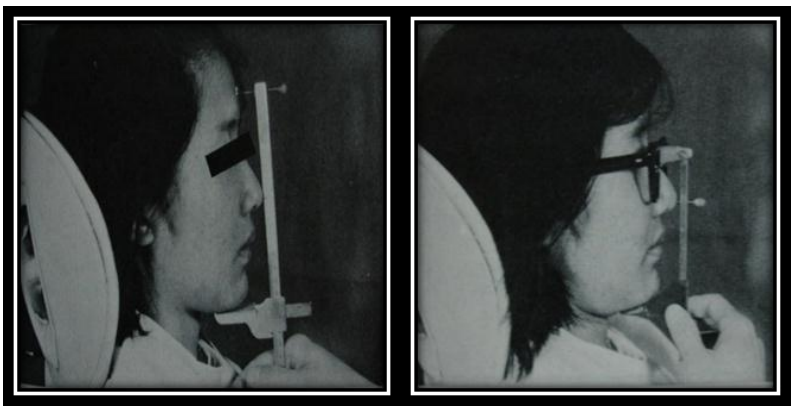


Fig11: A) Kom gauge B) Tom gauge.

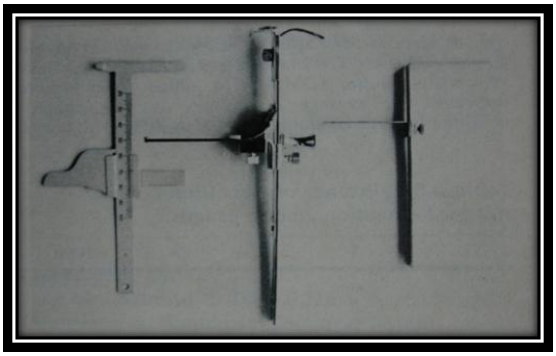


Fig 12: Conventional gauges that were tested. Left Tsu- bone gauge: Center Horie gauge: Right Willis gauge.

Ballard[43] advocated Cardboard Profile Record in this Plumber's Perforated Pipe strapping was adapted to the facial contours for use as a tray. The patient is placed in a reclined position. Irreversible hydrocolloid is used to make the impression.

Acrylic resin face mask is an elaborate and impressive method of making a facial record is to produce a transparent face form serve as an exact guide for production of the vertical dimension and will show the fullness of the face by enabling the operator to see through the transparent form and note the areas of contact or lack of contact. Practically all of the other methods give only two dimensions, whereas this face form gives the third dimension, which will enable the dentist to get an exact reproduction.[30]

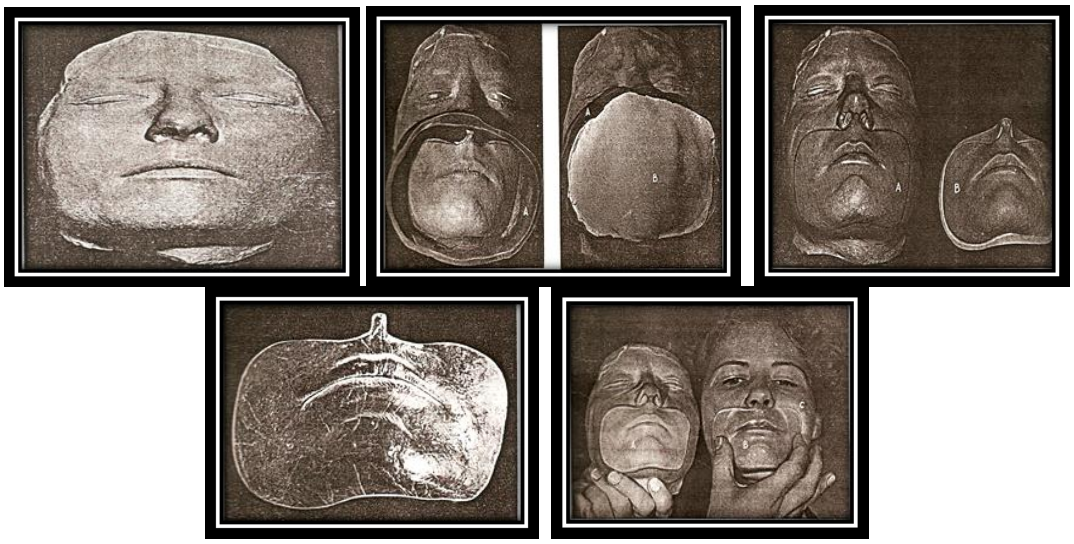


Fig 13: The above fig showing steps in making acrylic face mask.

Pre extraction records are utilized for determining vertical dimension of occlusion by measuring distance between maxilla and mandible.[25,26,27] Silverman[25] placed tattoos on the alveolar ridges of maxilla and mandible, to be used as reference points when the patient became edentulous. However, patients may not accept the placing of tattoos on the gingiva. Silverman[26] also proposed measuring the closest speaking space of patients, after 20 years of age, for later use, if needed. Gillis[27] advised measuring the interocclusal rest position before the extraction of the natural teeth and recording that measurement for future reference.

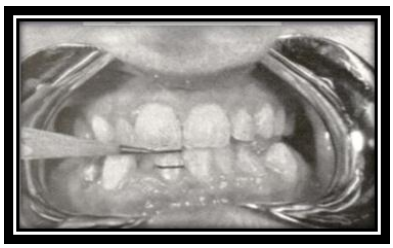


Fig 14: The closest speaking line is drawn on a lower anterior tooth during the sounding of the phonetic sound s of yes. The distance from the centric occlusion (lower) line to the closest speaking (upper) line is the closest speaking space. This space is the phonetic measurement for vertical dimension. If the closest speaking line is at the same level as the upper incisal edge while the s sounds are pronounced during rapid speech, it is certain that an accurate measurement of the vertical dimension has been obtained.

Both methods were simple and could be helpful, but Rivera-Morales and Mohl[34] did not support using the closest speaking space in determining the vertical dimension of occlusion. Some authors[35,36,37] reported instability of the physiological rest position. Profile photographs were used by Wright[28] to compare measurements of anatomic landmarks using the same anatomic landmarks on the face for many edentulous patients.

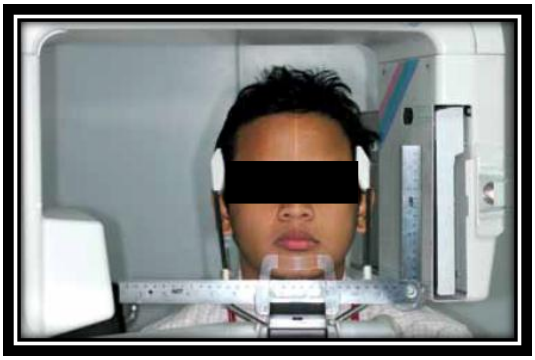


Fig 15: Standardization of subject for photography.

Wright stated it was advantageous to relate, through the arithmetical process of proportion, certain measurements made from previous patient photographs to measurements on the patient's face, such as the interpupillary distance and the distance from the top of the eyebrows to the base of the chin. The method was simple but, unfortunately, the skin covering the chin was movable.

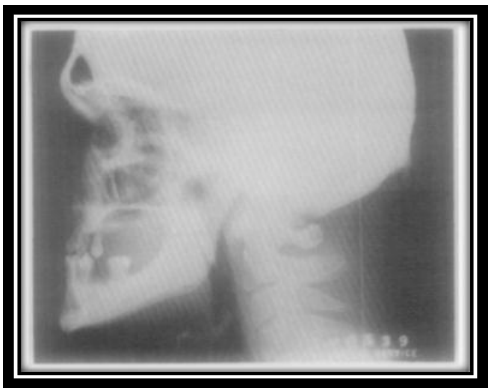


Fig 16: An example of a pre-extraction lateral radiograph.

Some authors also suggest vertical dimension of occlusion could be determined by using Profile radiographs.[30] The image should have approximately a 1:1 ratio to the patient's head. The exposure of a full lateral skull film was made with the teeth in occlusion, and after extraction, another skull film was made with occlusion rims in contact. The 2 films were compared, and necessary adjustment was made.[30] Major disadvantage with this was conventional radiographic equipment used to provide profile radiographs was not available in most dental offices.

A **B** **C**

Fig 17: The Cephalogram at various stages - A) before extraction of remaining natural teeth B) after extraction of remaining natural teeth; C) after complete denture rehabilitation.

Although most pre extraction records may not be completely accurate, some authors,[18,23,26] agreed that pre extraction records were more useful than the conventional methods for determining physiological rest position, closest speaking space, and the vertical dimension of occlusion for edentulous patients. Turrell[18] assessed many methods of recording vertical dimension of occlusion in edentulous patients and declared that in spite of the problems with most pre extraction recording instruments, some of them were more accurate in the assessment of the vertical dimension of occlusion than numerous post extraction aids.

Smith[23] also evaluated the reliability of 5 methods for making pre extraction records of the vertical dimension of occlusion and 3 methods for making pre extraction records of the maxillary incisal points. He established that all the methods used in determining vertical dimension of occlusion were clinically useful, and the potential for variation of the methods he evaluated was less than the potential variation for the physiological rest position in common use. Silverman[26] also stated that when CDs are made without pre extraction records of the closest speaking space, the clinician must use arbitrary methods to establish the proper vertical dimension of occlusion.

PRE-EXTRACTION RECORDS FOR RECORDING CENTRIC RELATION

Various authors proposed recording the centric relation position for edentulous patients before the extraction of the natural teeth to be used in the fabrication of complete dentures.[13,14,16,17] Heintz and Peters[12] and Quinn et al[13] suggested using diagnostic casts made before the extraction of the remaining natural teeth for recording centric relation. Murphy[15] also recommended using pre extraction diagnostic casts to record the centric relation position by means of wax occlusion rims, for patients who had edentulous areas in both maxilla and mandible, to be used after extraction of the remaining natural teeth to record the patient's centric relation. Sproull and Broone[16] mounted maxillary and mandibular casts in an articulator, removed the mandibular cast from the articulator, and replaced it with an index. Plaster indexes were made on the hard palate and the occlusal and incisal surfaces of the maxillary teeth, and using the plaster indexes, the maxillary edentulous definitive stone cast was mounted in the articulator and the maxillary teeth were arranged. Because this method was recommended for patients with maxillary complete dentures only, it was of limited value for the completely edentulous patient. Fortunately, if temporomandibular joints disorders are not present, the centric relation position is reproducible and stable with or without teeth present. necessary.

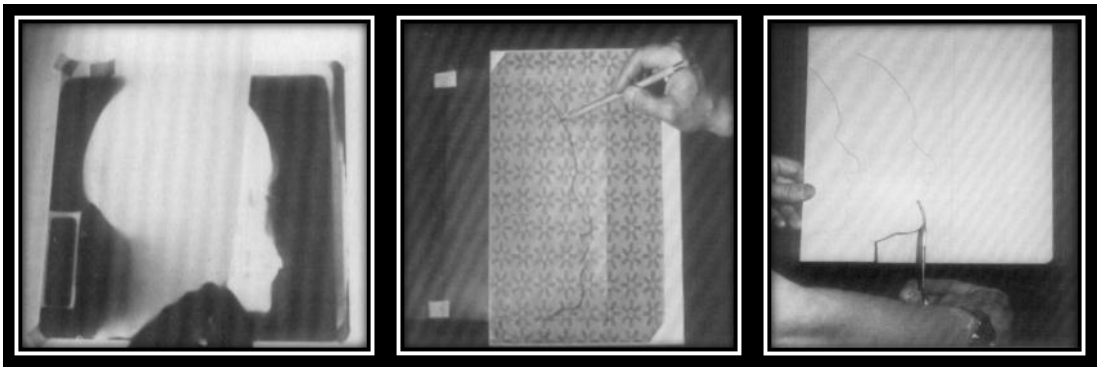
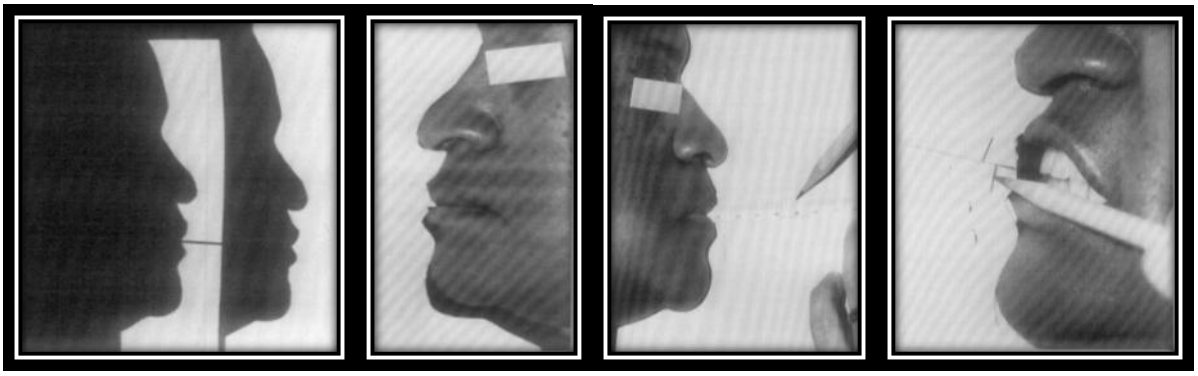


Fig. 18: a) Tracing paper is taped to cephalometric radiograph on view box. b) Soft tissue profile is traced onto cardboard. c) Profiles are cut out with scissors.



A B C D

Fig 19: A) Large template and sectional template are ready to be assembled. B) Upper part of sectional template is positioned on large template. C) Reference distance of maxillary central mesial incisal point is recorded on occlusal plane line. D) Labial-lingual inclination of maxillary and mandibular central incisors are recorded.

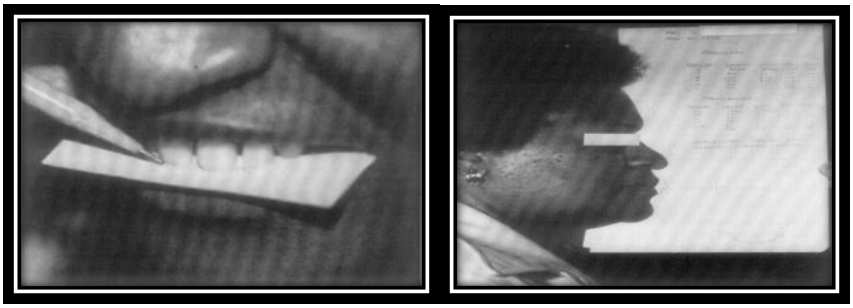


Fig. 20: e) Incisal arrangement of maxillary anterior teeth are traced on cardboard template. f) Completed template placed on patient's face.

PRE-EXTRACTION RECORDS IN ARRANGING THE MAXILLARY ANTERIOR TEETH

Most methods that had been proposed using pre extraction diagnostic casts and instruments for determining the edentulous patients vertical dimension of occlusion and centric relation, proposed recording the position of the maxillary anterior teeth as well.[12,13,16,19-21]

In addition, Bissasu[17] reported making a transparent vacuum-formed template on the patient's maxillary PEDC, then transferred the template to the patient's edentulous definitive stone cast and positioned the maxillary anterior artificial teeth in the same position. The method was reported to be simple and practical. Smith[23] designed an instrument, the incisor point locator, which allowed transferring the location of the maxillary incisor point from a PEDC to the wax occlusion rims placed on the edentulous definitive stone cast. Irreversible hydrocolloid was placed without a tray into the palate of the maxillary PEDC and over the central incisors. The anterior portion of the irreversible hydrocolloid was cut at the midline and removed to expose a maxillary central incisor on one side only. The edentulous definitive stone cast was clamped into the locator and the irreversible hydrocolloid record positioned on the palate. A pointer was clamped so that the stylus was located at the maxillary incisor point. The irreversible hydrocolloid record was removed from the definitive stone cast and replaced by the patient's wax occlusion rim. Then the labial surface and the height of the maxillary wax occlusion rim were trimmed, and the midline was marked to correspond to the stylus of the clamped pointer. The procedure required special equipment and took additional time. Bliss[29] emphasized the use of 3-dimensional photography as a valuable aid in evaluating tooth arrangement and fullness of the face. Photographs of the patient's face were made by positioning the head in the V formed by 2 mirrors placed at right angles to each other.

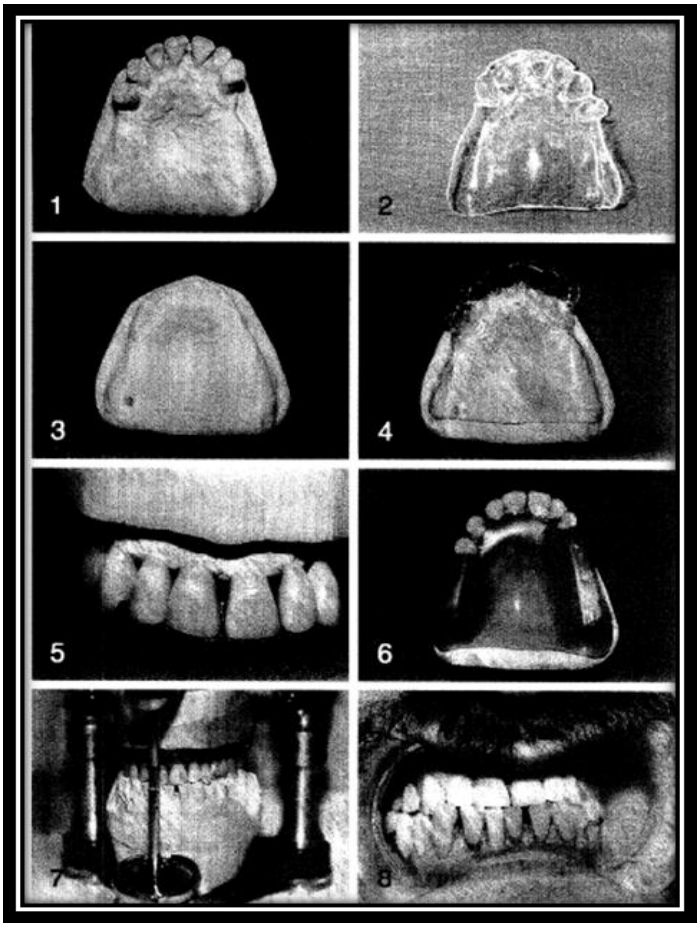


Fig. 21: 1. Pre extraction maxillary cast.
2. Clear vacuum-formed stent.
3. Final maxillary cast.
4. Sent on final cast.
5. Teeth in position ready for waxing.
6. Anterior teeth and occlusion rims.
7. Posterior teeth are arranged and ready for try-in.
8. Completed maxillary denture.

CONCLUSION

This article reviewed the PERs proposed for determining the VDO, recoding centric relation, and arranging the maxillary anterior teeth for a completely edentulous patient. The review of the literature indicated that PERs provided a useful guide in determining the edentulous patient's original VDO and arranging the maxillary anterior teeth. Therefore, PERs are preferred to arbitrary methods in common use. However, PERs were not necessarily needed for recording centric relation position for edentulous patients. Prosthodontist who do not make use of pre-extraction records and give due consideration to the natural findings of the patient while denture fabrication is missing the scientific component in denture fabrication, translating into compromised patient's satisfaction. The information recorded in pre extraction records allows the dentist to have access to and compensate for the progressive changes which occur when the natural teeth are extracted. Therefore, pre extraction records is a reliable tool for complete denture fabrication.

REFERENCES

1. Akarslan ZZ, Sadik B, Erten H, Karabulut E (2009) Dental esthetic satisfaction, received and desired dental treatments for improvement of esthetics. Indian J Dent Res., 20: 195–200.
2. Stockheimer C, Waliszewski MP (2012) A survey of dentulous and edentulous patient preference among different denture esthetic concepts. J Esthet Restor Dent, 24: 112–124. doi:10.1111/j.1708-8240.2011.00449.x Epub 2011 Jun 10
3. Zarb GA, Bolender CL. Boucher's prosthodontic treatment for edentulous patients. 11th ed. St Louis: Elsevier, 1997.
4. Winkler S. Essentials of complete dental prosthodontics. 1st ed. Philadelphia: WB Saunders, 1979.
5. Pleasure MA. Correct vertical dimension and freeway space. J Am Dent Assoc., 1951; 43: 160-3.
6. Shanahan TE. The physiologic vertical dimension and centric relation. J Prosthet Dent, 1956; 6: 741-7.
7. Lytle RB. Vertical relation of occlusion by the patient's neuromuscular perception. J Prosthet Dent, 1964; 14: 12-21.
8. Van Willigen JD, Rashbass C, Melchior HJ. "Byte-ryte," an apparatus for determination of the preferred vertical dimension of occlusion required for the construction of complete denture prosthesis. J Oral Rehabil, 1985; 2: 23-5.
9. Fayz F, Eslami A, Graser GN. Use of anterior teeth measurements in determining occlusal vertical dimension. J Prosthet Dent, 1987; 58: 317-22.
10. Hurst WW. Vertical dimension and its correlation with lip length and interocclusal distance. J Am Dent Assoc., 1962; 64: 496-504.
11. Fayz F, Eslami A. Determination of occlusal vertical dimension: a literature review. J Prosthet Dent, 1988; 59: 321-3.
12. Heintz WD, Peters GP. Esthetic occlusion rims providing for jaw relations. J Prosthet Dent, 1959; 9: 587-93.
13. Quinn DM, Yemm R, Ianetta RV, Lyon FF, McTear J. A practical form of pre-extraction records for construction of complete dentures. Br Dent J., 1986; 160: 166-8.
14. Bissasu M. Use of lingual frenum in determining the original vertical position of mandibular anterior teeth. J Prosthet Dent, 1999; 82: 77-81.
15. Murphy WM. Pre-extraction records in full denture construction. Br Dent J., 1964; 5(3): 91-5.
16. Sproull JB, Boone ME. An accurate method of duplicating natural tooth position in maxillary complete dentures. J Indiana Dent Assoc., 1984; 63: 25-6.
17. Bissasu M. Copying maxillary anterior natural tooth position in complete dentures. J Prosthet Dent., 1992; 67: 668-9.
18. Turrell AJW. Clinical assessment of vertical dimension. J Prosthet Dent, 1972; 28: 238-46.
19. Turner LC. The profile tracer: Method of obtaining accurate pre-extraction records. J Prosthet Dent, 1969; 21: 346-70.
20. Stansbery CJ. Complete full denture technique. The pre-extraction visit. Dent Dig, 1933; 39: 156-9.
21. Crabtree DG, Ward JE, McCasland JP. A pre-extraction profile record. J Prosthet Dent, 1981; 45: 479-83.
22. Willis FM. Features of the face involved in full denture prosthesis. Dent Cosmos, 1935; 77: 851-4.
23. Smith DE. The reliability of pre-extraction records for complete dentures. J Prosthet Dent., 1971; 25: 592-608.
24. Aboul-Ela LM, Razek MKA. Pre-extraction records of occlusal plane and vertical dimension. J Prosthet Dent., 1977; 38: 490-3.
25. Silverman MM. Pre-extraction records to avoid premature aging of the denture patient. J Prosthet Dent, 1955; 5: 465-76.
26. Silverman MM. Speaking method in measuring vertical dimension. J Prosthet Dent, 1953; 3: 193-9.
27. Gillis RR. Establishing vertical dimension in full denture construction. J Am Dent Assoc., 1941; 28: 430-6.
28. Wright WH. Use of intra-oral jaw relation wax records in complete denture prosthesis. J Am Dent Assoc., 1939; 26: 542-5.
29. Bliss CH. Three-dimensional photography in prosthodontics. J Prosthet Dent., 1959; 9: 708-16.
30. Sharry JJ. Complete denture prosthodontics. McGraw-Hill, 1974.
31. Angadi GS, kakodkar PV, Bahert SG. Archiving the natural dentition to serve as pre extraction record: Evaluating perceptions among Indian prosthodontists. J Indian Prosthodont Soc., 2014 July; 14(3): 273-80.
32. Bissasu M. Pre extraction records for complete denture fabrication: A literature review. J Prosthet Dent., 2004 Jan; 91(1): 55-8.

33. Mathema SRB. Pattern of lingual freanum nd its role in establishing incisal level of mandibular central incisors during vertical dimension, 8(1): 1-9.
34. Rivera-Morales WC, Mohl ND. Variability of closest speaking space compared with interocclusal distance in edentulous subjects. J Prosthet Dent., 1991; 65: 228-32.
35. Atwood DA. A cephalometric study of the clinical rest position of the mandible. Part 1. The variability of the clinical rest position following the removal of occlusal contact. J Prosthet Dent, 1956; 6: 504-19.
36. Sheppard IM, Sheppard SM. Vertical dimension measurements. J Prosthet Dent, 1975; 34: 269-77.
37. Garnick J, Ramfjord SP. Rest position. An electromygraphic and clinical investigation. J Prosthet Dent, 1962; 12: 865-911.
38. Ash MM, Ramfjord S. Occlusion. 4th ed. Philadelphia: WB Saunders, 1995.
39. Bocher CO. Swensons Complete Dentures. 5th ed. St Loius.The C.V Mosby company, 1964: 170-4.
40. Feldman S, Leupold RJ, Staling LM. Rest vertical dimension determined by electromyography with biofeedback as compared to conventional methods. J Prosthet Dent, 1978 Aug; 84(2): 216-9.
41. Merkely HJ. A complete standardized pre extraction record. J Can Dent Assoc., 1953; 19: 124-6.
42. Morikawa M, Kozono Y, Noguchi BS, Toyoda S. Reproducibility of the vertical dimension of occlusion with an improved measuring gauge. J Prosthet Dent., 1988 July; 60(1): 58-61.
43. Ballard. Cardboard profile as pre- extraction record. J Prosthet Dent, 1971; 25: 592-608.