

CLINICALLY SIGNIFICANT LANDMARKS FOR REHABILITATION OF COMPLETELY EDENTULOUS PATIENTS– A REVIEW.

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ABSTRACT: The basic foundation of prosthodontic treatment planning involves the analysis and interpretation of structures inside and around the oral cavity. There are specific anatomic landmarks for maxilla and mandible respectively. These proposed landmarks act as a guide for accurately establishing the occlusal plane, condylar guidance and vertical dimension of patients face in clinical practice of complete oral rehabilitation. In completely edentulous patients, the knowledge of combination of anatomical landmarks and analysis of various planes associated with the landmarks determines the accurate and reliable recording of jaw relation and the overall esthetic and functional success in prosthodontic rehabilitation. This review highlights the significance of various landmarks associated with maxillo mandibular jaw relation to achieve the functional, mechanical and esthetic rehabilitation of completely edentulous patients.

KEYWORDS: Articular eminence, camper's line, centric relation, condylar guidance, hinge axis, maxillo mandibular relation.

INTRODUCTION

For Prosthodontic rehabilitation the construction of prosthesis is not purely mechanical, it involves combination of biological and mechanical principles. McCollum in 1926 states that the dentist should have thorough knowledge of Oral anatomy, physiology of supporting and surrounding structures for being the doctors and physicians of the mouth.^[1] In case of construction of fixed or removable partial dentures, there are remaining natural teeth which act as a guide for recording jaw relation and registering the existing occlusion. But in cases of fabrication of complete dentures and bilateral distal extension removable partial denture there will be difficulty in recording jaw relation, orientation of occlusal plane and recording vertical dimension^[2]. Loss of teeth and its associated structures, habitual jaw closure, altered neuromuscular coordination are some of the challenges in rehabilitation of completely edentulous patients^[3] This review article discusses about certain essential landmarks of maxilla and mandible which are present intra orally and extra orally ,their significance and influence in establishing jaw relation and other important procedures of complete denture prosthodontics.

ESSENTIALS OF CRANIO-MANDIBULAR JAW REALTION

Establishing the ideal arch to arch relationship, the optimum position of jaws to the base of the skull, the healthy, comfortable and functional TMJ, vertical dimension in harmonious with the surrounding structures are very controversial than any other procedures in dental subjects.^[4] In orientation jaw

relation for completely edentulous patients the maxillary occlusal plane should be made parallel to the base of the skull. Occlusal plane is defined as “the average plane established by the incisal and occlusal surfaces of the teeth – GPT (July 2005)”. It is anatomically related to the cranium and not a plane in the true sense of word but represents the mean curvature of the surface which theoretically touches the incisal edges of the incisors and tips of the occluding surfaces of the posterior teeth, it can be the surface of wax occlusal rim or a flat metallic plate for arrangement of artificial teeth. ^{[5] [11]}

According to Gillis and Olsen, the vertical dimension as determined by the length of the face in physiologic rest position of the mandible to the maxillae and when the maxillary and mandibular teeth are in occlusion are the two important dimensions measured for the complete denture construction.^{[6] [14]} Stuart in 1969 declared that for correct horizontal relationship between the jaws with equalized vertical pressure, retruding the mandible with the condyles in uppermost, rearmost and unstrained position to the glenoid fossa which is called as centric jaw position is very important. It is bone to bone relation, repeatable, recordable and physiologically acceptable position. This position is conducive to the overall health and function of odontostomato-gnathic system. ^{[7] [28]}

In order to make this procedure of recording orientation of occlusal plane, vertical dimension and centric jaw relation easier there are several landmarks proposed from which measurements or reference can be made. These significant landmarks which act as Plane of reference and their practical applications are elaborated briefly for the successful complete denture treatment. ^{[4] [18]}

ANATOMIC GUIDES FOR ESTABLISHING JAW RELATION

The accuracy of recording maxillomandibular jaw relation begins with the rigidity and stability of denture base which is used to retain the occlusal rim or other recording medium. There are landmarks to guide for each step in the jaw relation starting from the contouring of occlusal rims to the calculation of horizontal condylar inclination ^[9]. Those proposed landmarks for accurately establishing the various steps in the jaw relation involved in clinical practice of complete oral rehabilitation can be categorized into Anatomic landmarks for 1) Contouring occlusal rims 2) Orientation of occlusal plane 3) Determining vertical dimension 4) Centric jaw relation 5) Deriving horizontal condylar inclination.

1) Contouring occlusal rims using anatomic guides.

The occlusal rims are contoured by using the position and morphology of lips and cheeks. MacArthur stated that the contouring of both rims is completed to provide the normal function of muscles of facial expression and facial contour ^{[8] [10]}. Maxillary anterior occlusal rim is contoured based on nasolabial sulcus, mentolabial sulcus, and philtrum and lip commissures. Posteriorly the maxillary occlusal rim is contoured to provide adequate buccal corridor space. The mandibular occlusal rim from right cuspid to the left cuspid should occupy the space over the crest of residual alveolar ridge and the thickness should not extend one half of the width of labial vestibule. The buccolingual position of the mandibular occlusal rim posteriorly should be on the crest of the ridge and should terminate 2-3 mm anterior to retro molar papilla. ^[10]

2) For Orientation of occlusal plane

The maxillary occlusal rim in the anterior region is reduced to approximately 2 mm below the relaxed lip coinciding with the horizontal line drawn from the lip commissures to the inferior border of the upper lip during rest position. Miller et al. concluded that the posterior vertical length of maxillary occlusal rim is made to coincide with the line drawn from inferior border of alae of the nose to the superior border of tragus of the ear called as Campers line.^{[11] [12]} Theoretically and anatomically, Frankfort's horizontal plane which is located on the radiographs can be used for reference for orientation of occlusal plane. ^[13] The mandibular occlusal rim anterior height can be 10 to 16 mm and the posterior height is equal to the one half the height of retro molar pad. Philtrum of the lips, labial frenum and Incisal papilla are the guides to draw the midline on the occlusal rim. A line parallel to the pupils of the eyes at the corners of the mouth is drawn vertically called as the Cuspid line for teeth arrangement. The inferior border of the upper lip helps to draw the Lip lines for determining vertical incisal length and for arrangement of anterior teeth.

According to Neufeild, these basic dimensions using the anatomic landmarks can be subjected to variation based on patient requirements, differences in the location of anatomic landmarks and esthetics. ^[9]

3) Basic anatomic landmarks for measuring Vertical dimension.

Vertical dimension at rest can be measured by both facial measurements and facial expression. The distance between the points marked at the end of the patient's nose and point on the tip of the Chin will give tentative dimension of facial height at rest. Joniot declared that the position and contour of the lips, skin around the eyes and chin are the indications of relaxed facial expression in measuring vertical dimension at rest. Using the Willis guide the facial measurements are made from the pupils of the eyes to

the rima oris and from the anterior nasal spine to the lower border of the mandible, when these measured distances are equal then vertical dimension at rest can be confirmed.^{[6] [14]}

The recording of vertical dimension at occlusion can be made with the measurements of anatomic landmarks on the pre extraction records like photographs and radiographs. The lateral cephalogram made with the occlusal rims in contact representing occluding position can be used to measure the occlusal vertical dimension.^[15] The cephalometric points which are considered is Nasion **N**, Gnathion **Gn**, Point **A** (Subspinale), Point **B** (Supramentale), Pogonion and Mandibular plane. Atwood analyzed and confirmed that the distance measured between **N** to Point **A** gives the upper facial height, Point **B** to **Gn** gives the lower facial height and the distance between Point **A** to Point **B** denotes the mid facial height.^[14]

4) Accurate transfer of Centric jaw relation using Terminal hinge axis Position

The Centric jaw relation and terminal hinge axis are together considered as stable, recordable and reproducible positions and so the hinge axis act as an important reference for mounting of casts in articulators.^[16] Lucia in 1960 concluded that the terminal hinge axis position is the starting position of the maxillo mandibular relation. The centric relation coincides with the terminal hinge axis position in which pure rotation of condyles takes place in 10°-13° arc of mandibular opening and closing movements. The location of terminal hinge axis will act as the guide for transfer of centric relation position from patients face to the articulator. The hinge axis can be located by arbitrary method about 6mm within the true hinge axis called as Arbitrary hinge axis.^{[17][19]}

There are certain posterior reference points representing arbitrary hinge axis which are commonly used in the arbitrary face bow. They are 1) Beyrons point-13 mm anterior to posterior margin of tragus to outer canthus of eyes 2) Gysi point-13 mm anterior to anterior margin of external auditory meatus 3) Snows point-11-13mm anterior to the tragus 4) Denars point-12 mm anterior to the posterior border of the tragus and 5mm inferior to the line from external auditory meatus to the outer canthus 5) Bergstroms point is 10 mm anterior to external auditory meatus and 7 mm below the Frankfort's horizontal plane.^[20]

The true hinge axis can be located by using the hinge axis locator called as Kinematic (hinge axis) face bow example TMJ Instrument. In this device, approximate rotation center of condyle is marked on skin of the patients face and the hinge axis locator is adjusted to coincide with condylar rods with the condylar markings. The condylar rods are locked in the point of pure rotation indicating terminal hinge axis and transferred to the articulator.^{[21] [22]}

In order to justify the centric position of condyle, the radiographs like CT, CBCT (Cone Beam Computed Tomography) and DVT (Digital Volume Tomography) can be used.^[24] Brewka, Willis, Hatjigiorgis described the method of locating the center of condyle and center of the fossa. It was considered that in centric relation position of the mandible, the center of the condyle will be almost coincides with the center of the glenoid fossa.^{[26] [27]} The measurement of joint space mathematically between the condyle and glenoid fossa was suggested by Zhang Zhenkang. The width of the joint space measured in anterior, superior and posterior dimensions will give the condyle/fossa relationship in centric and eccentric positions.^[30]

5) Anatomic landmarks for setting horizontal condylar guidance in articulator.

Jankelson (1962), A, Westesson (1991), Akerman S (1995), Gilboa et al. Gross (2008) stated that the angle of inclination of articular eminence to the Frankfort's Horizontal plane can be used as guide for setting the horizontal condylar inclination in semi adjustable articulators.^[24] There exists mathematically and statically strong correlation between the protrusive condylar path and the inclination of articular eminence. Lateral Cephalometric radiographs, Orthopantomogram and CBCT radiographs can be used to determine this value of inclination of articular eminence.^[27] Norman E. Corbett, Brewka used cephalometric radiographic analysis for their studies on protrusive condylar path registrations in semi-adjustable articulators. In Lateral Cephalometric radiographs of patients face, two points A and B were marked at superior and inferior curvature of the articular eminence and a line was marked joining these two points representing the slope of articular eminence. Then the line X and Y parallel to the Frankfort horizontal plane and tangent to the point A was drawn representing the horizontal reference line. The angle formed at the intersection of these two lines gives the degree of inclination of articular eminence to horizontal plane.^[25] The condylar guidance angle, also referred to the angle of articular eminence, is related to four different anatomic factors: the anatomy of the articular tubercle (hard tissue), the anatomy of the articular disc (soft tissue), the functional anatomy of the articular disc (pliable tissue), and the anatomy of the occlusal surfaces of the involved teeth (hard tissue).^[26]

LIMITATIONS OF THIS REVIEW

- 1) Within the limited review of literature, it was suggested that though the anatomic landmarks and reference planes can be used as viable guide, the combination of techniques with these proposed

landmarks will be more accurate than using single anatomic guide for the recording of jaw relation in edentulous patients.

- 2) Further studies can be carried out with more literatures and references for justifying the use of various landmarks in establishing jaw relation.
- 3) Variation in the location of these anatomic landmarks and difference in the quality of radiographic images between various imaging modalities are two important challenges to be considered for the use of anatomic references.
- 4) Anatomic and physiological alterations in TMJ can also produce inaccuracies in locating centric relation position and condylar guidance of the edentulous individuals.^[28]
- 5) Errors and differences can occur due to the inexperience, lack of adequate knowledge of the operator in utilizing these landmarks as the reference guide for jaw relation.^[29]

Conclusion

The diagnosis and treatment planning in rehabilitation cannot be completed without understanding the patient's needs. Different Patients have different Opinion, similarly their anatomic landmarks also differs. However accurately the impression is obtained, it differs from one patients mouth when compared to another. Muller De Van statement that "the perpetual preservation of what remains is more important than the meticulous replacement of what is lost". So, the knowledge of Oral Anatomy and physiology with Gnathologic principles makes every Prosthodontist clear that the entire masticatory apparatus should be treated as one unit. The anatomic landmarks can be used as starting guide for achieving proper maxillo mandibular jaw relation in harmonious with the components of Stomatognathic system.

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