Magnitude of clearance in the anterior region and displacement after complete denture insertion

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Fig.1-1 Clearance space was given in the anterior region at the time of denture placement.



Fig.1-2 One year after denture placement. Given clearance was lost. It is difficult to maintain the occlusal relation established at the time of construction over a long time. Even from this case presentation, the fact is clear that given occlusal relation cannot be maintained.

Introduction

After a period of time of complete denture placement, when sufficient space or clearance is provided in the anterior region between upper and lower jaws, this clearance is lost at some time or other. And this is common experience from a clinical phase in complete denture therapy. (Fig.1-1,2) Contrary to our good wish, this fact confirms that a given occlusion will be lost easily because of denture displacement in an early stage.

In this regard, this article will present what is important for complete denture occlusion, why this phenomenon takes place in complete denture and how we can maintain occlusal relationship clinically which we have provided at first thinking proper from scientific view.

Ideal occlusion in dentulous arches and the occlusion that is to be given for edentulous arches

In order to understand complete denture occlusion, understanding of dentulous occlusion would be an easier way, and so ideal occlusion of natural dentition will be described first.

1. Ideal occlusion of dentulous jaws

Fig.2 shows an ideal occlusion of dentulous arches as a demonstration model mounted on an articulator.

First of all, discussion will be on how much existing the clearance is in the anterior region.

A leaf gauge is bitten lightly so that the gauge can be pulled out easily. And a stronger bite is presupposed by pushing down the upper part of the articulator with hand and a withdrawal of leaf gauge is tried. Now some amount of resistance can be felt on the withdrawal. (Fig.3-1,2)



Fig.2 Healthy dentulous demonstration model. The occlusion scheme is a mutually protected occlusion. When strongly occluded, the condyle would maintain most ideal positional relation via joint disc, and the posterior teeth that resist most against vertical pressure would take the loading. When in protrusive or lateral excursions, the anterior teeth that are sensitive would proceed in sliding contact and the posterior teeth that are weak against the rolling would separate, and the temporomandibular joint would be protected, which is in mutually protected mechanism.



Fig.3-1,2 The magnitude of the anterior clearance in a healthy dentulous demonstration model is such that a thin sheet of paper can be pulled out. When a leaf gauge is strongly bitten, resistance will be felt when pulled out.

Actually in a dentulous mouth, when lightly occluded with upper and lower anterior arches, a sheet of paper can be pulled out with allowance of minimum clearance. And this clearance permits stronger biting with tight and intimate contact. What an amazing mechanism in the living body!

As nerve cells of periodontal membrane are more concentrated in the anterior region than in the posterior, a guarding mechanism is known to work to protect from other needless damages than essential functions. And also it controls to receive stimulations when it is truly needed.

Next observation is made on lateral excursion seen on the articulator simulation. On right and left lateral excursions, only canine tooth does contact and slide while other anterior and posterior teeth are separated in disclusion. (Fig.4-1, 2)

Actually in the mouth, however, it is rare for the canine tooth to slide solely in occlusal contact, but lateral incisor and first premolar are additionally joined, and occlusal contacts are often made in groups.



Fig.4-1 The posterior teeth disclusion at right lateral excursion on the healthy dentulous demonstration model. Only canine tooth is in sliding contact, and anterior or posterior teeth are separated. With this mechanism, fulcrum point during movement is on canine tooth, and the temporomandibular joint will be protected.



Fig.4-2 Similarly on left lateral movement.

And then, if you observe protrusive excursion on the articulator, only the upper and lower anterior teeth are in contact sliding. In the meantime, the posterior teeth are separated in disclusion. (Fig.5-1, 2)



Fig.5-1 Intercuspal position on a healthy dentulous demonstration model.



Fig.5-2 Similarly on protrusive movement. Only the anterior teeth are in sliding contact while the posterior teeth in disclusion.

Again, what an amazing mechanism in the living body!

By using the canine tooth in the lateral excursion as it has longer tooth root and broader root surface area, it guards the posterior arch that is known as weak when rolling at lateral forces. And also by establishing fulcrum point of support distant from the temporomandibular joint site, it tries to minimize damages on the joint. In addition, on the protrusive excursion, it reduces loading on the posterior region as well as on the temporomandibular joint.

This kind of dentulous occlusal mechanism is called a mutually protected occlusion, or "Occlusion that protects arches alternatively each other".

When strongly occluded, the mandibular condyle would maintain most ideal relationship through the interposing joint disc, and the posterior teeth that are resistant to vertical pressure would bear a load. In this instance, thanks to any existing clearance slightly in the anterior arch, no stronger force will be applied. At protrusive or lateral excursions, while highly sensitive anterior teeth are sliding in contact accepting weaker force, the posterior teeth that are less resistant to lateral force are separated and will be protected. Good advantages on both sides are brought out for mutual protection.

But in a complete denture case, occlusion is totally different from occlusion in the dentulous arches. Reasons are that dentures do function through moving on the residual ridges.

2. Ideal occlusion of complete denture (Ideal)

Here is presented an ideal occlusion of complete denture as a demonstration model mounted on an articulator. (Fig.6-1,2)

Observation of the clearance (or space) of the upper and lower anterior teeth confirms about 2.0mm of overbite and about 1.5~2.0mm of anteroposterior space of artificial teeth. This space is larger than what we see in the dentulous demonstration model. Why is this larger space necessary for a complete denture case?



Fig.6-1 Right lateral view of an edentulous jaw demonstration model



Fig.6-2 Same on front view

First we see right and left lateral movements on the articulator. On the working side, from the upper and lower first premolars to the second molars, when these four molar teeth are sliding, other four molar teeth on the opposite balancing side are sliding at the same time. In the meantime, the mandible is moving while the anterior teeth contact is off separated or, if any, in slight contact. (Fig.7-1~3, Fig.8-1~3)



Fig.7-1~3 On right lateral movement, right and left 4 pieces of posterior teeth are in sliding contact simultaneously.



Fig.8-1~3 An edentulous jaw demonstration model with a lingualized occlusion (an occlusal scheme of maxillary lingual cusps are exclusively in contact). Through a face bow transfer and provision of a compensating curve, a balanced occlusion will be accomplished on an articulator. On left lateral excursion, right and left 4 pieces of posterior teeth are in sliding contact simultaneously.

Next we see protrusive movement. At the same time when the anterior teeth are in contact, the posterior teeth are also joined with the contact sliding.

In a dentulous case, at the anterior or lateral excursions, they are sliding in disclusion in order to protect the anterior and posterior teeth mutually. But in a complete denture case, right and left posterior teeth are in contact simultaneously at lateral movement, and anterior and posterior teeth are in contact at protrusive movement. (Fig.9-1,2)



Fig.9-1,2 On protrusive movement, anterior and posterior teeth are in sliding contact simultaneously.

A denture that works on a resilient nature of residual ridge is likely to dislodge on lateral movement when stronger force is stressed only on one side of molars and the other side is lifted up. And at protrusive movement when only the anterior teeth are in contact, the maxillary denture is pushed up by the mandibular denture and toppled easily. Meanwhile when a thin type of food is chewed in the anterior teeth or when food bolus is crashed and chewed strongly in the posterior teeth, a denture on the chewing side will hurt and inhibit chewing if teeth contact is not available on the opposite side.

In order to control denture tilting as much as possible on mastication, this tilting should be prevented by the contact on the balancing side. This kind of occlusal scheme is a practical technique to minimize denture mobility in the least possible amount, as it is assumed that a denture is mobile on the residual ridge. And so the occlusion is called a balanced occlusion that requires balancing from back and forth and around.

So the demonstration model on the articulator in this article is provided with an occlusal scheme of balanced occlusion, where only upper lingual cusps of posterior teeth are allowed to contact to the lower teeth.

Reason for larger clearance created in the anterior region is a result of grinding adjustment of anteroposterior, right and left artificial teeth in an object of obtaining balancing effect at the time of denture functions, and consequently there is $1.0 \sim 2.00$ mm of clearance is inevitably created.

Clinical reality that clearance is lost in the early stage (Reality)

Clinical reality however suggests that the clearance that has been given in 1.0~2.0mm after careful adjustment as above can be lost mostly after certain period of time of denture insertion. Fig.1 shows an example case where a clearance is lost completely within 1 year after denture seating. Without doubt, the denture has exhibited anterior displacement and cannot maintain proper maxillo-mandibular occlusal relation that has been given previously.

We dentists may have to admit clinical reality that the complete denture occlusion which we thought right to give from viewpoints of function has been denied by the nature of living body

Scientific report that supports clinical reality

Douglass¹⁾ observed cephalometric radiograph taken with metal markers embedded within denture base of 64 patients over 20 years, and analyzed final data of 24 patients (14 females and 10 males). Results are as follows;

- There is a loss of vertical intermaxillary distance.
- There is a counterclockwise rotation in the mandible with relative prognathism.
- · Mandibular denture also is in counterclockwise rotation with slight forward shift.
- No maxillary bone resorption is confirmed.
- Mandibular bone resorption is present but no significant difference among the sex of the patient or the denture technique employed.

And he reports on an upper and forward shift joined clearly with rotation of mandibular body together with denture after placement. (Fig.10) This conclusion is consistent with clinical realities that we mentioned above. Reason for losing clearance in the anterior region is that not only mandibular jaw itself is shifted anteriorly but also mandibular denture is displaced on the residual ridge with addition of artificial teeth abrasion.

In these years, Declaration of Helsinki prohibits studies that allow X-ray exposure like this in order to minimize human sufferings through scientific experiments, but this report should have definitely aroused controversies to our clinical verification.



Fig.11 Okeson states that mandibular jaw is in unstable position from bone skeletal structure and its position is maintained with muscles.²⁾

Upper and lower jaw clearance in the anterior region might as well be smaller when chewing. (Result)

The issue of clearance is closely related with the issue of denture stability during chewing. However sufficient a space is given on an articulator, denture rotation and tilting take place in every possible direction when various shapes and qualities of foods are chewed with a complete denture.

Yoshitomi³⁾ reports that contact of upper and lower anterior teeth when chewing is essential for maintaining denture stability and that smaller clearance of upper and lower anterior teeth is advantageous for minimizing denture mobility. (Fig.12)

A denture that becomes unstable on account of interposed food between occlusal surfaces when chewing will make denture mobility smaller by repeating anterior teeth contacts between lower and upper dentures. Smaller denture mobility means for the denture to shift small on the residual ridge, and as a result, denture pain can be controlled. Accordingly, as regards complete denture stability when chewing, it is concluding that clearance in the anterior teeth should be better in smaller distance likewise in case of dentulous jaws, and the author is also basically agreeable with this conclusion.

Fig.12 Clearance in the anterior region should be maintained in minimum so that it would help stabilize the lower denture on the residual ridge.

Yoshitomi, N.: Effect of anterior teeth occlusal contact of complete denture on mandibular movements, J.Stomatol.Soc.Jpn., 64(3): 436~453,1997 (Japanese) Yoshitomi, N.: Anterior occlusal contact of complete denture during mastication

Anterior teeth contact behaviors during mastication under two different conditions of posterior occlusion regarding Bilateral Balanced Occlusion and 0° Non-balanced Occlusion were observed toward complete denture wearers. And also presence or absence of anterior contact sliding surfaces and masticatory movements depending on different conditions of posterior occlusion were comparatively studied in an object of researching functional significance in anterior teeth arrangement of complete dentures.

It has been suggested that the anterior region of complete dentures are in contact during mastication and that, when masticatory movements become unstable following different changes of posterior occluding conditions, contact behaviors will change to get involved with stable masticatory movements.

As for anterior clearance, it should narrow down as much as possible for better stability of mandibular denture on the residual ridge.

Fig.13~1~3 demonstrate a clinical case of Angle's ClassII mandibular single denture. A larger space of clearance was given in the anterior part and a complete denture was constructed. If the lower anterior teeth were forcibly set up in front to meet the upper anterior teeth, the lower lip would flip up and dislodge the lower denture, and for this reason a larger clearance is permitted anteriorly.

Taking account of back and forth stability of denture, a balancing lump was given to an anterior part of retromolar pad, but the ridge was severely hurt in pain. A balancing lump is a device to prevent dislodgement of the opposing upper denture caused by exclusive contact of anterior teeth of upper and lower dentures, when monoplane occlusion is arranged (occlusion scheme using artificial teeth with 0° cuspal inclination). Denture oriented pain at chewing was largely controlled by reducing this clearance with addition of acrylic resin to the lingual surface of upper lateral incisor without touching the arrangement of lower denture teeth.







Fig.13-1 Angle ClassII: If priority of mandibular teeth arrangement is to give a larger clearance, mandibular jaw will go unstable and the lower denture becomes mobile on the residual ridge.

Fig.13-2 Balancing lumps were given but denture mobility was not prevented.

Fig.13-3 The residual ridge was extensively damaged.

Complete denture principles are the achievement of "Stable and backward chewing"

The author mentioned above to the agreement with the notion, "In order to attain denture stability at chewing it is better to keep the anterior clearance minimum."

Complete denture therapy, however, is involved with various circumstances, and every case is not given with occlusion of minimum amount of clearance.

For denture stability there should be an absolutely essential condition. It is the achievement of "Stable and backward chewing". In a case of maxillary single denture where the natural mandibular anterior teeth is predicted to push up, or in another case of single denture or both maxillo-mandibular complete dentures where its maxillary ridge is flabby, concentration of occlusal forces (center of gravity of occlusal force) is often shifted in the front direction, demonstrating, what we call, a forward chewing habit. In these cases, maxillary complete denture is likely to drop easily, and patient satisfaction will decrease. 【原書560頁】 In such a case, any dentist may be called "a quack dentist" who has made a useless denture. Also such a case, if untreated, would advance ridge resorption rapidly, and terminal symptoms will develop, including Kelly⁴⁾ combination syndrome. (Fig.14-1,2)

Therefore, in such a case of forward chewing habit which jeopardize this absolute requirement, "Achievement of stable and backward chewing in the posterior region", it is necessary to prevent the anterior teeth contact intentionally by giving larger amount of clearance. (Fig.15-1~5)

The author thinks that secret to success of edentulous case is to keep treating with point of views on what is most important for complete denture occlusion and stability.



Fig.14-1 Combination Syndrome. Uhyperplasia of the maxillary palate, 2 growth of fibrous tissues in the maxillary tuberosity, 3 mucosal ridge inflammation in the anterior maxilla, 4 extrusion of the lower anterior teeth, and 5 posterior bone loss in the mandible under free end partial denture. Fig.14-2 Changes associated with Combination Syndrome. ①decrease of occlusal vertical dimension, ②absence of occlusal plane, ③forward displacement of the mandible, ④fitness deterioration of prosthetics, ⑤flabby gum, and ⑥periodontal tissue changes of remaining teeth.



Fig. 2. Six additional clinical changes often found in patients with edentulous maxillae and partially edentulous mandibles.



Fig.15-1~3 Case of a single denture in the maxilla. The remaining teeth in the mandible jolted the maxillary anterior ridge where occlusal force were likely concentrated and shifted in the front direction.



Fig.15-4 Telescopic AGC crown supported denture. Anterior clearance was intentionally given to achieve a backward chewing. By designing a denture with telescopic crown retention, contact sensation in the anterior region was made indirect, and also occluding sensation in the posterior region could be transmitted toward rigidly supported remaining teeth in order to help the backward chewing.



Fig.15-5 Verification test with a Dental Prescale device after 2 years postoperatively. Anteroposterior center of gravity was around the mesial area of first molar tooth. Due to the remaining teeth distribution, the weight gravity center was likely to the left side. Occlusal force of 453.8 N was detected.

Provision of anterior clearance for complete denture so as to attain "Backward chewing in the posterior region" (Clinical practices)

As for complete denture that has attained "Backward chewing in the posterior region", if an anterior clearance is not kept small, denture will be shifted to contact the upper and lower anterior teeth after denture placement and an occlusal scheme that has been given by an operator will be lost. Therefore, in order to maintain an established occlusion as long as possible, all depend on the fact that a mandibular denture should remain stable with minimized anterior clearance in balanced occlusion.

Now in the following five clinical cases, any skills that are involved with dental laboratory techniques about working on an articulator will be demonstrated. (Fig.16~20)

Case 1: Clearance is minimized and a balanced occlusion is obtained through occlusal adjustment. (Fig.16-1~12)

Case 2: Edge-to-edge occlusion is given to reduce overbite. (Fig. 17-1~6)

Case 3: Maxillary single denture case with minimally reduced clearance in spite of larger overbite provided, because longer axes in the lower anterior teeth are inwardly inclined. (Fig.18-1~9)

Case 4: An edentulous case where shallow vertical overlap is arranged by inclining longer axes of the lower anterior teeth inwardly. (Fig.19-1~8)

Case 5: Case where clearance is minimized by inclining longer axes of the maxillary jaw of Angle ClassII. (Fig.20-1~8)

Case 1: Clearance is minimized and a balanced occlusion is obtained through occlusal adjustment. (Fig.16-1~12)



Fig.16-1,2 A larger clearance is made when occlusion is adjusted so that the anterior teeth should not slide independently at lateral and protrusive movements. If it is a large one, the mandibular denture would be moved to compensate the gap naturally in the living body. And the maxillomandibular occlusal relationship that is given from us will be lost at early stage. Therefore, any idea of occlusal adjustment is needed wherever possible to minimize clearance in the anterior region. Considering that careful adjustment is made on an articulator, face bow transfer is essential in our dental office. In this case, artificial teeth are arranged, first of all, to minimize the clearance of maxillomandibular anterior teeth.



Fig.16-3~6 Even though a compensation curve is given, the posterior teeth are separated, and only the anterior teeth are in contact sliding when protrusive sliding is made along the average value angle of condylar path on an articulator. If a denture is seated in this situation, maxillary denture will be dislodged easily by jolting from mandibular denture.





Fig.16-7,8 Grinding adjustment on the anterior teeth in the maxilla. Proper function of complete denture cannot be attained unless simultaneous sliding contacts are given both in the anterior and posterior teeth regions of maxillomandibular jaws. The trick is to adjust occlusion in a way that the lingual surface of maxillary anterior teeth should be shaped in concavity while keeping attention so that clearance will not become larger. Sometimes incisal edges of mandibular anterior teeth are to be ground in minimally necessary amount.



Fig.16-9,10 Comparison of protrusive movements in the mandible, before and after adjustment. Before adjustment: contact in the anterior region is sparse and nearly no contact in the posterior region. After adjustment: even contact in the anterior and simultaneous contact is made also in movements.





Fig.16-11,12 Comparison of magnitude of clearance before and after adjustment. After adjusted, clearance is kept to the minimum.



Case 2: Edge-to-edge occlusion is given to reduce overbite. (Fig. 17-1~6)

Fig.17-1~4 Patient visited with complaints that the denture dropped when the lower denture was moved forward. In case no esthetic problem is to be raised, an edge-to-edge occlusion is given in order to prevent any possible jamming with the anterior teeth in the mandibular movement. But care has to be taken so that the mandible should not happen to move forward over to the point of a cross bite.

Case 3: Maxillary single denture case with minimally reduced clearance in spite of larger overbite provided, because longer axes in the lower anterior teeth are inwardly inclined. (Fig.18-1~?)



Fig.18-1 \sim 5 Intercuspal position: the lower anterior teeth are inwardly inclined. In such a case, even if the anterior overlap is large, the posterior simultaneous sliding contact will be possible with a compensating curve after minimum adjusting at the protrusive movement

Fig.18-6,7 Even if the clearance is in small magnitude, because the lower anterior teeth are inclined inwardly, independent sliding contact in the anterior teeth can be avoided easily at protrusive movement.

Fig.18-8 Intercuspal position

Fig.18-9 At protrusive movement, anterior and posterior teeth are adjusted to slide in contact simultaneously. By setting the condylar and incisal path inclinations in approximate angles, simultaneous sliding contact of anterior and posterior teeth is possible at minimal magnitude of over jet.



Case 4: An edentulous case where shallow vertical overlap is arranged by inclining longer axes of the lower anterior teeth inwardly. (Fig.19-1~8)

Fig.19-1,2 A female patient at age 76. In her edentulous jaw case, history of cross bite during her dentulous period was not recorded, but her mentum region was markedly in strain when the mouth opened.





Fig.19-3~5 Final impression of mandibular jaw. Impression was taken in constricted form on the lingual surface of lower anterior teeth owing to her strained mentum region. Contrary to normal teeth arrangement in the lower jaw, a dental technician was advised to set up their lower anterior teeth with inward inclination.



Fig.19-6~8 Denture was completed in an edge-to-edge occlusion and in the lower anterior teeth with inward inclination. This is a case where the anterior teeth jammed at protrusive and lateral movement was successfully prevented.

Case 5: Case where clearance is minimized by inclining longer axes of the maxillary jaw of Angle ClassII. (Fig.20-1~8)



Fig.20-1~3 In case of maxillary protrusion (Angle ClassII), with esthetic priority of maxillary anterior teeth arrangement, as the mandibular anterior teeth are properly arranged based on the information regarding the residual ridge, larger clearance will be created in the anterior region. As breathing air-leaking may be possible, the lower anterior teeth were intentionally arranged in the labial direction to contact the upper anterior teeth. But now this time, the lower denture would happen to be uplifted by the lower lip at the mouth opening. Better options were to be decided whether larger clearance was accepted or alternatively clearance was minimized by arranging the maxillary artificial teeth within the range of no harm on esthetics using our skills.



Fig.20-4 \sim 6 The lower anterior teeth were arranged in a proper position, and the upper anterior teeth were moved slightly upward and inward direction. And then, the upper anterior teeth were moved from the amount what the patient became satisfied, and this amount was reproduced in convexity form on the alveolar polished surface for solution to her problem.





Fig.20-7,8 Final dentures and patient's facial appearance after seated. She looks active in good shape and fitness for her advanced age of 84.

Conclusion

If any facts that are obtained from clinical practices are common to many clinicians, they would be understood as "established facts" without waiting for scientific evidences from research institutions.

One of them is "Given clearance will be lost" or, in other words, issues of denture shifting on the residual ridge after placement and of mandibular jaw displacement.

In order to solve this problem, an extensive change of consciousness should be needed for artificial teeth arrangement and occlusal adjustment working on an articulator in the hands of not only dentists but also dental technicians, including an alveolar part waxing as a solution of esthetic deterioration caused by minimizing the magnitude of clearance.

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