

Use of Non-Rigid Connectors to Counteract the Flexure of the Mandible in a Long Span Bridge Crossing the Midline: A Review of Concepts and Case Report

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Abstract

During opening and closing jaw movements, it is thought that the muscles of the floor of the mouth and the Lateral Pterygoid muscles exert a contracting force upon the mandible, causing a Flexure which results in arch width changes. The mandibular rigidly connected long span FPDs that crosses the midline and extend beyond the mental foramina, supported by natural abutments or implants, may cause loosening and unnecessary stresses and strains on the prosthesis as well as on the abutments. Fabricating a prosthesis having a non-rigid connector at the mid-line offsets the Flexure effect of the mandible. In this article we will be discussing a case in which a long span mandibular FPD was given extending from first molar on one side to the first molar on the other side having a non-rigid connector at the midline to offset the flexure of the mandible.

Keywords: Mandibular Flexure; Long Span FPDs; Non Rigid Connector

Introduction

The term “flexure” refers to the action of bending or curving or the condition of being bent or curved. Mandible is a long U-shaped bone and has a tendency to flex during various mandibular movements, especially in the opening and protrusive movements [1,2]. During opening jaw movements, it is thought that the muscles of the floor of the mouth and the lateral pterygoid muscles exert a contracting force upon the mandible causing a flexure which result in arch width changes [3,4]. It is a proven fact that this phenomenon of Medial mandibular flexure causes stress concentration in the symphysis region, thereby affecting the otherwise successful prosthodontic treatment [5,6]. The clinical Implications become all the more prominent when the treatment planning includes bilateral prosthesis, rigid in nature, crossing the midline and extending atleast to or beyond mental foramina. Because of this phenomenon of MMF, effectively mandibular cross arch dimension is constantly changing. It is an environment and situation which is not good for rigid prosthesis. Medial mandibular flexure could lead to challenging problems with both conventional and implant supported prosthesis by increasing the stresses in prosthesis and abutment. The phenomenon of MMF can lead to Screw loosening, Bone resorption and pain in the cases of full arch implant rehabilitation. All of these factors can be attributed to MMF. MMF also can lead to constant soreness under a cast partial denture. Abutment mobility,

decementation and fractures of conventional FPDs have also been attributed to the phenomenon of MMF [7-9]. It is to be remembered that MMF is clinically significant only when the prosthesis is a large span one, crosses the midline and extends bilaterally beyond the mental foramina. These are the conditions which are commonly encountered during full mouth/arch rehabilitation procedures. The detrimental effects of Bruxism and clenching become all the more damaging in the presence of MMF [10,11].

There is a lot of controversy regarding the clinical effectiveness of the phenomenon of MMF. but increasingly as the concept is getting clearer, Clinicians are realizing the Importance of MMF while planning the treatment in full mouth rehabilitation cases as well as long span FPD cases.

Review of Literature

In 1955, Weinmann and sicher stated that lateral pterygoid muscles pull condyles towards medial by their strong contraction and this results in arch width changes in mandible [12]. In 1961, McDowell and Regli reported that cross arch width changes by 0.4mm during opening and by 0.5 mm in protrusive movements [13]. In 1973, Goodkind and Heringlake concluded that mandibular flexure occurs around molars and premolars which is influenced not only by mandible opening size but also by factors such as age, bone, density and muscular strength [14]. In 1981, Omar and Wise reported that mandibular flexure occurs by the action of jaw muscles [15]. In 2000, Chen, *et al.* based on their studies stated that when lower jaw opens, mandibular arch width tends to reduce [16]. In 2001, Tylmann also supported closed bite double arch method. It leads to the reduction of negative mandibular flexure effects in prosthetic procedure with opening mouth [17]. In 2005, Balci, *et al.* stated that in predictive accuracy of mandible to recognise the sex, ramus flexure for this indicator is more reliable in men than women [18].

Procedure to overcome MMF

Non-rigid connectors

Non rigid connectors are the connector that permit limited movement between the otherwise independent members of the FPD. The non-rigid connector could be made by an incorporation of prefabricated inserts, by use of a custom milling machine or by use of the prefabricated plastic patterns [19].

Although, the rigid connectors are most commonly used, there are certain special circumstances where a non-rigid connector is required such as:

1. Long-standing abutment (pier abutment) with edentulous spaces on either side that allow physiological tooth movement and relieve stress.
2. When it is impossible to prepare two abutments with a common path for the placement.
3. When prognosis of an abutment is uncertain; in such cases if the abutment fails only a portion of FPD needs to be remade.
4. In the mandibular arch, with an FPD consisting of anterior and posterior segments, a non-rigid connector is indicated, as the mandible flexes mediolaterally during the opening and closing strokes [20].

The non rigid connectors can be made either through the incorporation of pre formed plastic patterns in the wax patterns or through free hand carving. The prefabricated inserts require a preparation of the box in the wax pattern. The plastic slot is incorporated in the wax pattern with the help of custom milling machine or a dental surveyor. The custom milling machine could also be used for a refinement of the casted slot [18].

Types of non-rigid connectors [21]: There are four types of non-rigid connectors. These are

1. Dovetail (key-keyway) or (Tenon -Mortise) connectors.
2. Loop connectors.
3. Split connectors.
4. Cross pin and wing connectors.

Principle of non-rigid connector

- This connector employs a stress breaking principle, which consists of a keyway (female part) and a key (male part).
- This connector when placed between a Pontic and retainer permits some type of movement.

The design and passive fit of NRC is critical to the success of a long-span FPD [22].

Split prosthesis: It is a prosthesis which is split longitudinally in an attempt to distribute the stress in a long span FPD more favourably over a larger area. This prevents stress concentration in the mandibular symphysis region in cases of long span bridge crossing the midline in the mandible.

Distal cantilever: Distal cantilever, though portrayed very negatively in the literature can be one of the ways to counter the MMF. There is consensus that an increase in abutment teeth with a reduction in the number and size of cantilevered pontics is essential. Although abutments should have suitable periodontal support, investigators have demonstrated that extensive cross-arch FPDs with cantilevers can be inserted with a minimal periodontal ligament support if the occlusion is stable and harmonious. The deflective capacity of the cantilever with the stimulation of the mechanoreceptors in the periodontium reduces the stress on the restoration aiding the compromised periodontal ligament.

Impression making in physiological rest position: Also known as stress free method because the jaw opening and closing muscles are in tonic balance [23].

Case Report

A 22 year old female patient reported to the Department of Prosthodontics, Chandra dental college and hospital, Lucknow, with the chief complaint of missing lower anterior teeth. The period of edentulism was approximately 5 years. The Oral Examination revealed missing 31, 32, 33, 41, 42, 43. The Radiological evaluation of the patient consisted of OPG and I.O.PA x rays in the region of 34, 35, 36, 44, 45, 46. The OPG and the IOPA x-rays revealed healthy abutments with good bone support. There was no evidence of any periapical pathology. The width of periodontium was normal and the lamina dura were intact. Clinically the abutments were evaluated for periodontal health and the health of periodontium was found to be excellent.

Patient was told about various treatment modalities e.g. Implant prosthesis, fixed dental prosthesis and Cast partial denture. Special emphasis was placed on implants because of her age. The patient however, did not want to go for any surgical procedure and therefore she opted out of the implants. The patient wanted the treatment in the form of Fixed Partial Denture. It was then decided to rehabilitate the case with 12 units FPD using a Non rigid connector in the midline to counteract the effect of flexure of the mandible (Figure 1-3).



Technique:

Step by step procedure is described here:

1. Diagnostic impressions were made with alginate and poured in dental stone and diagnostic casts were obtained.
2. The diagnostic casts were mounted on the articulator to evaluate the existing occlusal pattern.
3. Teeth preparation of premolars and first molars on both sides was done for metal ceramic retainers (Figure 4).
4. The finish line was equi gingival shoulder finish line.
5. Putty wash reline impression technique was used for impression making. The final impression was poured in die stone (Figure 5).
6. Face bow transfer was done. The maxillary cast was mounted with the help of face bow. The mandibular cast was attached with the help of centric record on the semi adjustable articulator.
7. The provisional restorations were fabricated and were cemented with temporary luting cement.
8. Fixed partial denture Wax pattern was prepared with inlay wax. Key and key way non-rigid connector design was prepared in the midline (Figure 6).
9. Surveying was done to determine the position/parallelism of key and keyway.
10. The key and keyway design was modified from the conventional design. The matrix and the patrix were alongside each other, to accommodate for the medial flexure.
11. After Investing and Casting, metal try in was done (Figure 8-10).
12. After the trial, patient was sent and ceramic application was done (Figure 11-13).
13. The cementation was done with Glass-Ionomer cement. First the cementation of right segment was done and then the cementation of the left segment was done (Figure 14 and 15)
14. It is to be remembered that the key and the keyway are not cemented.



Discussion and Conclusion

As discussed earlier the mandible flexes towards the midline in the opening and protrusive movements [14]. The flexion of the mandible has a significant effect on long span prosthesis which cross the midline and extend beyond the mental foramina, bilaterally. This is a situation most commonly encountered in Long span FPDs joining anterior and posterior segments, utilizing either natural teeth or/ and implants as abutments. The phenomenon of flexure may result either in the failure of prosthesis or the failure of abutments [9]. In literature, a lot of ways have been discussed to counteract the effect of median mandibular flexure. One of the methods which can be successfully used is non rigid connector. In the above discussed case we have given a non-rigid connector in the midline to counteract the effect of flexure which will improve the prognosis of the prosthesis as well as the abutments considerably as there is an incorporation of non-rigid element in a rigid prosthesis. The incorporation of Non-Rigid component allow for the dimensional change of the mandible in flexure, without stressing the abutments. So, in effect this design becomes a stress breaking concept and the abutment and prosthesis are not unduly stressed because of the phenomenon of MMF.

The incorporation of key and keyway Non rigid connector is simple yet very precise and effective because the prosthesis is not rigidly connected where it crosses the midline; it negates the detrimental effect of MMF on the abutments as well as the prosthesis. Mandibular flexure is a concept which is still not clearly understood and the extent to which it is relevant clinically, yet to be clearly ascertained. Further research and understanding of the concept will lead to better prosthesis designing in the mandibular arch, be it natural tooth supported prosthesis or Implant supported prosthesis.

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