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Mandibular Width and Length Deformation During Mouth Opening in Female Dental Students

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Abstract: The aim of this clinical study was to examine the mandibular flexure in two transverse and longitudinal dimensions of female dental students. Thirty-five fully-dentate female dental students were selected for the study. Intermolar, intercanine and canine to second molar distance in the most open position and occlusion were measured using the Mitutoyo digital calipers. Lower arch width and length change were calculated and proposed as the mandibular flexure. Data were analyzed using one-way ANOVA and paired t-test. The mean reduction of intermolar and intercanine distance at maximum open and closed mouth positions was 0.19 and 0.17 mm, respectively. The mean longitudinal dimensional change of right and left side of the mandible was 0.05 and 0.15 mm, respectively. No significant differences was seen ($p = 0.76$). It is concluded that mandibular arch width in the posterior and anterior regions decreases at the most open position compared to rest position. Also, Increasing in longitudinal dimension of the lower arch between canine and second molar in maximum open position was seen.

Key words: Mandible, flexure, maximum open position, closed mouth position, female

INTRODUCTION

The proper direction of the lateral pterygoid muscles leads to contraction over the two halves of the mandible, resulting in mandibular flexure (Zarone *et al*., 2003). Simultaneous contraction of the lateral pterygoid muscles during mandibular opening and protrusion exerts a medial forward and downward traction of the condyles (Gates and Nicholls, 1981; Weinmann and Sicher, 1955; DuBrul and Sicher, 1954). Decreasing the mandibular arch width during maximum opening and anterior movement has been reported in several studies, which hypothesize that the lateral pterygoid muscles travel in a posterior-lateral direction and pull the mandible forward when forcefully contracted. Adduction occurs when the mandible is pulled forward and the condyles are pulled medially (Gates and Nicholls, 1981; McDowell and Regli, 1961; Osborne and Tomlin, 1964; Regli and Kelly, 1967; De Marco and Paine, 1974; Fischman, 1990).

There is a linear relationship between the degree of opening and mandibular flexure (Jiang and Ai, 2002). In addition, mandibular flexure probably represents a destructive factor on the dentoalveolar system in bruxers with periodontal problems. Moreover, clenching not only applies an additional force on teeth but can also lead to mandibular flexure (Korioth and Hannam, 1994).

Hobkirk and Schwab (1991) showed mandibular flexure in patients with at least two implants. The results revealed that the implant position change during mandibular flexure in the most open, protruded and lateral movements, which may be effective in fixed and removable prosthetic impression procedures and the occlusal bite records. However, Law *et al*. (2011) in their literature review reported that the clinical significance of mandibular flexure on the success of dental implant treatment is at this time unclear. This deformation of the mandible may result in biomechanical and prosthetic complications such as porcelain fractures, cement failures and open contacts (Zarone *et al*., 2003; Chen *et al*., 2000). Moreover, mandibular flexure may lead to postinsertion sore spots at the posterior borders of complete and partial removable dentures (Chen *et al*., 2000).

Impressions obtained with the mandible in a most open position will have the location of the teeth recorded in a more lingual position than would be found in the mandible at rest or in occlusion (Fischman, 1990), which creates two clinical problems. First, centric relation records may not exactly fit to the casts from impressions at the maximum open position. Second, interferences may occur when crowns and bridges made on casts from impressions at the most open position, are place on tooth intraorally.

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Based on the importance of mandibular flexure, the effect of this phenomenon on the width and length of lower arch were investigated on a group of female students of Mashhad Dental School.

MATERIALS AND METHODS

Subjects were recruited from the undergraduate female students in Mashhad Dental School. Thirty-five students volunteered to participate in the study. The age of the participants ranged from 22 to 25 years old. Inclusion criteria included complete class I dentition and same weight and height. Subjects with malocclusion, history of trauma to the mandible, orthodontic therapy, temporomandibular disorders and missing teeth were excluded from the study. Informed consent was obtained from all subjects, using a written form approved by the Ethic Committee of Mashhad University of Medical Sciences.

Deformation of the mandible was studied by the Mitutoyo digital calipers (Mitutoyo Corporation, Tokyo, Japan) fixed on mandibular second molars and canines to record the lower arch width and length change in the most open position and occlusion. Posterior mandibular width change during mouth opening were recorded from the second molar buccal notch of one side to the second molar buccal notch of the opposite side (intermolar). In addition, mandibular width change in the anterior segment was recorded from the distal canine on one side to the distal canine on the opposite side (intercanine). For measuring mandibular length change during mouth opening, measurements were recorded from the distal aspect of the second molar to the distal aspect of the canine.

The main outcome measures were mandibular intermolar and intercanine width as well as right and left length change in the most open and closed mouth positions, which presented normal distribution and homogeneity of variances. Data were analyzed by one-way ANOVA and paired t-test at the 0.05 level of significance.

RESULTS

The results of mandibular deformation during mouth opening in each subject are presented in Table 1. The quantity of deformation represented the amount of arch width change at the intermolar (MM) and intercanine (CC) regions as well as arch length change at canine to molar in the right-side (CMR) and left side (CML) of the mandible. The range of changes at MM, CC, CMR and CML regions were as follows, respectively: -1.35-2.60, -0.53-1.14, -3.30-5.02 and -2.70-3.32 mm. As shown in Table 2, the average difference for intermolar and intercanine distance is positive (0.1894 for MM and 0.1671 for CC areas), which suggest that medial flexure occurs in the posterior and anterior regions during maximum opening compared to the mouth closed position. In addition, lower arch length change between the maximum opening and closed mouth position at both sides of the jaw is negative (-0.0519 for CMR and -0.1547 for CML areas), suggesting that this dimension in the most open position is greater than the length of the mandible in occlusion.

The mean measurements of dimensional change in four planes is analyzed using one-way ANOVA, which

Table 1: Intermolar (MM), intercanine (CC), canine to molar in the right-side (CMR) and canine to molar in the left-side (CML) change during mouth opening

No.	CML	CMR	CC	MM
1	-0.17*	0.62	0.46	0.46
2	-0.83	-1.01	0.06	0.32
3	-0.11	0.46	0.56	-0.40
4	2.81	-3.30	0.05	0.49
5	0.21	-0.43	-0.40	1.87
6	-0.91	0.63	-0.53	-0.99
7	-0.96	-1.69	1.01	0.01
8	-0.90	-0.52	-0.72	-0.24
9	-0.106	2.57	-0.49	0.63
10	-0.25	-0.79	-0.52	0.12
11	0.01	1.33	0.11	0.24
12	-2.70	2.58	0.37	0.12
13	0.80	0.24	-0.01	0.17
14	-0.88	0.89	0.63	-0.15
15	1.15	0.14	0.62	-0.14
16	0.44	-0.01	0.69	0.42
17	-0.20	1.60	0.90	0.70
18	3.32	5.02	0.96	0.13
19	0.65	0.41	0.05	-0.39
20	-2.52	0.75	-0.07	0.49
21	-1.02	-0.16	-0.65	0.04
22	-1.37	-1.07	0.54	-1.35
23	-1.73	-2.10	-0.01	0.73
24	2.41	0.71	0.34	2.60
25	-0.34	-1.54	0.09	0.44
26	0.24	0.61	-0.12	1.32
27	-0.09	-1.81	1.14	0.53
28	-0.34	1.24	-0.18	0.04
29	0.20	0.00	-0.27	-0.13
30	-0.77	-1.96	0.65	-0.20
31	1.23	-1.18	0.16	-0.37
32	-0.55	-0.77	-0.13	0.25
33	-0.85	-0.76	-0.16	-0.13
34	0.05	-2.53	0.26	0.03
35	-0.38	0.02	0.47	-1.09

*Mean distortion values, Negative values represent the increase of arch length or width

Table 2: Means and standard deviations for mandibular deformation obtained on mouth opening

Measurement areas	N	Mean (mm)	SD
MM	35	0.1894	0.73809
CC	35	0.1671	0.49155
CMR	35	-0.0519	1.60498
CML	35	-0.1547	1.27176
Total	140	0.0375	1.11329

showed that there is no statistically significant difference between the values obtained in the four groups (p = 0.76).

DISCUSSION

The consideration of mandibular flexure during various types of jaw movements is an important factor in determining the appropriate strategy for restorative treatments of the lower jaw. Lateral pterygoid muscle contraction results in mandibular flexure. It has been shown that mandibular medial flexure is more obvious in women (Chen *et al*., 2000).

In the present study, the effect of the mandibular flexure on width and length deformation of lower arch in a group of female dental students was evaluated. To eliminate bias in the current study, all subjects were selected with class I complete dentition.

It is important to note that the present study is the first research which evaluates mandibular deformation in both anterior (intercanine) and posterior (intermolar) regions, while previous studies have assessed the mandibular flexure only in the posterior area (Burch and Borchers, 1970; Chen *et al*., 2000; De Marco and Paine, 1974; Fischman, 1990; Gates and Nicholls, 1981; McDowell and Regli, 1961; Regli and Kelly, 1967). Also, the mandibular length changes have been investigated for the first time in our study.

Posterior and anterior arch width changes in the most closed and maximum open positions were investigated. The mean measurements of posterior and anterior width deformation were 0.19 and 0.17 mm, respectively. These dimensions of the mandible in the maximum open position were smaller than the closed mouth position. The mandible exhibits elastic behavior under functional forces, which may be due to its horseshoe shape, the different direction of masticatory muscles and bone density (Korioth and Hannam, 1994; Misch, 2008). Burch and Borchers (1970) found that the mandible changed by as much as 0.438 mm between maximum open and closed mouth positions in the first molar region. A study by Chen *et al*. (2000) demonstrated that the mandibular flexure in the first molar region was 0.20-0.43 mm.

According to the results of the current study, the effect of mandibular flexure/tension in anterior segment is less than posterior region. It can be explained by the distance between the anterior segment of the mandible from masticatory muscles. It has been suggested that the prostheses made in anterior region demonstrated better prognosis (Misch, 2008). De Oliveria and Emtiaz (2000) found a relationship between mandibular flexure and the inconvenience of patients treated with implant.

Increasing in longitudinal dimension of the lower arch between canine and second molar during mouth opening was seen, which may be due to mandibular flexure. Bending the mandibular ramus inward would cause tension along the body of the mandible, which may lead to a minute elongation of the lower arch. The mean length change in right and left arches was 0.05 and 0.15 mm, respectively. Although, the mean measures of length change in the most open and closed positions were greater in left side, there were not statistically significant differences.

It is important to note that mandibular flexure during mouth opening may affect on occlusal stability, implant prognosis, crown and bridge fitness and removable denture stability. Therefore, impressions should be performed with the patient's mouth in a most closed position. Long span fixed dental prostheses also should be avoided.

In the further studies, evaluation of mandibular flexure on fixed and removable prosthetic failures as well as the effect of masticatory muscles and ramus shape in patients with parafunctional habits will be investigated.

CONCLUSION

It is concluded that mandibular arch width in the posterior and anterior regions decreases at the most open position compared to rest position. Also, Increasing in longitudinal dimension of the lower arch between canine and second molar in maximum open position was seen.

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