

MANDIBULAR RANGE OF MOTION AND ITS RELATION TO TEMPOROMANDIBULAR DISORDERS

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ABSTRACT

INTRODUCTION: One of the most important signs and symptoms of temporomandibular disorders (TMD) is deviation or restriction in the mandibular range of motion. Limited or increased movement is considered as a sign of dysfunction, so measurement and evaluation of mandibular movement ranges are considered important parameters within the clinical examination and a significant component in the treatment and follow up of the temporomandibular disorders.

MATERIAL AND METHODS: A total of 34 articles are included in this comprehensive review of the relevant studies on mandibular range of motion related to temporomandibular disorders. This review provides summarized clinical and cephalometric analyses focused on the three planes of the mandibular range of motion used in all classifications and diagnostic criteria for temporomandibular disorders.

RESULTS AND CONCLUSION: The majority of the studies show variations in the degree of mandibular movements in patients with TM pathology. This review of the literature presents a synthesized version of the basic parameters of the mandibular movements that can be considered in the diagnosis of temporomandibular disorders in accordance with the postulates of the relevant research and diagnostic criteria.

Keywords: *mandibular range of motion, temporomandibular disorders, RDC/TMD, interincisal distance*

INTRODUCTION

Muscle and TMJ disorders are often causes of limited mandibular movements. Some studies have pointed to significant differences in mandibular

movement between asymptomatic subjects and patients with TMD. One of the most important signs and symptoms of TMD according to the American Dental Association is deviation or restriction in the mandibular range of motion. Limited or increased movement is considered as a sign of dysfunction, so measurement and evaluation of mandibular movement ranges is an important parameter within the clinical examination and a significant component in the treatment and follow up of the temporomandibular disorders. According to the condensed version of Research Diagnostic Criteria for the Temporomandibular Disorders (RDC/TMD), myofascial pain with limited opening group requires pain-free unas-

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sisted opening < 40 mm and passive stretch \geq 5 mm; for Disc displacement without reduction with limited opening group – unassisted opening (even painful) \leq 35mm and passive stretch \leq 4 mm and contralateral excursion < mm or uncorrected ipsilateral deviation on opening; Disc displacement without reduction without limited opening group requires unassisted opening (even painful) > 35mm and passive stretch > 4mm and contralateral excursion \geq 7mm (12).

DEFINITIONS

Normal mouth opening has been defined either as the interincisal distance or as the interincisal distance plus the overbite. Interincisal opening has been defined as “the greatest distance between the incisal edge of the maxillary central incisors to the incisal edge of the mandibular central incisors at the midline when the mouth is open as wide as possible. Measurement of the interincisal distance plus overbite means measurement of the vertical distance traveled by the mandible. An advantage of the incisal edge distance measurement is that the measuring point is relatively more permanent and more easily determined. (1,22,25) Measurements using a millimeter ruler have been used for assessment of mandibular mobility in large population studies, and measurement reliability has been shown to be very good (21).

VERTICAL RANGE OF MOTION

There is a wide range of values of mouth-opening capacity that are considered to be normal. Values from 32 mm to 77 mm have been reported in the literature for adults. Severely restricted mouth opening may occur as a result of intra or extra capsular pathology of the TMJ. Studies of asymptomatic subjects demonstrated that 1.2% of young adults and 15% of an elderly group opened their mouth less than 40 mm (23). The average intrinsic vertical mouth opening measures 40-50mm, an opening of 25-35mm is functional, and 10-24mm is severely limiting. (14) The cutoff values for restricted opening are less than 40 mm for muscular disorders and less than 35 mm for joint-related disorders (12). Some researchers judge the opening to be limited if the interincisal distance is <40 mm. Whereas other investigators consider <35 mm for men and <30 for women as restricted opening (14). Landtwing (20) stated

that 36-38 mm incisal edge distance is regarded as the minimal limit for adultsq while some other researchers report as normal an average maximum opening of 43.4 mm. Ingervall (17) recorded a value of 52 mm (range 33-65 mm), while Agerberg (1) found the mean to be 58.6 mm (range 44-77 mm) in men and 53.3 mm (range 42-75 mm) in women. Travers et al. (31) found a mean value of 46.6 mm for women. According to Bumann (5) the mean of normal mouth opening averages 53–58 mm. Uzunov et al. (33) investigated the range of interincisal opening among the Bulgarian population. The study comprised of 100 subjects with equal male to female ratio i.e. 50 of each, and age range 18-50 years. The average mouth opening of males was 51.76 mm, and of females – 47.56 mm. The minimum/maximum mouth opening of males was 33.51 mm/69.20 mm, and of females – 25.26 mm/59.00 mm.

Research has shown that the measurement of mouth opening varies significantly with age, gender and race. The significant difference of values between men and women is likely due to the differences in anatomic characteristics between the genders. Men have a tendency to open on average 5 mm more than women (29). According to Cortese (9) measurements range from 40 mm to 77 mm in men, with more frequent values around 50-60 mm, and from 32 mm to 75 mm in women, with more frequent values around 45-55 mm. Travell (31) found that the average maximum opening value was 59 mm (range 50 to 73 mm) in men and 53 mm (range 45 to 65 mm) in women. He concluded that the average normal maximum opening should not be less than 50 mm for men and 45 mm for women. The results of Rosenbaum (29) were similar, with an average maximum opening of 44.9 mm in the adults. Rieder (28) found that the mean maximum mouth-opening was between 40-60 mm in men and 35-55 mm in women. A research by Kardari (18) showed maximum mouth opening values slightly higher in women than in men. Ingervall's findings (16) suggest that the maximum jaw opening varies depending on the length of the mandible, the length of the anterior cranial base and ramus inclination. Maximum mouth-opening significantly increase when the overjet exceeded 5 mm. Excessive or even negative overjet is positively associated with TMJ pain. The subjects with an overjet of more than

5 mm show a mean mouth opening of 44 mm instead of 42 mm observed in subjects with smaller overjet. Subjects with a normal or greater overbite exhibited a smaller maximum opening capacity compared to those with small overbite or open bite. Racial differences are believed to affect the degree of mouth opening. Mouth opening values of Asians seem to be smaller than those of Caucasians (13). According to Kitsoulis et al. (19) the mean mouth opening in Greeks (aged 18-26 yrs, mean 19.6 yrs) was: 46.56 mm in men, 44.43 mm in women and 45.09 mm for the overall population. For Arabic population the lowest mean value for males is between the ages of 40 and 50 years (41.15 mm), and for females at the age of 30 to 40 years (33.45 mm). Yao et al. (34) found for the Chinese population that maximal unassisted mouth opening (MMO) significantly decreased with the increasing of age. The average MMO values were 51.11±6.47 mm for the young, 48.45±5.76 mm for the middle age and 46.62±5.71 mm for the senior age groups. For every 10 yrs MMO decreased by about 1.4 mm in men and 0.9 mm in women. For the age range of 20–80 years, the authors gave the following regression equation: MMO (mm) = 56.60 – 0.14 x age, for males; and MMO (mm) = 52.33 – 0.09 x age, for females. They concluded that gender and age had significant influences on the MMO value and age was a significant predictor of MMO measurements.

LATERAL AND PROTRUSIVE RANGE OF MOTION

Lateral movements of less than 8 mm are classified as restricted (some authors set the cut-off point

to 7 mm). The mean values of protrusive movements usually range from 8.8 to 9.5 mm (6,24). Protrusive movements of less than 7 mm are considered to be restricted, although they are not always signs of pathology that urgently calls for treatment. The results of Buschang et al. (6) suggest that in women laterotrusion to the right is greater (11.45 mm) than laterotrusion to the left (10.98 mm). For 41 adults aged 21 to 44.8 years it is found a mean value of laterotrusion to the right 10.6±2.1 mm, and to the left 10.7±2.1 mm, thus there were no significant differences between the right and the left side. Reicheneder et al. (27) found that both in adults and in children the difference between the mean laterotrusion to the right (12.2 mm) and left (11.7 mm) was not significant. Piehslinger et al (24) reported a significant difference between the mean lateral movements in male volunteers (right – 11.1 mm; left – 11.12) and male patients with TMD (right – 9.54 mm; left – 9.37). There are significant differences in length and form of protrusive movements of left and right joints between asymptomatic subjects and patients with TMD. The values of opening, lateral and protrusive movements could not reliably differentiate between patients with osteoarthritis, arthromyalgia, arthromyalgia with disk condyle incoordination and disk condyle incoordination. In a research by Kardari (18) women showed a more restricted laterotrusion than men. Laterotrusion to the left had greater values than to the right, contrary to the majority of studies. Badel et al (3) reported that the increase of the left laterotrusion by 1 mm increased the right laterotrusion by 0.62 mm. Alpaslan et al (2) observed that the major-

Table.1. Range of mandibular movements of asymptomatic men and patients with muscle and TMJ disorders (7)

	Mouth opening mm		Right lateral shift mm		Left lateral shift mm		Protrusion mm	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Age of all groups : 19- 28 yrs								
Control group	40-61	49.89±5.27	4-14	8.36±2.46	3-14	8.34±2.49	3-11	6.16±1.90
Muscle disorder group	35-56	46.47±5.10	2-12	7.10±2.06	3-12	7.47±2.03	2-8	5.57±1.70
Disc displacement with reduction group	36-57	46.97±5.05	3-12	7.10±2.45	3-11	7.00±2.08	3-9	5.17±1.62
Disc displacement with reduction, associated with muscle disorder	37-58	47.93±5.60	3-11	6.87±2.19	3-11	6.97±2.95	2-8	4.87±1.61
Total in asymptomatic and TMD patients groups	35-61	47.82±5.26	2-14	7.69±2.43	3-14	7.74±2.38	2-11	5.68±1.84

ity of healthy people and TMD patients could move their jaw more to the left. The mean absolute difference between left and right movement (in mm) was 1.24 among healthy females, and 2.09 among healthy males. In the TMD group, the corresponding values were 2.62 and 2.83, respectively. In healthy subjects, the mean ratio between opening and left excursion was 5.0, and between opening and right excursion was 5.5. In a TMD group, the corresponding values were 4.6 and 6.1. The authors concluded that moderate deviations from symmetric movements (mean: 1.2 mm for women, 2.1 mm for men) appeared to be the norm even in healthy individuals.

In the studies by Celic et al. (7, 8) the statistically significant differences in the range of mandibular movements clearly separated asymptomatic men and patients with muscle and TMJ disorders:

Blečić et al. (4) stated that myofacial pain had a huge influence on mandibular mobility. They observed a significant difference between patients with myofacial pain of the masticatory muscles and healthy controls in relation to unassisted opening without pain, maximal unassisted opening, assisted opening and protrusion:

De Leeuw et al. (10) observed that:

- ❖ a. Mandibular movement capacity was more often restricted in joints of the reducing disc displacement (RDD) and non-reducing disc displacement (NRDD) group than in joints of the control group.
- ❖ b. The mean maximal mouth opening was significantly larger in controls than in patients.
- ❖ c. No differences between patients and controls were found in horizontal movement rang-

Table 2. Mandibular movements in patients with myofacial pain of the masticatory muscles and healthy controls (4)

Movements in mm	Unassisted opening without pain	Max. unassisted opening	Assisted opening	Right excursion	Left excursion	Protrusion
Control group, 30-57 yrs	51.36±5.35	51.37±5.34	52.43±5.33	10.59±2.09	10.59±1.89	11.12±2.04
Myofascial pain group, 29-52 yrs	42.64±8.60	48.01±8.43	49.19±8.58	9.89±2.10	10.01±2.56	9.12±2.15

In spite of these findings, they could not conclude that measurements of mandibular movements could discriminate one group (TMD patients) from the other (asymptomatic subjects), because the mean ranges of movements of the majority of TMD patients were measured in clinically normal values.

es. d. Even though more than 90% of the patients could attain a mouth opening of 35 mm or more, the mean maximal mouth opening of the patients was smaller than that of control subjects, as was the joint mobility. The mean maximal movement ranges were:

Table 3. Mean maximal movement ranges of patients with reducing and non-reducing disk displacement (10)

	Mean age	Mouth opening mm	Lateral excursion to affected side mm	Lateral excursion to unaffected side mm	Protrusion mm
Control gr.	58.9 yrs	47.9 ± 7.2	9.1 ± 3.6	8.6 ± 3.9	8.0 ± 2.7
Reducing disc displacement group	58.2 yrs	44.5 ± 6.5	8.5 ± 2.8	8.0 ± 3.0	7.8 ± 2.0
Non-reducing disc displacement group	58.2 yrs	42.1 ± 6.8	8.0 ± 2.8	7.6 ± 3.1	7.3 ± 2.9

RATIO BETWEEN VERTICAL AND THE HORIZONTAL RANGE OF MOTION (ROM)

The ratio between the vertical and the horizontal ROM is used to predict the vertical ROM on the basis of the horizontal ROM and vice versa. Hochst-edler et al. (16) suggested using the ratio of maximum opening to lateral movement, instead of the simple MMO measurement, to evaluate TMJ function. This ratio was found to be 4.4:1 in normal subjects. However, the authors stated that in patients with intracapsular and extracapsular disorders, both components of the ratio might be affected similarly, with the risk that limitations in all movements might yield a “normal” ratio, even though dysfunction was present. Dijkstra et al. (11) found that this ratio was from 6.0:1 to 6.6:1 (on an individual basis from 3.6 to 15.5), rather than 4:1 as suggested in the literature, and concluded that the ratio had poor predictive value.

CONCLUSION

The most common values of the normal movement range established for adults in the literature are as follows: mouth opening: from 35 to 60 mm, average 53.3-58.6 mm, lateral excursions and protrusion: from 7 to 10 mm. Differences across studies are mainly due to methodological discrepancies; the anthropometric data in the studies is directly relevant to the racial profile that makes up a population group. Studies evaluating lateral and protrusive movements in asymptomatic and symptomatic subjects have suggested varied results. In the majority of studies lateral movements are ranged from 7 to 10 mm or from 8.7 to 11.1 mm.

Mandibular movement ranges vary greatly from one subject to another and their numerical values are not indicators of dysfunction unless they are associated with pain or other symptoms. Their evaluation is recommended by many authors as a diagnostic criterion in the assessment of temporomandibular disorders. Early recognition of limited or increased mandibular movements is necessary for a prompt and efficient approach to diagnosis and to plan out the treatment options. Knowing numerical values of the normal range of mandibular movements serve as a guide for treatment and diagnosis of diseases which directly or indirectly affect jaw movements.

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