

# Clinical Utility of Mandibular Movement Ranges

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*The range of mandibular movements was studied on 600 randomly selected people. Mandibular mobility varied widely from subject to subject. There were considerable age and sex differences but no differences were found between the mobility values of persons who were functionally healthy and those with dysfunctions. These factors make it difficult to construct cutoff values that reflect normalcy in mandibular mobility and thus render the clinical utility of such values questionable. The use of age- and sex-corrected border values for mandibular mobility is proposed. The clinical utility of patients' opinions concerning mouth-opening capacity is stressed. On the basis of statistically significant differences, the use of different border values for the protrusive and laterotrusive movements seems to be necessary.*

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**R**estricted mandibular mobility is commonly accepted as one of the main signs of mandibular dysfunction, and so it is an important variable in evaluating the functional state of the masticatory system. According to Agerberg,<sup>1</sup> the lower limit of normal mandibular opening movement is 40 mm; that of horizontal movements of the mandible (protrusion, right and left lateral movements) is 5 mm. He proposed the use of different cutoff values for the opening movement for men (42 mm) and women (38 mm), as well as for children<sup>2</sup> (35 mm) and elderly people<sup>3</sup> (37 mm for men, 35 mm for women, and 32 mm for complete denture wearers).

Helkimo's Clinical Dysfunction Indexes<sup>4</sup> are based on the same lower limit for the opening movement (40 mm) but on somewhat greater values for horizontal movements (7 mm). His system does not allow any differentiation in mobility values between the two sexes or among persons of different ages.

Previous investigations<sup>1-8</sup> have shown that the range of mandibular movement varies considerably from one individual to another. Statistically significant differences in jaw mobility are present between men and women<sup>1,5,7</sup> as well as between young and old people.<sup>1,3,5</sup>

Conflicting information concerning mandibular mobility from the patient history and from the clinical investigation is often confronted in clinical practice. Patients with jaw opening values well over 40 mm may complain of restricted mobility, while some patients with opening values below 40 mm (the lower limit of "normal") do not have any complaints.

Considering these discrepancies, it is highly questionable whether measurements of mandibular mobility are valid means in deciding whether a person is suffering from mandibular dysfunction.

The aims of this study were to: (1) Analyze the range, age, and sex variability of mandibular mobility in a randomly selected,

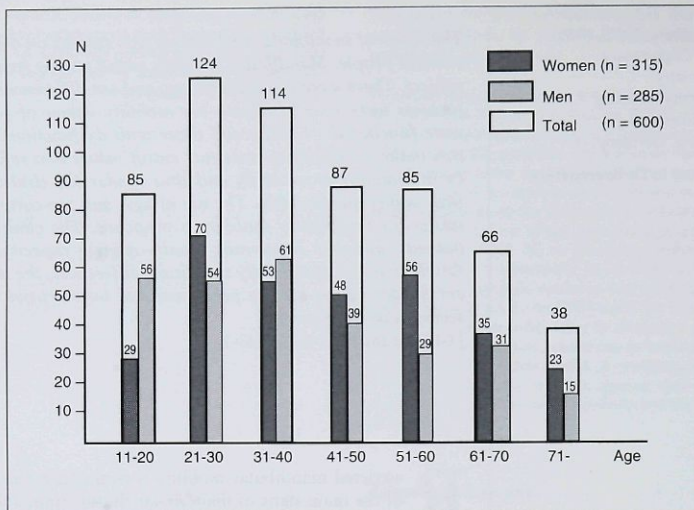


Fig 1 Sex and age distribution of the sample (n = 600).

healthy population; (2) Prove or disprove the validity of existing cutoff values as criteria of impaired mandibular mobility; and (3) Analyze the clinical utility of impaired mandibular mobility as a sign of mandibular dysfunction. The data of a previous epidemiologic investigation on mandibular dysfunction were reevaluated.<sup>8</sup>

## Materials and Methods

The mandibular mobility of 600 persons between 12 and 85 years of age (mean age 40.7 years) was measured to the nearest millimeter according to Agerberg's<sup>1</sup> method. The sample consisted of 285 men (47.5%, mean age 39 years) and 315 women (52.5%, mean age 42 years). Sex and age distribution of the sample are shown in Fig 1.

The sample comprised patients who had been screened at the radiography clinic in the Hungarian town of Szeged, where all citizens are contacted, in alphabetical order, for annual compulsory screening. The clinic receives an average of 500 persons each day. Of these, every 20th was

selected for this investigation, providing a perfectly randomized sample.

The measurements included the range of mandibular opening, protrusion, and right and left lateral movements. Signs and symptoms of craniomandibular dysfunction have been assessed according to Krogh-Poulsen<sup>2</sup>, Agerberg,<sup>1</sup> and Helkimo<sup>4,10</sup> and expressed numerically in the form of Helkimo's anamnestic (A<sub>1</sub>) and clinical (D<sub>1</sub>) dysfunction indexes.<sup>8</sup>

The dependence of mandibular mobility on sex, age, and functional state of the masticatory system has also been studied.<sup>5,8</sup> Mean values, range, and standard deviation of the mobility data were calculated for the whole sample, for men and women separately, and for seven different age groups.

Furthermore, the sample was divided in two subgroups: functionally healthy persons (n = 257), and dysfunctional persons (n = 343). A patient was considered functionally healthy when the sign complexes B, C, D, and E of Helkimo's index had a value of 0. Sign complex A (mandibular mobility) as the criterion under investigation was not considered. Thus, subjects with restricted man-



**Table 1** Differences in Mandibular Mobility (in mm) Between Men and Women

Movement	Men (n = 285)		Women (n = 315)		Both (n = 600)		P
	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	
Opening	30-78	53.3 (7.3)	27-66	49.1 (6.6)	27-78	51.1 (7.3)	*
Protrusion	0-15	7.1 (2.3)	0-13	6.6 (2.2)	0-15	6.9 (2.3)	*
Right laterotrusion	0-16	9.6 (3.2)	0-15	8.5 (3.0)	0-16	9.0 (3.2)	*
Left laterotrusion	0-16	9.8 (2.9)	0-16	8.8 (3.0)	0-16	9.3 (3.0)	*

\*Indicates significance ( $P < .05$ ).

**Table 2** Mean Values of Variables of Mandibular Mobility (in mm) According to Age (n = 600)

Movement	Age						
	11-20	21-30	31-40	41-50	51-60	61-70	71+
Opening	55.6	53.1	52.1	50.2	47.7	46.8	48.0
Protrusion	7.7	7.1	7.0	7.0	6.4	6.3	5.4
Right laterotrusion	10.0	9.7	9.1	9.4	8.2	7.6	7.5
Left laterotrusion	10.7	9.6	9.3	9.6	8.3	8.2	8.3

dibular mobility as the sole sign of mandibular dysfunction were included in the subgroup of the functionally healthy. All other subjects were classified dysfunctional.

Finally, interdependencies of three major signs of craniomandibular dysfunction were studied: impaired mobility, pain, and TMJ sounds.

### Statistical Methods

Range, mean, and standard deviation of the four components of mandibular mobility were calculated for the whole sample and for men and women separately. Statistical significance was set at  $P < .05$ . Sex differences as well as mobility differences between the two subgroups (healthy and dysfunctional) were investigated by means of Student's *t* test. Differences in mobility between different age groups were tested by means of variance analysis. Statistical work was carried out on a Videoton R-10 computer.

### Results

Mandibular mobility varied widely, with ranges to 51 mm for the opening movement and 16 mm for the horizontal movements. Both the vertical and horizontal components of mandibular mobility were significantly larger in men than in women. The mean value of protrusive movement (6.9 mm)

**Table 3** Mandibular Mobility (in mm) According to the Functional State of the Stomatognathic System (n = 600)

Movement	Healthy (n = 257)	Dysfunctional (n = 343)	P
Opening	51.7	50.6	NS
Protrusion	6.8	6.9	NS
Right laterotrusion	9.2	8.9	NS
Left laterotrusion	9.4	9.2	NS

was significantly smaller than that of either lateral movement (9.0 mm and 9.3 mm) (Table 1).

All measurements of mobility peaked in the 11- to 20-year-old subjects (Table 2). From there a slow but steady decrease could be observed parallel with aging. This decrease proved to be statistically significant.

No statistically significant differences in mobility could be observed between the groups of the healthy and dysfunctional persons (Table 3). Mandibular mobility was by far the most independent sign in our sample (Table 4). Opening movement was impaired in less than 5% of the samples, while in almost half of the subjects protrusion proved to be under the limit of normal (Table 5).

Impaired mandibular mobility, as determined by using Helkimo's border values of 40 mm and 7 mm, was the most common objective sign in this

**Table 4** Distribution of the Single or Combined Presence of the Three Major Objective Signs (n = 600)

Sign	Distribution (%)	
	with other signs	As a single sign
Pain on palpation or pain on movement	83.6	16.3
Joint sounds	66.7	33.3
Impaired mobility	52.7	47.3

**Table 5** Distribution of the Different Components of Impaired Mobility (n = 600)

Movement	Distribution (%)
Opening	4.5
Protrusion	44.5
Right laterotrusion	21.5
Left laterotrusion	16.3

**Table 6** Distribution of the Three Major Dysfunction Signs (n = 600)

Sign	Distribution (%)
Impaired mobility	53.5
TMJ sounds	46.5
Pain	18.3

**Table 7** Frequencies (%) of Impaired Mandibular Mobility (n = 600)

Method of determination	Distribution (%)		
	Men	Women	Both
Subjective	1.1	3.2	2.2
Objective	46.1	60.0	53.5

**Table 8** Proposed Cutoff Values of Mandibular Opening (in mm)

	Age		
	≤ 30	31-60	≥ 61
Men	44	42	40
Women	40	38	36
Both	42	40	38

sample (Table 6) and was found about 2.5 times more frequently than was determined by patient history (Table 7).

## Discussion

In light of the data found in this study, impaired mobility, as determined by the border values of Helkimo,<sup>4</sup> is a highly unreliable sign of mandibular dysfunction. Considering the broad ranges of all basic mandibular movements, as well as the considerable age and sex differences, it is questionable whether useful cutoff points can be defined for determining impaired mobility.

Comparable age and sex differences of mandibular mobility have been reported in several previous studies.<sup>11-13</sup> Agerberg<sup>1</sup> determined the lower limits of normal mandibular movements in young men and women by using the range  $\bar{x} - (2 \times SD)$  to  $\bar{x} + (2 \times SD)$ , which, at least theoretically, corresponds with 95% of a normal population. His values are somewhat lower than those reported by Helkimo,<sup>4</sup> and in the case of opening movement, different for men and women. In consecutive studies in children<sup>2</sup> and in 70-year-old persons,<sup>3</sup> Agerberg determined border values for these age categories as well.

Unfortunately, none of these specialized border values are being used in daily practice, and they are not generally considered in constructing dysfunction indexes routinely used.<sup>4</sup> The results of the present study confirm those of previous epidemiologic studies regarding age and sex. It is therefore proposed that Helkimo's dysfunction indexes be adjusted accordingly. In Table 8 a set of cutoff values for the opening movement is proposed, with both sex and age taken into account.

Even these adjusted border values should be used with utmost care in examination of patients, as they cannot be compared to the habitual mobility values of the individual obtained in a functionally healthy state. It is the intraindividual change in the extent of mobility that is clinically important, and not a meaningless cross-section value. A person whose mouth will usually open to 65 mm, and whose opening range is 48 mm at examination has a restricted opening. A person with a habitual opening of 40 mm who has an opening of 30 mm has a restricted opening as well. However, a person with a habitual opening of 38 mm (age 63) and whose measured opening is 36 mm does not have a restricted opening. Such interindividual differences are realistic, as was shown in the present study.

The patient's perception of changes in mouth



opening ability might be more meaningful and reliable than predetermined cutoff values. Starting values from a previous examination can serve as a reliable basis for subsequent control appointments.<sup>14</sup>

In this epidemiologic investigation Helkimo's indexes were used so that data could be compared with those of other studies. On this basis, considering only mandibular mobility, 53.5% of the otherwise healthy sample in this study falls below the limit of normal. If more than half of the healthy population proves to be abnormal as determined on the basis of a single sign, then either this criterion is wrong (ie, impaired mandibular mobility is not a criterion of mandibular dysfunction), the border values are incorrect (ie, too high), or the sample studied was in fact dysfunctional. Because muscle spasm, internal derangements, ankylosis, etc, may cause restricted mandibular mobility, the cutoff limits are too arbitrary to be clinically useful. If the proposed age- and sex-adjusted cutoff values (Table 8) are applied to this sample, the percentage of impaired mobility will decrease below 20; this is at least a more realistic reflection of the percentage of patients with a disorder characterized by restriction of movements without pain or clicking.

Another interesting finding of this study was the significantly lower mean value for protrusion than for either left and right laterotrusion movements.<sup>3</sup> Neither Agerberg nor Helkimo found such differences, nor has anyone else reported this finding.

Based on the findings of this study, it is proposed that the cutoff value for normal protrusive movement be at least 1 mm less than that for laterotrusion movements. The fact that comparable values were found for mobility in the healthy group suggests that dysfunctional patients were also included in this group. This is supported by the finding that mandibular mobility frequently occurs as a single sign, ie, without pain or joint sounds.<sup>15</sup>

Based on the evidence in this study, the three major signs of mandibular dysfunction form only a loose entity or none at all. People with pain or joint sounds might have absolutely normal mandibular ranges of movement, and, conversely, impaired mobility might be the only sign of a functional derangement of the craniomandibular system.

## Conclusion

Because mandibular opening and all three horizontal movement ranges vary widely in randomly

selected healthy urban populations, the determination of clinically useful cutoff values for normal mandibular movement is rather arbitrary. If such cutoff values are desired, sex and age differences must be considered also. A set of such values is proposed in this paper.

The mean values for the protrusive and laterotrusion mandibular movements differ significantly. Consequently, it is suggested that different cutoff values be used for these separate movements, ie, a somewhat lower one for the protrusive motion.

The different signs of mandibular dysfunction do not form an entity.

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## Resumen

### Utilidad clínica de los límites de extensión de los movimientos mandibulares

Se estudiaron los límites de extensión de los movimientos mandibulares en 600 personas seleccionadas al azar. La movilidad mandibular varió ampliamente de sujeto a sujeto. Se determinaron diferencias considerables en cuanto a la edad y al sexo, pero no se encontraron diferencias entre los valores de movilidad de las personas que estaban sanas funcionalmente, y aquellas que tenían disfunciones. Estos factores dificultan la construcción de valores limitrofes que reflejen normalidad en la movilidad mandibular, y por lo tanto hacen que la utilidad clínica de tales valores sea cuestionable. Se propone el uso de valores limitrofes corregidos en cuanto a la edad y al sexo, para la movilidad mandibular. Se enfatiza la utilidad clínica de la opinión de los pacientes en lo que se refiere a la capacidad de la apertura bucal. El uso de los diferentes valores limitrofes para los movimientos protrusivos y laterotrusivos parece ser necesario, basados en las diferencias estadísticamente significativas.

## Zusammenfassung

### Klinische Brauchbarkeit von Messwerten der mandibulären Mobilität

Das Ausmaß der Unterkieferbewegungen wurde an 600 nach dem Zufallsprinzip ausgewählten Probanden studiert. Die mandibuläre Bewegungskapazität zeigte von Proband zu Proband große Unterschiede. Alters- sowie geschlechtsbedingte Unterschiede waren beträchtlich, jedoch konnten hinsichtlich der Mobilitätswerte zwischen Personen, die funktionell gesund waren und jenen mit Funktionsstörungen, keine Unterschiede gefunden werden. Diese Faktoren erschweren die Konstruktion von Grenzwerten, welche die Normalität der mandibulären Mobilität anzeigen. Deshalb ist die klinische Brauchbarkeit solcher Werte fragwürdig. Die Anwendung alters- und geschlechtsberechtigter Grenzwerte für die mandibuläre Mobilität wird daher vorgeschlagen. Die klinische Nützlichkeit der Patientenmeinung hinsichtlich ihrer eigenen mandibulären Bewegungskapazität wird hervorgehoben. Die Anwendung von verschiedenen Grenzwerten für protrusive und laterotrusive Bewegungen scheint auf Grund von statistisch signifikanten Unterschieden notwendig zu sein.