ASSESSMENT OF MANDIBULAR MOVEMENTS IN 10 TO 15 YEAR-OLD PATIENTS WITH AND WITHOUT TEMPOROMANDIBULAR DISORDERS

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ABSTRACT

The aim of this study was to establish reference values for mandibular movements in 10- to 15-year-olds without dysfunction and compare these values to those in patients of the same age with tempromandibular disorders (TMD) and those found previously in a group of children younger than 11 years old without TMD. Children of both genders who visited the Department of Comprehensive Pediatric Dentistry at Buenos Aires University in 2013 and whose parents or guardians provided consent were evaluated using TMD/RDC by standardized pediatric dentists (Kappa 0.88). Three groups were formed according to diagnostic summary: Group C, without TMD; Group Ia, with myofascial pain, and Group Ib, pain with limited mouth opening. The following variables were analyzed: age, gender and mandibular movements. The sample included 169 patients aged 12.5±1.76 years, of whom 62.36% did not have TMD (C) while 37.27% were diagnosed with muscle disorder (29.58% Ia and 7.69% Ib). For Group C, the following values (in mm) were recorded: maximal unassisted opening: 48.28±6.14; right lateral movement 8.78±2.50; left lateral movement: 9.60±2.64; protrusion: 4.94±2.58 and overbite: 2.98 ± 2.5, with no variation associated to sex, but with differences in the values recorded for all movements compared to those obtained for mixed dentition (p= 0.0001). Analysis of mean values for mandibular movements in all 3 groups only revealed differences for maximal unassisted opening (p= 0.0317). With relation to gender, TMD was more frequent in females, with significant differences between Groups C and Ia (p= 0.019). In males without dysfunction, average maximal opening was 48.28±6.14mm, with lower values in patients with TMD. Mandibular movements in pediatric patients without TMD showed significant differences according to dentition type and age.

Key words: *Temporomandibular joint disorders; Facial pain; Children.*

VALORACIÓN DE MOVIMIENTOS MANDIBULARES EN PACIENTES DE 10 A 15 AÑOS CON Y SIN TRASTORNOS TÉMPORO-MANDIBULARES

RESUMEN

El objetivo del presente trabajo fue establecer valores de referencia de movimientos mandibulares en niños de 10-15 años sin disfunción; compararlos con los de pacientes de la misma edad con trastornos temporomandibulares (TTM) y con los hallados anteriormente en un grupo menor de 11 años sin TTM. Niños de ambos sexos que acudieron a la Cátedra Odontología Integral Niños de UBA en 2013 y cuyos responsables brindaron consentimiento fueron evaluados con CDI/TTM por odontopediatras estandarizados (Kappa 0.88) conformándose 3 grupos en función del resumen diagnóstico; C: sin TTM, Ia: con dolor miofacial e Ib: dolor con limitación de la apertura bucal, para el análisis de las siguientes variables: edad, sexo y movimientos mandibulares. La muestra quedó constituida por 169 pacientes de 12.5±1.76 años. El 62.36% no presentó TTM (C) y en el 37.27% se estableció un diagnóstico de trastorno muscular (29.58% Ia y 7.69% Ib). En C se registraron los siguientes valores en mm: Apertura máxima no asistida: 48.28±6.14; Lateralidad derecha 8.78±2.50; izquierda: 9.60±2.64; Protrusión: 4.94±2.58 y Sobremordida: 2.98 ± 2.5 sin variaciones en relación al sexo, pero con diferencias en los registros de todos los movimientos comparados con los obtenidos en dentición mixta. (p= 0.0001). El análisis de los valores medios de los movimientos mandibulares entre los 3 grupos sólo reveló diferencias para la apertura máxima no asistida (p= 0.0317). En relación al sexo, los TTM fueron más frecuentes en niñas siendo significativa la diferencia entre C e Ia (p= 0.019). En los niños sin disfunción se estableció una apertura máxima promedio de 48.28±6.14mm, observándose valores inferiores en los pacientes con TTM. Los movimientos mandibulares en pacientes pediátricos sin TTM mostraron diferencias significativas en función del tipo de dentición y la edad.

Palabras clave: *articulación temporomandibular; lesiones-dolor facial- niños.*

INTRODUCTION

Mandibular movement measurements are a simple but important parameter for evaluating and monitoring dysfunctions of the masticatory system known as temporomandibular disorders (TMD)[1]. In pediatric patients, multifactorial etiology for muscle dysfunction

is accepted; nevertheless, and less frequently, mandibular mobility can also be affected by causes such as severe trauma (fractures), developmental alterations, tumors and rheumatoid arthritis, among others.[2] The temporomandibular joint (TMJ) is affected in half of the children who have juvenile idiopathic arthritis, causing limited opening; thus, these measurements are also useful to rheumatologists[3,4].

TMJ development begins during the eighth week of intrauterine life and finishes in the second decade of life. Postnatal development is closely related to and interacts with maturation of masticatory and swallowing functions; growth of mandibular, masseter and temporal muscles; and development of dentition[5]. Monitoring TMJ physiological changes is relevant in pediatric patients. Condylar growth, like growth in general, slows during childhood, accelerates during adolescence and slows again after the pubertal growth spurt. Between the ages of 10 and 15 years, males have greater growth potential than females[6].

During mouth opening there are simultaneously rotational and translational movements of the two condyles and their disks along the articular eminence. The articular eminence and the temporomandibular ligament limit mouth opening. Mandibular closing movement should not be considered the inverse of opening because it is not limited by the same anatomical structures, but rather, the condyle moves against the anterior wall of the articular fossa through the muscles of mastication. During protrusion, the two condyles move forward and downward, making contact with the articular eminence. Lateral movements are more complex than opening or protrusion because they are asymmetrical, with the muscles on each side acting in different ways[1].

Very large range of movement (hypermobility) or limited range (hypomobility) are considered signs of dysfunction; therefore simple, objective recording methods and reference values are needed for each age group in order to facilitate TMD diagnosis[7].

There is little information in this regard for children, and the values reported are not consistent and have been gathered by means of different sampling and data recording methods[8].

In view of the difficulties caused by methodological differences for diagnosis, the International Association for Dental Research (IADR) adopted Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) (índex prepared by Dworkin and LeResche), which provide a standardized system for examining, diagnosing and classifying the most common subtypes of TMD[9]. These criteria, currently used by many research groups, have been validated in 18 languages for children as from 10 years of age, and were used for our study. The system has two components for evaluation. "Axis I" is a questionnaire and clinical evaluation designed to distinguish myofascial pain, disk displacement, arthralgia, arthritis and arthrosis[9].

The aims of this study were to establish reference values for mandibular movements in 10- to 15-year-olds without dysfunction and compare them to those of patients of the same age with TMD and to those found in a previous study on a group of children younger than 11 years old without TMD[10].

MATERIALS AND METHODS

Design, subject selection and methods

We designed an observational, prospective, cross-sectional study, which was approved by the Ethics Committee of the School of Dentistry at Buenos Aires University (code number 26/09/2012 – 27). We evaluated all 10- to 15-year-olds of both genders who sought care at any of the four different shifts at the Department of Comprehensive Pediatric Dentistry at Buenos Aires University from March to August 2013, whose parents or guardians provided consent for participation in this study. We excluded children with medical compromise; developmental, neurological and/or psychiatric disorders, and/or undergoing orthodontic treatment. Patients were evaluated using RDC/TMD Axis I by standardized pediatric dentists (Kappa 0.88). Data were entered into a spreadsheet (MS Excel 2010, version 14) for subsequent statistical analysis.

Three groups were formed according to the results of the RDC/TMD diagnostic summary: without TMD (C), with myofascial pain (Ia) and with limited mouth opening (Ib).

The following variables were analyzed: gender, age, overbite in mm, maximal unassisted and assisted mouth opening, right and left lateral movement and protrusion. Frequencies were estimated using percentages with confidence intervals (95%), and the rest of the quantitative variables were analyzed using means, standard deviation, Student and Welch test, ANOVA analysis of variance and Chi squared

with 95% significance. The values recorded for C were compared to previous findings for mixed dentition and to findings for Ia and Ib
Reference values for opening were calculated by subtracting overbite from maximal opening.

Clinical recording
Patients sat in a dental chair and were measured using a millimeter ruler.
Maximal Unassisted Opening. The patient was asked to open his/her mouth as wide as possible, even if it caused discomfort. The edge of the millimeter ruler was placed at the incisal edge of the upper central incisor and the distance between it and the incisal edge of the lower incisor (interincisal distance) was measured and recorded (Fig. 1).
Right and Left Lateral Movements. The patient was asked to open his/her mouth a little and move the mandible as far as possible to one side (right or left). With teeth slightly apart, the distance between the interdental space between upper central incisors and interdental space between lower incisors was measured and recorded, for both sides (Fig. 2).
Protrusion. The patient was asked to open his/her mouth slightly and protrude the mandible without interference from the incisors. The distance on the midline between upper and lower incisor edges was measured and recorded (Fig. 3).
Table 1 shows diagnostic criteria used[11].

Fig. 1: Recording Maximal Opening.

Fig. 2: Recording Lateral Excursion.

Fig. 3: Recording Protrusion.

RESULTS
The sample comprised 169 patients; mean age was 12.5 years, SD 1.76. Of these, 62.36% (54.59-69.67) did not have TMD (C), while 37.27% (CI 30-45,05) were diagnosed with muscle disorders: 29.58% (CI 22.80-37.09) in Group Ia and 7.69% (CI 4.14-12.80) in Group Ib.

Analysis of Group C: without TMD
Group C comprised 106 children, mean age 12.37± 1.6 years, of whom 41.50% (31.99-51.51) were female. Table 2 shows the average values for final maximal comfortable opening, with compensation for overbite, broken down according to age.
Comparison for maximal opening according to gender shows that males (age 12.5±1.55) had 48.38±6.47 mm and females (age 12.2±1.66) had 48.12±5.70 mm (p=0.83).
Values in mm were: maximal unassisted opening 48.28±6.14 (CI 47.1-49.46), right lateral movement 8.78±2.50 (8.30-9.26), left lateral movement 9.60±2.64 (9.09-10.11), protrusion 4.94±2.58 (4.44-5.44) and overbite 2.98 ± 2.5 (1.61-2.38). Values in mm found previously in mixed dentition in a group of 107 children, mean age 6.9±1.65 were:

Table 1: Summary of diagnostic criteria for TMD.

	RDC/TMD Diagnostic Criteria Axis I [11]
Muscle Disorders	Ia Myofascial pain: • Pain at 3 or more muscle points evaluated. • At least one of them matches the questionnaire report.
	Ib Myofascial pain with limited opening: • Pain similar to Ia • Unassisted opening < 40 mm • 5 mm or more difference with maximal assisted opening
Disc displacements	IIa Disc displacement with reduction • Reciprocal click 2 out of 3 consecutive times, or • Reproducible click on vertical movement 2 out of 3 consecutive times and reproducible click during lateral or protrusive excursion on 2 out of 3 consecutive times.
	IIb Disc displacement without reduction with limited opening • Significant history of limited opening • Maximal unassisted opening ≤35 mm • Increase in maximal opening by unassisted passive stretch ≤ 4 mm • Contralateral excursion <7 mm and/or uncorrected deviation to ipsilateral side during opening • Absence of noise or presence of noises that do not meet the criteria for IIa.
	IIc Disc displacement without reduction without limited opening • Significant history of limited opening • Maximal unassisted opening >35 mm • Increase in maximal opening by unassisted passive stretch ≥5 mm • Contralateral excursion ≥7 mm • Presence of noises that do not meet the criteria for IIa.
Arthralgia, osteoarthritis, osteoarthrosis	IIIa Arthralgia • Pain in one or both joints during palpation • One or more instances of self reported joint pain during maximal assisted and unassisted opening and during lateral excursion • Absence of crepitus.
	IIIb Osteoarthritis • Arthralgia similar to IIIa • Crepitus or radiographic evidence of arthrosis.
	IIIc Osteoarthrosis • Absence of signs of arthralgia • Gross crepitus or radiographic or radiographic evidence of arthrosis.

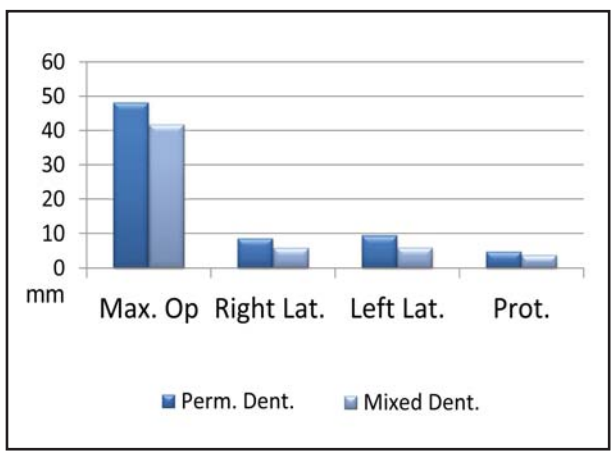

Fig. 4: Comparison of mandibular movements in permanent and mixed dentition.

maximal opening 41.9 ± 5.27 (40.96-42.98), right lateral movement 6.05±1.99 (5.67-6.43), left lateral movement 6.13±2.21 (5.75-6.51) and protrusion 3.96±1.92 (3.59-4.33)[10]. The differences recorded for all movements between the two groups were significant (p=0.0001, Fig. 4).

Analysis of Groups Ia and Ib

A total 63 patients had muscle disorders, 2 patients from Group Ia also had disc displacement with reduction (IIa) and 6 patients from Group Ib had disc displacement without reduction (IIb). Table 3 shows the composition both groups. The values in mm were: maximal unassisted opening 45.8±4.37, 33.38±5.63; right lateral movement 7.98±2.76,

8.53±2.25; left lateral movement 8.98±2.86, 9.30±2.78; protrusion 4.62±2.42, 4.92±2.49 and overbite 2.67±2.12, 3.38±1.93 for Groups Ia and Ib, respectively.

In Group Ia, 17 patients had lower values for maximal opening than those found for Group C, considered as reference values (42.14-54.42).

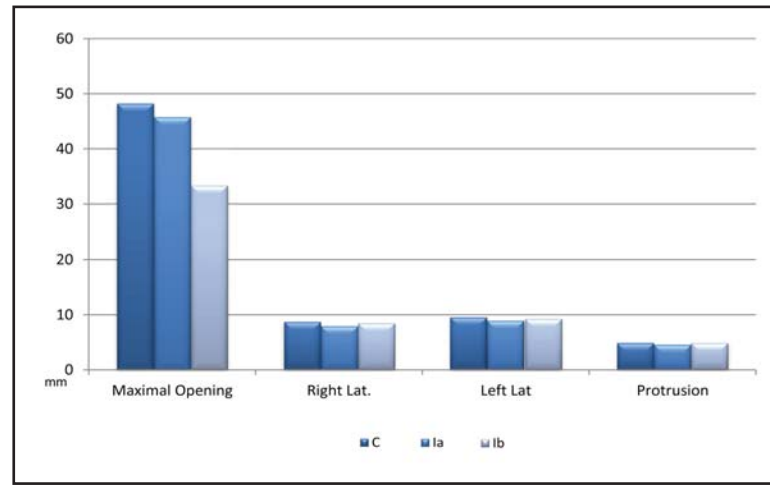

Fig. 5: Comparison of mandibular movements with and without TMD in permanent dentition.

Comparison of Groups C, Ia and Ib

Fig. 5 shows mean values for mandibular movements in all 3 groups.

TMD was more frequent in females, with significant difference between Groups C and Ia (p=0.019) (C-Ib p=0.100; Ia-Ib p=0.499).

Comparison of all 3 groups revealed significant differences for maximal unassisted opening (p= 0.0317), and no significant difference for the rest of the variables analyzed. Table 4 shows the p values.

DISCUSSION

There is little available information on mandibular movements in children, and results are inconsistent, possibly due to differences in recording methodology and inclusion criteria[12-16]. In a previous paper, reference values were established for primary and mixed dentition without signs of TMD[10].

Table 2: Distribution of maximal opening according to age.

Age	N	Maximal Opening (mm)	SD
10	15	44.0	3.5
11	22	46.9	6.3
12	21	49.7	5.7
13	17	47.3	6.6
14	19	51.9	6.1
15	12	49.3	5.2

Table 3: Composition of Groups Ia and Ib.

	Ia	Ib
N=	50	13
Age	12.57±2.05	13.30±1.47
Female	68% (53.26-80.51)	61.5% (31.49-6.25)

Reference values for maximal opening in a group of 4- to 17-year-olds have recently been published, though without prior evaluation of the TMJ; therefore the results reported with percentiles include people with dysfunction[3].

Cases have been evaluated with different methods, ranging from the very simple and imprecise, such as thickness of fingers, to the sophisticated, such as the system used by Hayasaki et al. on a small sample, which analyzes simultaneous movements in three dimensions[17-19]. In addition, pantographic and ultrasound systems have been designed and placed on the market, though there has been little application of them in epidemiological research and clinical practice[20].

The International Association for Dental Research (IADR) recommends the use of the RDC/TMD[21]. Their diagnostic parameters, which were followed

Table 4: Comparison of C, Ia and Ib (ANOVA).

	p=
Age	0.1828
Maximal opening	0.0317
• C –Ia	<0.05
• C-Ib y Ia-Ib	<0.001
Right lateral excursion	0.1788
Left lateral excursion	0.4114
Protrusion	0.7571
Overbite	0.5701

in this research protocol, do not discriminate variations in limited opening according to age.

Several studies have shown that opening increases progressively from birth to the end of adolescence and then decreases progressively with age[12, 22, 24]. Our study considered opening less than 40 mm to be limited, as provided in the RDC/TMD. Nevertheless, the group without TMD had a mean value of 48.28±6.14mm, therefore in this age range, openings lower than 43 mm should be considered limited.

The most extreme opening movements are observed at puberty, which is believed to be a consequence of the hyperlaxitude characteristic of this stage[25, 26]. The increase in values for mandibular movement with increasing age may be due to anatomical changes, maturation of the central nervous system, skeletal growth and maturation of the occlusal function[10,14,15,27,28]. Ingervall suggests that by 10 years of age, children have attained adult mandibular motion range[12]. Thus, statistically significant differences were found between values for Group C and those found previously in a group of children younger than 11 years for all variables in the mandibular motion ranges.

The values for protrusion movement that we found for Group C were noticeably lower than those reported by other authors[5,12,14,16,18] , which may be because they added overjet, which our study did not take into account[8,12,15,16,27]. For Group C lateral movements, our study found higher values than those reported by other authors[15,16,27].

Our results for patients without TMD according to gender are consistent with those published by Müller, who reported no significant difference in opening between genders up to the age of 13 years[3]. Female joints are usually more flexible and laxer than male joints, which would explain the greater incidence of temporomandibular dysfunction in females[1,8].

TMD frequency was 37.27%, with 29.58% in Group Ia and 7.69% in Group Ib. Hirsch reported for a group with mean age 13 years a frequency of 10.2 %, with 7.9% corresponding to IIa and 2.3 % to Ia, III a/b [8]. Our study only found 1.18% IIa and 3.55% IIb and high frequency of muscle disorders without movement limitation (Ia).

Pizolato et al. report 26.3% TMD in 8- to 12-year-old patients with no difference according to gender[29]. In contrast, other authors found prevalences of over 70% in older adolescent patients[30,31]. According to the RDC/TMD, Group Ia has no limitation of movement; nevertheless, in our study and applying those criteria, we found significantly lower maximal opening values compared to Group C.

Our sample is made up of patients from a pediatric dental care facility, where pathologies may be found more often than in the general population. It would be interesting to conduct a similar study on samples of the population not demanding care.

The results of this study may contribute to providing professionals with more precise indicators for early diagnosis of TMD in patients in an age range at which visits due to this problem are frequent and information is scarce and controversial.

CONCLUSIONS

Mandibular movements in pediatric patients without TMD showed significant differences according to age and dentition type. Average maximal opening was established at 48.28±6.14mm, with no difference according to gender.

In the 37.27% with TMD, maximal opening was significantly lower, at 45.8±4.37mm for the group with myofascial pain and 33.38±5.63 mm for the group with myofascial pain and limited opening.

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