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Quantitative evaluation of the orofacial morphology: Anthropometric measurements in healthy and mouth-breathing children

Débora Marins Cattoni (*University of Sao Paulo*)
Fernanda Dreux Miranda Fernandes *(University of Sao Paulo)*
Renata Cantisani Di Francesco *(University of Sao Paulo)*
Maria Do Rosário Dias De Oliveira Latorre *(University of Sao Paulo)*

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QUANTITATIVE EVALUATION OF THE OROFACIAL MORPHOLOGY: ANTHROPOMETRIC MEASUREMENTS IN HEALTHY AND MOUTH-BREATHING CHILDREN

DÉBORA MARTINS CATTONI, PHD
FERNANDA DREUX MIRANDA FERNANDES,
RENATA CANTISANI DI FRANCESCO, PHD
MARIA DO ROSÁRIO DIAS DE OLIVEIRA LATORRE

ABSTRACT

The anthropometric orofacial measurements of mouth-breathing children were compared to those of children with no history of speech-language disorders, according to age. Methods: 100 children participated, both males and females, with ages ranging from 7 to 11 years and 11 months, leukoderm, in mixed dentition period, with a mouth-breathing diagnosis. The control group was comprised of 254 children, of both sexes, with ages ranging from 7 to 11 years and 11 months, leukoderm, in mixed dentition period, with no history of speech-language disorders. The control group did not demonstrate any mouth-breathing. The children were submitted to anthropometric assessment and the orofacial measurements obtained were upper lip, lower lip, philtrum, upper face, middle face, lower face, and sides of the face. The instrument used was the electronic digital sliding caliper Starrett Series 727. There was statistically significant difference between the majority of the orofacial measurements of mouth-breathing children and the measurements of children with no history of speech-language disorders. Some orofacial measurements were different in the studied populations. The possibility of comparing orofacial measurements of children with and without mouth-breathing behavior allows the clinician to determine normal and altered structures of the orofacial morphology. The main advantages of the anthropometry are its noninvasive nature, its technological simplicity, low cost and objective analysis. The anthropometric procedures also have clinical applications in myofunctional assessment and therapy.

KEYWORDS: Anthropometry, Measures, Face, Stomatognathic system, Mouth breathing, Children, Mixed dentition.

INTRODUCTION

Many morphologic adaptations of the stomatognathic system, such as short upper lip, malocclusion, narrow hard palate, and dental arch, long lower face, can frequently be observed in mouth-breathing individuals (Andrade et al., 2005; Di Francesco, 2003a; Jardini, 1999; Junqueira et al., 2002; Lessa et al., 2005; Marchesan, 2000; Rodrigues et al., 2005; Seikel et al., 2005; Tessitore, 2004). Morphologic adaptations demonstrate the importance of investigating the height of orofacial structures from mouth-breathing children and compare them to the norms of children without functional disorders.

The knowledge acquired from anthropometry helps during the evaluation of the orofacial morphology and increases the precision of the obtained data and the accuracy of the analysis. The use of the caliper among speech-language pathologists is becoming more frequent because professionals wish to obtain quantitative and objective data from their clinic procedures (Bianchini, 2000; Cattoni, 2003a, 2004, 2006a, 2006b; Cattoni et al., 2003, 2005; Cattoni, Fernandes, 2004, 2005; Jardini, 1999, 2005; Junqueira, 2004; Marchesan, 1997, 1998, 2004; Pierotti, 2004; Quintal et al., 2004; Ríspoli, Bacha, 1998; Rodrigues et al., 2003; Silva, Cunha, 2003).

The anthropometric landmarks used to determine orofacial measurements are: glabella (g), which is the most prominent midline point between the eyebrows; trichion (tr), located on the hairline in the midline of the forehead; subnasal (sn), which is the midpoint of the angle at the columella base where the lower border of nasal septum and the surface of the upper lip meet; labiale superius (ls), located on the midpoint of upper vermillion line; stomion (sto), which is the imaginary point located at the crossing of the vertical facial midline and the horizontal labial fissure between gently closed lips; gnathion (gn), which is the lowest median landmark on the lower border of the mandible, exocanthion (ex), located at the outer comissure of the eye fissure; and cheilion (ch), which is the point located at each labial comissure (Farkas, 1994a).

Measurement norms for the face from healthy children and adults are available in the literature (Bianchini, 1998a; Budai et al., 2003; Farkas et al., 1992a, 1992b, 1994a, 2003; Gregoret, 1999; Langlade, 1995; Proffit, 1995; Rodrigues, 2000; Suguino et al., 1996). Recently, some studies investigated the orofacial measurements of Brazilian children without functional disorders (Cattoni, 2003a, 2003b, 2006b; Cattoni et al., 2003, 2005; Cattoni, Fernandes, 2004, 2005).

The focus of this research was to demonstrate differences of orofacial measurements between the studied populations. The purpose of the study was to compare the anthropometric orofacial measurements of mouth-breathing children with those of children with no history of speech-language disorders, according to age.

METHODS

This research was approved by Ethics Committee (CAPPesq) of Hospital das Clínicas and Medical School of the University of Sao Paulo (protocol number 096/04). All the legal guardians of the children signed the informed consent form (ICF). 100 mouth-breathing children were evaluated, ranging in age from seven to 11 years and 11 months, with 51 (51%) males and 49 (49%) females. The mean age was 8 years and 5 months and the median was 8 years. Children were divided according to age: 31 children (31%) from 7 years to 7 years and 11 months; 22 children (22%) from 8 years to 8 years and 11 months; 21 children (21%) from 9 years to 9 years and 11 months; 12 children (12%) from 10 years to 10 years and 11 months; 14 children (14%) from 11 years to 11 years and 11 months.

The inclusion criteria of the children in this study were: mouth-breathing otolaryngologic diagnosis, carried out by the otorhino-laryngologist; functional alteration of breathing; leukoderm; mixed dentition period with four permanent first molars completely erupted. The exclusion criteria of the children in this study were history of speech-language pathology treatment (current and/or previous); history of facial and/or pharyngeal surgery; history of a syndrome and/or neurological disease and/or bifid uvula; history of orthodontics and/or facial orthopedics and/or craniomandibular treatments (actual and/or previous) and/or temporomandibular joint dysfunction (TJD).

The instrument used to obtain the anthropometric orofacial measurements was an electronic digital sliding caliper Starrett Series 727, made in Brazil. The protocol used to collect the data was published by Cattoni, (2006).

During data collection the children were asked to remain seated with both feet on the floor, with the head in resting position and closed lips, with teeth together in their natural position. The anthropometric orofacial measurements obtained (See Fig. 1) from each child included: height of the upper lip (from the subnasal to the stomion or sn-sto); height of lower lip (from the stomion to the gnathion or sto-gn); length of the philtrum (from the subnasal to the labiale superius or sn-ls), height of the upper face (from the trichion to the glabella or tr-g), height of the middle face (from the glabella to the subnasal or g-sn), height of the lower face (from the subnasal to the gnathion or sn-gn), right side of the face (from the exocanthion to the cheilion or ex-ch) and left side of the face (from the exocanthion to the cheilion or ex-ch).

Figure 1. Anthropomorphic Landmarks

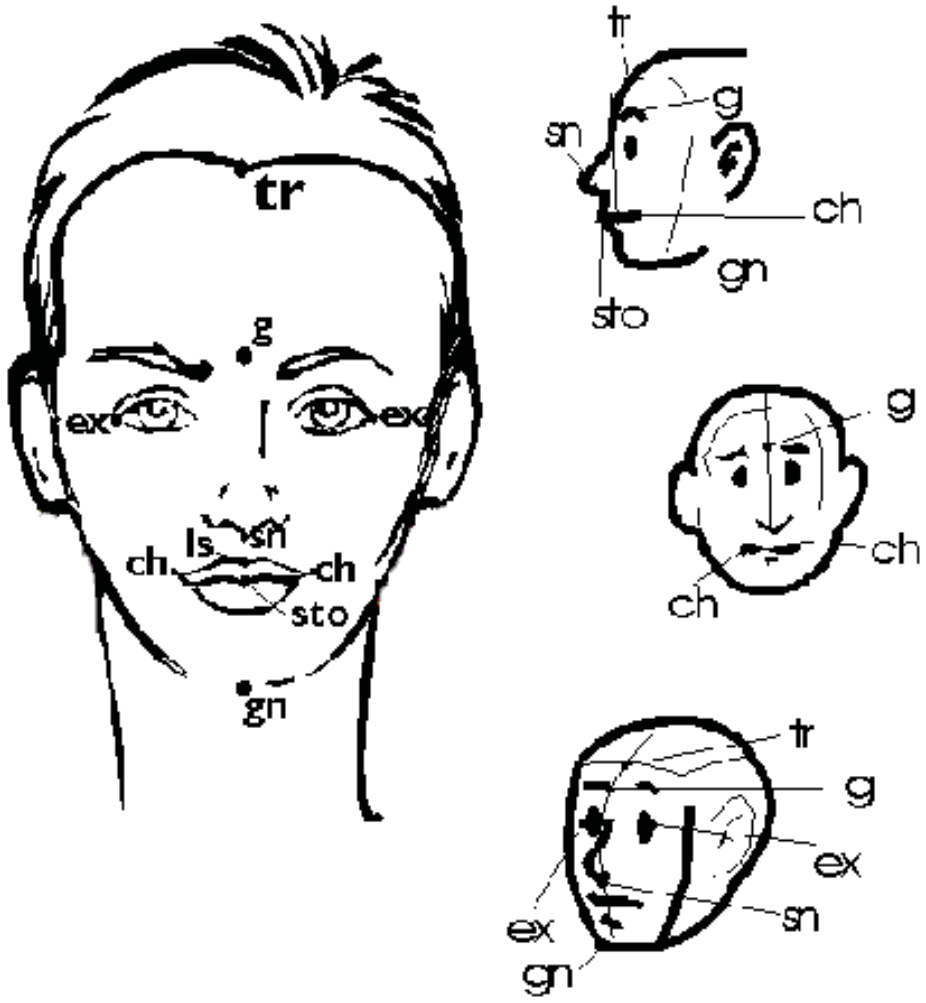

Figure 1 – Landmarks on the surface of the face (tr = trichion, g = glabella, ex = exocanthion, sn = subnasal, ls = labiale superius, sto = stomion, ch = cheilion e gn = gnathion)

The examiner sat in front of the child during the data collection and documented the child's at rest position of the head. The landmarks used in the surface measurements were identified by palpation. Each measurement was taken twice and the average recorded. The hard tips of the sliding caliper touched the skin surface but pressure was not applied. The procedure for each child took 15 minutes. The measurements of the mouth-breathing children were compared to those for the control group (Cattoni, 2003a).

The control group was composed of 254 children with ages between 7 years and 11 years and 11 months, being 137 boys and 117 girls, attending private schools of the city of Sao Paulo. Children were divided according to age: 48 children between 7 years and 7 years and 11 months; 52 children between 8 years and 8 years and 11 months; 50 children between 9 years and 9 years and 11 months; 54 children between 10 years and 10 years and 11 months and 50 children between 11 years and 11 years and 11months.

Statistical analysis

The analysis of the comparison between mouth-breathing children with the control group children was completed using t-Student test. All analyses were processed with SPSS for *Windows* version 12.0 and the considered level of significance was 0.05%.

RESULTS

For the control group, 2,032 measurements were taken and analyzed. For the sample of mouth-breathing children, 800 measurements were taken and analyzed. The total orofacial measurements taken and analyzed in this study were 3,184. The information in Table 1, indicates that the mean of the height of the upper lip (sn-sto) for mouth-breathing children was statistically higher than the control group, for 8 to 10 year olds ($p<0.05$). In reference to lower lip (sto-gn), it was observed that there was significant difference among the averages from children of the two studied populations with ages ranging from 7 to 9 years ($p<0.05$). There was no statistical difference for the length of the philtrum (sn-ls) between the studied populations, for all ages ($p>0.05$).

Table 2, provides the averages from the height of the thirds of the face, according to age, for both groups. There was no significant statistical difference among the means of the height of the upper face (tr-g) and the middle face (g-sn) between the studied populations, for all ages ($p>0. 05$). The mean values of the height of the lower face (sn-gn) of mouth-breathing children were statistically higher than the averages from control group children, from 7 to 9 year olds ($p<0. 05$).

Table 3 provides information on the measurements for the sides of the face (ex-ch), according to age for both groups. On the right side of the face (ex-ch), there was statistically significant difference for 9 year old children ($p<0. 05$), with the mean value for mouth-breathing children being statistically greater than the mean for the control group. There was no significant statistically significant difference for the remaining age groups ($p>0. 05$). On the left side of the face (ex-ch), the averages for the control group were statistically lower than averages for the mouth-breathing children, for 7 to 10 year olds ($p<0.05$). There was no significant statistical difference in 11 year old children ($p>0.05$).

DISCUSSION

The landmarks and the orofacial measurements considered in this study were a part of those proposed in previous research articles (Farkas, 1994a; Farkas et al., 1992a, 1992b, 2003; Gregoret, 1999; Suguino et al., 1996) which provided data about orofacial morphology. The researchers chose the methodology described by classical anthropometric studies (Farkas et al., 1992a, 1992b, 1994a; Farkas, Posnick, 1992; Ward, 1989; Ward et al., 1998, 2000), which included the head being positioned in the rest position with closed lips during the process of determining facial anthropometric measurements (Farkas et al., 1992a; Farkas, 1994a; Hunter, 1996; Shaner et al., 1998).

Table 1. Comparison of the orofacial measurements from nasolabial region, according to age

Age	N	*Control group* Mean (mm)	N	*Mouth-breathing children* Mean (mm)	p
Upper lip (sn-sto)					
7	48	18.09	31	18.91	p>0.05
8	52	17.90	22	19.42	p<0.05
9	50	18.13	21	19.65	p<0.05
10	54	18.05	12	20.22	p<0.05
11	50	18.31	14	19.02	p>0.05
Lower lip (sto-gn)					
7	48	38.43	31	40.90	p<0.05
8	52	38.68	22	41.25	p<0.05
9	50	39.19	21	41.55	p<0.05
10	54	39.99	12	42.02	p>0.05
11	50	41.61	14	42.55	p>0.05
Philtrum (sn-ls)					
7	48	13.19	31	13.72	p>0.05
8	52	13.07	22	14.27	p>0.05
9	50	12.71	21	13.86	p>0.05
10	54	13.24	12	14.21	p>0.05
11	50	13.30	14	13.91	p>0.05

Legend: N=number of subjects; mm= millimeters; p: t-Student test

Table 2. Comparison of the facial thirds, according to age

Age	N	*Control group* Mean (mm)	N	*Mouth-breathing children* Mean (mm)	p
Upper face (tr-g)					
7	48	53.63	31	55.91	p>0.05
8	52	54.91	22	57.41	p>0.05
9	50	54.93	21	56.82	p>0.05
10	54	57.06	12	54.93	p>0.05
11	50	56.47	14	56.28	p>0.05
Middle face (g-sn)					
7	48	48.83	31	49.84	p>0.05
8	52	50.22	22	50.50	p>0.05
9	50	51.81	21	52.46	p>0.05
10	54	52.60	12	52.63	p>0.05
11	50	53.73	14	54.05	p>0.05
Lower face (sn-g)					
7	48	57.35	31	59.83	p<0.05
8	52	57.56	22	61.37	p<0.05
9	50	58.28	21	61.86	p<0.05
10	54	59.92	12	62.54	p>0.05
11	50	60.71	14	62.46	p>0.05

Legend: N=number of subjects; mm= millimeters; p: t-Student te

Table 3. Comparison of the sides of the face (ex-ch), according to age

Age	N	*Control group* Mean (mm)	N	*Mouth-breathing children* Mean (mm)	p
Right side of face (ex-ch)					
7	48	60.67	31	60.93	p>0.05
8	52	61.67	22	63.78	p>0.05
9	50	62.88	21	64.72	p<0.05
10	54	63.69	12	65.38	p>0.05
11	50	64.34	14	65.97	p>0.05
Left side of face (ex-ch)					
7	48	59.85	31	61.11	p<0.05
8	52	60.80	22	63.78	p<0.05
9	50	61.85	21	64.45	p<0.05
10	54	63.05	12	65.39	p<0.05
11	50	63.75	14	65.40	p>0.05

Legend: N=number of subjects; mm= millimeters; p: t-Student test

The procedures used were those that increase the confidence of the orofacial measurements taken, such as proper identification of landmarks before the examination (Allanson, Cole, 1996; Farkas, 1994a, 1994b; Hunter, 1996; Ward et al., 2000; Ward, Jaminson, 1991). The landmarks used in the surface measurements were identified by palpation (Ward, Jaminson, 1991). Measurements were taken twice (Farkas, 1994a; Moore et al., 2001).

Only leukoderm children participated in this study, because differences in the orofacial morphology have been identified in studies with multi-racial samples (Borman et al., 1999; Choe et al., 2004; Enlow, Hans, 1998; Farkas et al., 1994b, 2000; Farkas, Deutsch, 1996; Le et al., 2002; Miyajima et al., 1996; Porter, 2004; Yokota, 2005). With respect to the exclusion criteria for the subjects of this study, all mouth-breathing children with history of orthodontic treatment were excluded, because there is not enough knowledge about the influence of the orthodontic devices on orofacial measurements in children with orofacial myofunctional disorders. However, previous research indicates that for children who met criteria to be included the control group without mouth breathing behaviors, the use of orthodontic devices did not show significant difference for the majority of orofacial measurements (Cattoni et al., 2005).

Results of this study indicated that the height of the upper lip (sn-sto) was statistically higher in mouth-breathing children than in control group, for 8 to 10 year olds. However, there is research that indicates that for mouth breathing individuals a short upper lip was noted (Di Francesco, 2003b; Jardini, 1999; Sleiman, 1999; Tessitore, 2004; Tsuji, Chung, 2003).

The mean height of the lower lip (sto-gn) from the mouth-breathing children was statistically higher than the control group, for 7 to 9 year olds. Supporting data is found in the literature (Bianchini, 1998b; Marchesan, 1998; Tomé et al., 1996).

For all ages, equal means of the length of the philtrum (sn-ls) was found in both populations. According to Farkas (1994a) the recommended procedure to collect orofacial measurements is with closed lips. This may be the reason that the means were equal in both populations. When using the anthroposcopy approach during a speech-language evaluation, the patients are not asked to keep the lips closed. Therefore, measurements for the upper lip (sn-sto) and the philtrum (sn-ls) may be smaller, because the mouth-breathing individual often presents with open lips (Andrade et al., 2005; Fonseca et al., 2005; Jardini, 1999; Junqueira et al., 2002; Krakauer, 2003; Marchesan, 1998, 2000; Rodrigues et al., 2005; Seikel et al., 2005; Tessitore, 2004). It is suggested that additional investigation

with different methods should be carried out to provide further clarification for this finding. Moreover, the heights of the upper face (tr-g) and the middle face (g-sn) were equal in both studied populations. For 7 to 9 year olds, the mean of the lower face (sn-gn) measurement was statistically higher in mouth-breathing children. This was also cited by Di Francesco (2003a), Marchesan (2000), Tessitore (2004) and Tsuji, Chung (2003).

The knowledge about orofacial measurements in children and their variations according to age may be helpful during an orofacial evaluation in determining the functional diagnosis as carried out by the speech-language pathologist. This approach provides quantative data about the facial structures and the orofacial morphology of the patient.

There is a shortage of the anthropometric studies that investigate differences between orofacial measurements in mouth-breathing children and children who do not present with mouth-breathing. Therefore, the results of this research were also compared to the data for control groups from other studies that used an anthroposcopic approach (Bianchini, 1998a; Di Francesco, 2003a, 2003b; Jardini, 1999; Marchesan, 1998, 2000; Sleiman, 1999; Tessitore, 2004; Tomé et al., 1996; Tsuji, Chung, 2003).
The possibility of comparing orofacial measurements of children with and without mouth-breathing behaviors allows the clinician to identify normal and altered structures. Then, anthropometry may provide quantitative data and an objective analysis. The main advantages of anthropometry are its non-invasive nature, its technological simplicity, and low cost. It objectively allows the clinician to determine whether an individual face is within a "normal" range of variation. Anthropometric procedures have clinical applications in myofunctional assessment and therapy (Cattoni, 2006b).

This research has some limitations, because it compares two specific populations and the sample is relatively restricted. However, it may be considered an important step for future investigations in this area, which may then clarify the present results.

CONCLUSIONS

There were statistically significant differences in orofacial measurements for mouth-breathing children and the control group, according to age, except for the length of the philtrum (sn-ls), the height of the upper face (tr-g) and the height of the middle face (g-sn).

Finally, anthropometry is useful in speech-language assessment and supplements visual judgment with quantitative measurements (Cattoni, 2006b). Orofacial anthropometry has become an important tool used by orofacial myologists and it may serve as a powerful adjunct to the clinically trained eye. Orofacial anthropometry is gold standard in medical measurements. There are multiple descriptions of this technique; however, many clinicians do not have the resources to undertake their own anthropometric analysis. Therefore, results of this study help to establish critical standards necessary to demonstrate the scientific merits of this technique as an aid in further clarifying a diagnosis.

Contact person:
Débora Martins Cattoni
Speech Pathologist. Especialist in Orofacial Myology. Master and PhD. in Science/ Faculty of Medicine of University of Sao Paulo.
Address: Rua Barão da Passagem, 1330 apto. 91C – Sao Paulo – SP – 05087-000 - Brazil
Tel#: 011 55 11 3831-4080
E-mail address: dmcattoni@uol.com.br

Additional Authors:
Fernanda Dreux Miranda Fernandes
Speech Pathologist. Full-Professor of Speech and Hearing Pathology/ Faculty of Medicine of University of Sao Paulo.

Renata Cantisani Di Francesco
Otorhinolaryngologist. PhD. in Medicine/ Faculty of Medicine of University of Sao Paulo.

Maria do Rosário Dias de Oliveira Latorre
Statistician. Full-Professor of Epidemiology/ Faculty of Public Health of University of Sao Paulo.

Institutional affiliation: Faculty of Medicine of University of Sao Paulo.
Institutional review board: Ethics Committee of Hospital das Clínicas and Medical School of the University of Sao Paulo.

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