EVALUATION OF HARD PALATE DEPTH: CORRELATION BETWEEN QUANTITATIVE AND QUALITATIVE METHOD

Avaliação da profundidade do palato duro: correlação entre método quantitativo e qualitativo

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ABSTRACT

Purpose: to investigate the correlation between quantitative and qualitative methods of hard palate depth evaluation. **Method:** 74 children participated in this study. They were in mixed dentition phase and were evaluated by speech therapist and dentist, who made the plaster models of maxillary dental arch used later for measure. The quantitative method was measurement of molar distance and molar depth whose values were used to calculate the Palatal Height Index. The hard palate was classified into low medium and high palate. Qualitative analysis was performed through visual inspection of the plaster models by three speech therapists with experience in Orofacial Myology. The depth of hard palate was classified as low, normal or increased. The result was the consensus of at least two evaluators. For Data analysis the frequency of ratings was investigated and the Gamma Correlation Test was applied. **Results:** qualitative method: medium palate (55,4%) followed by low palates (39,2%) and high palate (5,4%). Quantitative method: high palates (51,4%) followed by medium palate (43,2%) and low palates (5,4%). The Gamma Correlation Test resulted in 0,6212 ($p<0,05$) which indicates moderate correlation. **Conclusion:** the correlation between quantitative and qualitative methods of hard palate assessment was moderate. There was a trend in the qualitative evaluation to consider the palates deeper than the quantitative method. Therefore, it is suggested that both forms of analysis to be used in clinical practice.

KEYWORDS: Hard Palate; Evaluation; Measures; Morphology; Speech, Language and Hearing Sciences

INTRODUCTION

The hard palate is the bony structure that forms the division between the oral and nasal cavities[1] and maintains a close relationship with the functional orofacial activities[2-5].

The harmonious growth of the face and the proper development of breathing, sucking, chewing,

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Conflict of interest: non-existent

swallowing and speech depend on the balance of the hard palate with the other structures of the sensory-motor-oral system[3,6,7], because the hard tissues are closely related to function[8,9].

The configuration of bone structures is genetically determined, but susceptible to the molding action of the orofacial muscles. As the function can adapt to the presence of altered shape, bone structure can also be altered by inappropriate usual positioning of the soft tissue in the performance of a specific function and the moments of inactivity. Accordingly, the detailed assessment of anatomical structures helps in understanding the changed functional behavior[10].

Morphological analysis of the hard palate is characterized as an important part of the evaluation of Orofacial Motricity, it contributes to the structuring of a therapeutic plan with strategies, prognosis and appropriate referrals. When the depth of this structure is altered, it can be expected that oral functions and/or breathing will be impaired to a greater or lesser degree[4].

The qualitative method of evaluation of the hard palate, i.e. intraoral visual inspection currently shows up as the most used in clinical examination, but without standardizing for the normal parameters or naming for their classification [3-5]. In order to enhance reliability of data of the miofunctional examining it can be observed a trend of studies in the area in suggesting methods for quantitative analysis of combined data measured in qualitative evaluation [5,11-14].

Obtaining these dimensions of the hard palate can be performed by measuring with tridimensional orthodontic compass (Korkhaus) in casts[15] or in the oral cavity of the patient[16,17]; through 18 millimeter ruler; scanned tridimensional measurement[19], or a caliper in plaster models[4,13,14,20].

The present study aimed to investigate the correlation between quantitative and qualitative methods of evaluation of the depth of the hard palate.

METHOD

This study is characterized as quantitative and transversal[21].

The sample consisted of 74 children of both genders, aged from seven to 11 years and 11 months old whose dentition present the first molars erupted, classified as mixed. We excluded those who had a history of speech therapy, previous and/or current facial orthodontic and/or orthopedics, as well as signs of neurological impairment and/or syndromes, cognitive limitations or craniofacial malformations.

In order to ascertain the suitability criteria for inclusion and exclusion anamnesis was held with those responsible for the children. In this interview it contained questions regarding the identification of the subject, historical development, general health, diet, oral habits, sleep, and previous treatments and/or current.

It was also carried out a visual inspection of the sensory-motor-oral system, in which there was the usual positioning of the lips, tongue and jaw, as well as the predominant breathing mode, according to the protocol used at the home institution.

Subsequently, subjects underwent dental evaluation. The dentist noted teething period, dental conservation, presence or absence of midline shift and occlusal changes, as well as casted the maxillary arch molding of children.

Later, the casts were properly identified and those that did not allow visualization of the midline palatal or all erupted teeth were replaced by a new model. They served as the basis for both the quantitative assessment as to the qualitative.

In molding the maxillary dental arch trays were used for printing polyamide orthodontic (Morelli ®) and normal alginate setting type II (Seaweed Gel ®), and type plaster cast stone to the roof of the hard palate and plaster type for extra padding. This process was conducted in a room with natural and artificial lighting. The children remained seated with hips, knees and ankles flexed at 90 degrees and head driven Frankfurt plane.

Quantitative evaluation of the depth of the hard palate

For this work it was considered that only the aspect depth of the hard palate, since the plaster models do not permit the viewing anthropometric estafilino point necessary for measuring the length of the hard palate and further obtaining of the index width Palatine[22].

Quantitative evaluation of the depth of the hard palate was performed by obtaining the Palatine Height Index, proximate relationship between the height and width palate which classifies this structure as *camestafilino* (low palate), *ortoestafilino* (medium palate) or *hipsiestafilino* (high palate) [20.22].

To obtain this index was necessary to measure the width and depth of the hard palate to the level of the first molars[20], with a digital caliper brand Western ®, with a resolution of 0.01 mm and accuracy of ± 0.02 mm, calibrated after each measurement.

To measure the width of palatal landmarks were marked on the plaster models at the level of the first molars in the region corresponding to the union of the edge palatal gingival sulcus[20]. The width corresponded to the palate transverse distance in millimeters between the points previously established (Figure 1).

Figure 1 – Palate Width

To measure the height of the palate it was cut a stainless steel wire with a length corresponding to the transversal measurement (width of the hard palate) and secured with red wax at the edges of the gingival sulcus of the first molars. This wire served as a support for the sliding of the rod of the caliper for measuring the depth (Figure 2). The height corresponded to the palate as the perpendicular distance between the palate and stainless steel wire, which subtracted 0.05 mm, corresponding to the diameter of the steel wire[13].

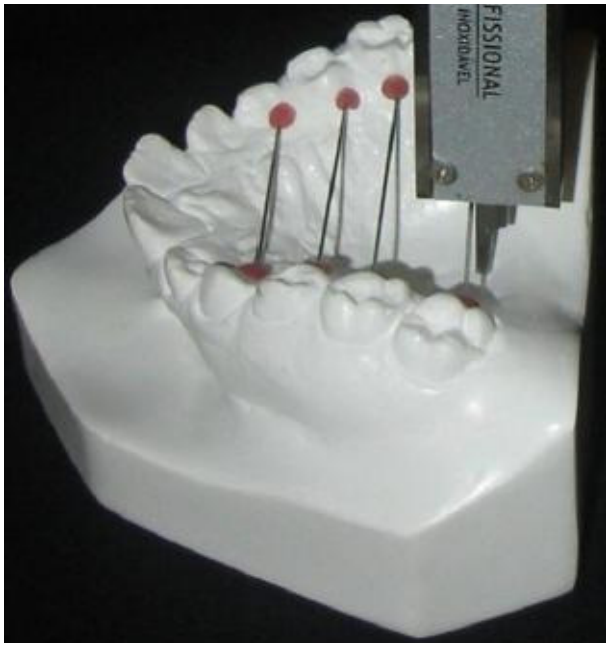

Figure 2 – Palate Height

From these measurements we calculated the index Palatine Height 20.22 according to the formula below.

$$\text{Index of Palatine's Height} = \frac{\text{Palatine height x 100}}{\text{Palatine width}}$$

The classification of the height/depth of the palate was given by inserting the result of the calculation in one of the following tracks:

- *Camaestafilino* (low palate): values less than or equal to 27.9 mm;
- *Ortoestafilino* (medium palate) values between 28.0 mm and 39.9 mm;
- *Hipsiestafilino* (high palate): values above 40.0 mm.

The measurement of the height and width palate was performed by a single researcher, who after 30 days from the first evaluation performed again the measures in 30% of randomly chosen models to verify the agreement between the first and second measurement by calculating the intraclass correlation coefficient (ICC). The results showed significant correlation between the two measures for all measurements of the hard palate.

Qualitative assessment of the depth of the hard palate

The qualitative assessment of the depth of the hard palate was performed by three experienced Speech Language Pathologist in Orofacial Motricity, through visual inspection of the 74 plaster models. Similarly, as in the quantitative assessment, it was analyzed only the deep aspect of the hard palate.

The three evaluators underwent prior visual training conducted in joint way[23], in order to standardize the qualitative assessment that considers the deep aspect of the hard palate decoupled from other parameters such as width, as proposed in the recent literature[5,12,13]. To this eight plaster models were randomly selected training, which constitutes approximately 10% of the sample.

In this step, the depth of the hard palate was rated as low, normal or increased[12] respectively corresponding to the low, medium and high palate. A visual inspection of the models and the marking of the evaluation sheet were undertaken by three evaluators concurrently but independently on the presence of the researcher in charge. None of the evaluators had access to the results of the quantitative method and the other evaluators.

As a result of qualitative assessment of each model it was considered the predominant responses, i.e. the concurrence of at least two evaluators. In cases where there were three discordant responses

it was considered consensus of the three examiners after reevaluation[24,25].

It is part of the research project approved by the Ethics Committee of the Federal University of Santa Maria, under number 0220.0.243.000-08. All participants had the Term of Free and Informed Consent signed by the guardians.

Data analysis found the frequency of palates considered low, medium and high in both evaluation methods and used the Gamma Correlation Test, applied through the software Statistica 9.0, to obtain the value of the correlation between the quantitative and qualitative methods, and values of γ from 0 to 0.3 indicate weak correlation, from 0.3 to 0.7 indicate moderate correlation and values from 0.7 on indicate strong correlation.

RESULTS

Figure 3 shows the relative frequency of classifications of low, medium and high palate through quantitative and qualitative methods of evaluation.

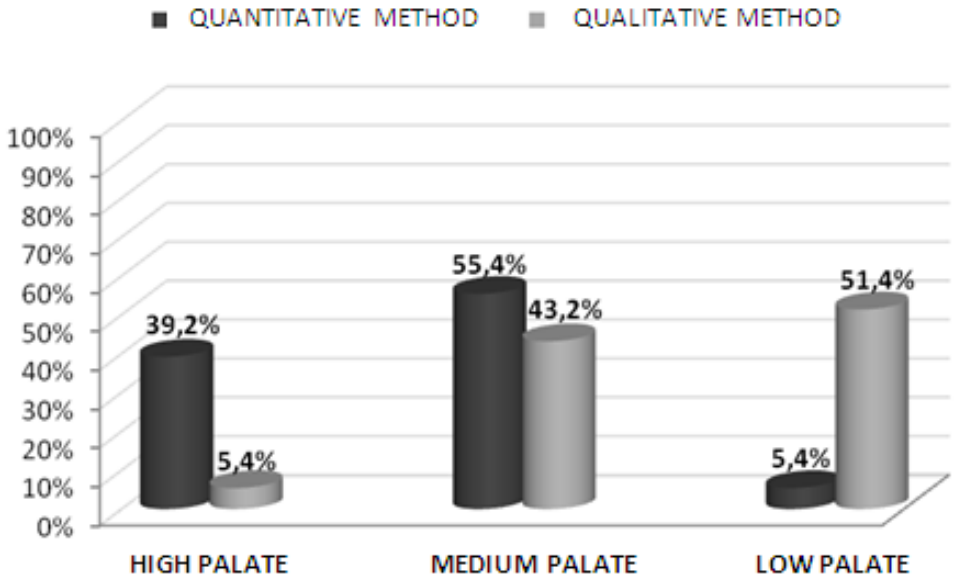

Figure 3 – Relative distribution of the frequency of the results of quantitative and qualitative methods for assessing the depth of the hard palate

Table 1 shows the concordant and discordant results of the classification of the depth of the hard palate as to the results of quantitative and qualitative methods of evaluation.

Table 2 explains the result of the correlation between the two methods of assessing the depth of the hard palate. The gamma value (γ) obtained classifies this correlation as moderate.

Table 1 – Absolute and relative values for the intersection of the results of quantitative and qualitative assessments of the depth of the hard palate

Quantitative method	Qualitative method					
	Low palate		Medium palate		High palate	
	n	%	n	%	n	%
Low palate (n=29)	3	10,34	17	58,62	9	31,03
Medium palate (n=41)	1	2,44	15	36,59	25	60,98
High/Deep palate (n=4)	0	0,00	0	0,00	4	100,00

Table 2 – Correlation between quantitative and qualitative methods to assess the depth of the hard palate

	Quantitative method	
	γ*	p
Qualitative method	0,6212	0,0007

* Index correlation by Gamma Correlation Test
p - significance level by Gamma Correlation Test (p <0.05)

DISCUSSION

Quantitative methods of evaluation in Orofacial Motricity are increasingly suggested[26] in order to standardize the results, establish normal parameters and change, as well as standardize the classifications. Although the measurement of the hard palate casts is considered a reliable method[4.27], there is disagreement as to the instruments and the reference points used for measuring[4,5,14,15].

In clinical practice it is observed that almost all professionals use the qualitative method for evaluation of the hard palate, due to the convenience, low cost and even the lack of knowledge of other forms of analysis. The reliability of the qualitative method, however, can be questioned, as the training and experience of the evaluator are factors that influence the analysis.

It is apparent, therefore, that the heterogeneity evaluation methods of the hard palate as well as the classification of this structure[4,5] limit the diagnostic of change and consequently the interdisciplinary treatment plan and labor.

By comparing the quantitative and qualitative methods for assessing the depth of the hard palate, it was found that there was no full equivalence of the results (Figure 3). Whereas the quantitative method is shown to be more reliable, these data demonstrate that the forms of analysis are complementary and not substitutes.

By the quantitative method it was found a higher frequency of medium palates, followed by low and high palates. Yet, in the qualitative assessment audiologists felt that there were more high palates, followed by medium and low.

The morphology of the hard palate is related to the growth pattern of the face. In subjects with medium facial type the depth of the palate tends to show itself as medium[28.29], in balance with other oral structures. Thus, the medium hard palate hardly entails functional impairment, being considered normal. Similarly, the hard palate classified as low, which is typically observed in individuals with short face[28,29], it may not significantly alter the vertical dimension of the oral cavity as to induce adaptations of oral functions. The results of this study show that most palates classified as low by quantitative method were considered average in the qualitative evaluation, which possibly indicates a difficulty in classifying the evaluative aspect alone and in depth casts.

On the other hand, all palates classified as high by quantitative method received the same rating in the qualitative evaluation, seeming to be the most easily identified morphology in visual inspection.

The hard palate with increased depth is characteristic of individuals who have long facial types[28,29] and most frequently induces adaptations of breath, chewing, swallowing and speech, as the increased vertical dimension complicates the accommodation of this language structure both at rest and in the execution of functions. Besides genetic characteristics, two important factors contribute to the increasing depth of the hard palate, which are predominantly oral breathing mode and prolonged sucking habits[5,13,14].

Mouth breathing induces morphological change by not allowing the tongue to exert its expander action on the hard palate as to allow the entry of air into the airway to keep open lips and tongue at the floor of mouth[30.31]. The absence of a negative pressure in the nasal cavity prevents the lowering of the palate and the action of other bones and muscles of the face assists in compressing the outer maxillary dental arch, so that growth is more pronounced in the vertical[20.32]. Mouth breathing alters the vertical and transverse dimensions of the hard palate mainly in the posterior hard palate[5,13-16].

Oral habits cause atresia of the maxillary dental arch, and the change is often reported as the pressures of maintaining the habit alter the morphology of the bone bases[33.34]. Children with non-nutritive sucking habits have hard palate deeper and narrower in anterior regions[14].

The results presented also demonstrate that there was a tendency of evaluators to rank the palates as higher than they actually were. By the qualitative method most of the low palates were considered medium and the medium palates were considered high. It was noted, therefore, that the qualitative analysis diagnosed more morphological

changes of the hard palate in regards to the increase in the vertical dimension.

It is stressed that this diagnosis is extremely important for establishing the correct behavior. In cases where the hard palate presents high, there may be some limitations to the therapeutic process, such as difficulty in accommodating the palatal papillae on the tongue to provide auxiliary nasal breathing and swallowing[33,35]; articulation disorder, once the hard palate supports the execution of rapid and complex movements of the tongue[36], among others. In such cases the most appropriate action is to refer patients for orthodontic evaluation, aiming anatomical suitability prior to miofuncional therapy.

The correlation between the quantitative and qualitative methods for assessing the depth of the hard palate was moderately positive (Table 2), which means that the results of both analyzes are configured in a directly proportional manner.

Thus, it is indicated that in clinical practice the two methods are used to evaluate the hard palate as complementary for the diagnosis of morphological changes. While the quantitative analysis provides a pre-established classification according to numerical values, the qualitative considers the relationship of structure to the soft tissues as well as in the performance of orofacial functions.

The interdisciplinary approach of Speech Language Pathology with orthodontics is essential in cases of Orofacial Motricity. As the plaster models are traditionally used by orthodontists for assessment of the occlusal without interference from soft tissues of the mouth, the Speech Language Pathologist can have in these devices a possibility of analysis of the maxillary dental arch model to obtain the measurements of the hard palate. It requires integration among professionals, as it implies the orthodontist providing orthodontic documentation pertaining to the patient, including plaster models for the analysis of the Speech Language Pathologist and the discussion between them, with consequent coordination of behaviors.

Some disadvantages are pointed out to the use of the plaster cast of the dental evaluation, the need for adequate space for storage and the risk of breakage, even though they are indispensable as a diagnostic means[27,37]. We indicate that the Orofacial Motricity professionals start considering the quantitative method and shared use of plaster models in the clinic so that the evaluation of the hard palate begins to establish itself as an evidence-based practice.

CONCLUSION

The correlation between quantitative and qualitative methods to assess the depth of the hard palate was presented as moderate.

The presented data showed that there was a trend in the qualitative assessment to consider the palates deeper than what the quantitative evaluation method.

RESUMO

Objetivo: verificar correlação entre método quantitativo e qualitativo de avaliação da profundidade do palato duro. **Método:** participaram da pesquisa 74 crianças, com dentição mista, submetidas à avaliação fonoaudiológica e odontológica que incluiu moldagem do arco dental maxilar para confecção dos modelos de gesso usados para posterior mensuração. Para análise quantitativa mediu-se largura e profundidade do palato duro ao nível dos primeiros molares, cujos valores foram utilizados para o Índice de Altura Palatina. Assim, os palatos duros foram classificados em baixo, médio ou alto. A avaliação qualitativa foi efetuada por inspeção visual dos modelos de gesso por três fonoaudiólogas com experiência em Motricidade Orofacial. A profundidade dos palatos duros foi classificada em reduzida (palato baixo), normal (palato médio) ou aumentada (palato alto). Como resultado considerou-se o consenso de ao menos duas avaliadoras. Para análise dos dados verificou-se a frequência de classificações e aplicou-se o Teste de Correlação Gamma. **Resultados:** a partir da avaliação quantitativa observou-se maior frequência de palatos médios (55,4%), seguidos de palatos baixos (39,2%) e palatos altos (5,4%). Pelo método de avaliação qualitativo a maioria dos palatos duros foram considerados palatos altos (51,4%), seguidos de palatos médios (43,2%) e palatos baixos (5,4%). Teste de Correlação de Gamma resultou em 0,6212 ($p<0,05$), indicando correlação moderada. **Conclusão:** a correlação entre os métodos de avaliação da profundidade do palato duro apresentou-se moderada. Na avaliação qualitativa houve tendência em considerar os palatos mais profundos do que indica o método quantitativo. Sugere-se que ambas as formas de análise sejam utilizadas na prática clínica.

DESCRITORES: Palato Duro; Avaliação; Medidas; Morfologia; Fonoaudiologia

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