PHONOLOGICAL DISORDER AND ALTERATIONS OF OROFACIAL PRAXIS AND THE STOMATOGNATHIC SYSTEM

Desvio fonológico e alterações práxicas orofaciais e do sistema estomatognático

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ABSTRACT

Purpose: to verify and correlate between each other, the performance of the children with Phonological Disorder and with Typical Phonological Development in the evaluation of the Stomatognathic System and in tests being evaluated yours orofacial praxis abilities. **Methods:** the sample consisted of 50 children, of both genders, with ages between four and eight years, with Phonological Disorder and with Typical Phonological Development. It was realized the phonological evaluation through the instrument of the Phonological Evaluation of Children. Then, it has applied the Protocol of the Stomatognathic System and the protocol *The Orofacial Praxis Test* to evaluate the orofacial praxis abilities. The data had been tabulated and submitted the statistical treatment, considering p<0,05. **Results:** with regard to Stomatognathic System, statistics difference between the groups was observed only whistles in it, contraction and vibration of lips and vibration of tongue, with lower performance of the children with Phonological Disorder. The same was observed to posture of tongue in the suction. The averages gotten in the praxis abilities tasks carried through after Imitation had been better that after Verbal Request, for all the ages. Still, the children with lower age had more alterations that the biggest, and also the children with Phonological Disorder had more difficulties that the children without speech alterations. **Conclusion:** the children with Phonological Disorder present more alterations of Stomatognathic System and the praxis abilities that those with Typical Phonological Development, with improvement of the same with the advance of the age and been relationship with the speech alterations.

KEYWORDS: Stomatognathic System; Speech; Child; Speech Disorders; Articulation Disorders

INTRODUCTION

It is common in clinic the presence of children with delays to produce certain phonemes, either in age of phonological acquisition or after that[1]. It is considered Phonological Disorder (PD)[2]. This disorder affects only the phonological level of the linguistic organization and not the speech gestural and/or articulatory activities[3]. So, according to authors, the children do not present articulatory and/or motor difficulties to produce phonemes, but alteration in the linguistic and phonological elaboration and organization.

According to some authors[4,5], the speech acquisition and development depend either on the development of organs and functions of the stomatognathic system (SS) or on the organization of the phonological system (PS). It means that it depends on phonetic and phonological aspects. When those structures present tonicity and praxis alterations, they may interfere in the phonemes production[5-7]. So, the articulatory imprecision also may contribute to this situation[8,9], because speech requires complex coordination and planning of lips and tongue movements to produce sounds[10-13].

Thus, there is a common neurophysical connection between the speech planning and the fine motor, which are altered in children with PD[2].

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For this reason, to evaluate the SS is necessary to a proper diagnosis of speech disorders[6].

When there is impairment of a subject's gestural activity, and the systems which are responsible for the performance of the motor act are relatively pristine and without significant intellectual deficit, it is a process called dyspraxia[2,14-16]. This situation is defined as a difficulty to produce specific and voluntary motor actions of the speech sounds related to the phono-articulatory production[6,17,18].

Speech inconsistent errors, imitation poorer than spontaneous speech, and gestural oromotor deficits[1] are some of the symptoms of development apraxia of speech. Studies indicate that the imitation praxis develop mainly between 5 and 6 years old and less between 6 and 7 years old. In those ages, after structuring those skills, children reinforce the knowledge which was acquired in previous years[11,19].

So, several authors[2,6,11,18,20-27] investigated the orofacial praxis abilities and other aspects of the oral motor control of children with typical phonological development (TPD) and with PD. In all performed studies, the children with PD presented higher number of alterations of the investigated praxis, when compared with children with TPD. For this reason, the present study is justified because it may confirm or contradict the previous hypothesis.

Based on the mentioned studies, this study had the purpose of verifying, as well as correlating the performance of children with PD and with TPD in the evaluation of the SS and in tests of praxis or orofacial abilities.

METHODS

This work is part of a research project, approved and registered in the Ethics Committee (EC) in a University, n. 0093.0.243.000-09. It was performed with children from public schools in the same city. The school principals signed the Institutional Informed Consent Term, and the participation of the subjects was authorized by the signature of the Consent Term by the parents and/or responsible people.

The sample consisted of 50 subjects, male and female, with ages between four and eight years old.

The children who were excluded from the sample were the ones who presented alterations of: language, orofacial motricity which impaired speech, auditory alteration, indicative signs of neurological and psychological alterations, verified during the evaluations, and/or the ones who were already patients of speech-language treatment.

The subjects were selected through the Speech Therapy Service (STS) at the University where the research was performed. Some children, to complete the sample, were selected at public schools. They were selected by observing the homogeneity in relation to the social, economical and cultural level of the participants previously evaluated.

First, all the children were submitted to anamnesis, speech-language screening and auditory screening. In the speech-language screening, it was investigated the alterations in relation to comprehensive and expressive language aspects, and the speech, through the thematic picture "circus", and other orofacial motricity aspects (anatomo-morphological and function).

During the auditory screening, it was performed, initially, the inspection of the ear canal, in order to verify the presence of cerumen and/or foreign bodies into it. In cases without alterations in the meatoscopy, it was performed auditory evaluation, using the portable audiometer INTERACOUSTICS AD-229, in frequencies of 500, 1000, 2000 and 4000 Hz. The children with consistent responses in the tested frequencies, in the level of 20 dB[28], went to the following steps, while the ones with suspicion of auditory loss were submitted to complete otorhinolaryngological and audiological evaluation.

Then, it was performed the children complete phonological evaluation, with determination of the severity of the phonological disorder, SS evaluation and evaluation of the orofacial praxis skills[11].

The phonological evaluation was performed through the instrument Children Phonological Assessment (CPA)[29]. After the collection, it was performed the restricted transcription and the analysis of speech data and, then, the determination of the PD severity, calculated through the Percentage of Consonant Correct (PCC)[30] .

The severity of the PD is classified by PCC as: Mild Disorder (MD), PCC from 86 to 100%; Mild-Moderate Disorder (MMD), PCC from 66 to 85%; Moderate-Severe Disorder (MSD), PCC from 51 to 65%; and Severe Disorder (SD), PCC lower than 50%.

The evaluation of the SS was performed through the application of the SS Evaluation Protocol (Figure 1), used at the STS from the University, which evaluates the SS structures and functions, to exclude any organic alteration which may cause speech disorder.

The evaluation of the orofacial praxis abilities was performed through the application of the protocol *The Orofacial Praxis Test*[11]. The test consists of 36 items, which should be performed by the children, after verbal elicitation by the examiner and after the imitation of the task performed by the examiner. Among the total of items which compose it, there are 12 movements of verbal praxis, 12 orofacial praxis without sound production, six sequences of

movements and six parallel movements. When it is correctly produced or imitated, the item receives 1 point; and when it is produced or imitated incorrectly or not performed, it receives 0 points.

After that, it was compared the result obtained in the SS evaluation and the result of the orofacial praxis abilities of the children with PD, with the results obtained in the evaluation of the children with TPD. The data were tabulated and submitted to statistical treatment, using the Fischer's Test and the t-Test for independent samples, considering $p<0.05$.

RESULTS

In Table 1, it is presented the number of subjects and the percentage of alterations presented by children with PD and TFD in the SS evaluation, comparing both groups through the percentage of errors of each one. It is noticed that for both groups there were not alterations regarding intra and extra oral sensibility, in relation to the aspects of the lips and labial frenulum and regarding the lip mobility to blow. However, about the tongue mobility, it was observed alteration in the task to put it down. Alterations were also verified in relation to the cheeks and jaw aspects and mobility of the last one (open and close). The posture and mobility of the soft palate, as well as the uvula and the breathing type and mode, were not altered.

It is possible to observe that children with PD presented more difficulties in the performance of the abilities related to lips mobility, such as contraction, vibration and whistle when compared with the ones with TPD, who presented less alterations. When compared with each other, it was observed statistically significant difference in those abilities.

The statistical analysis revealed the statistically significant difference, equally, between the groups, in relation to the ability of tongue vibration. In it, the children with PD presented more alterations than the children with TPD.

In the other aspects related to the SS (structures and mobility) there was also higher number of alterations in the group with PD, but this difference was not statistically significant.

Table 2 consists of the number of subjects and the percentage of alterations presented by the children with TPD and with PD regarding the SS functions. It is verified that the children with PD presented more alterations in relation to the sucking function than the children with TPD. This difference was statistically significant for both groups only regarding the tongue position in this function. About chewing, it was observed more alterations of symmetry, movements and masseter contraction in children with TPD, a not statistically significant difference. The same was verified in chin contraction, salivation and labial action in swallowing. In the other aspects, the children with PD presented more negative performance than the children with TPD.

Table 3 presents the averages and standard deviations for each performed variable, after Verb Solicitation and Imitation of the examined gesture, for the children with TPD and with PF, in the evaluation of the orofacial praxis skills[11]. The obtained averages reveal that the children with TPD presented higher average of right answers than the children with PD, as in the performance of the tasks after Verbal Solicitation as after Imitation, in all analyzed variables. However, they were statistically significant only for the tasks of Orofacial Praxis and Sequence of Movements, when performed after Verbal Solicitation. It was also observed statistically significant difference between the groups in the performance of Sound Praxis, performed after Imitation of the task performed by the examiner.

Moreover, the averages in the performance of each variable are higher when performed after Imitation of the examiner than when performed after Verbal Solicitation, only, for all variables of groups of skills.

Table 1 – Distribution of the alterations of the children with Typical Phonological Development and with Phonological Disorder in the evaluation of the Stomatognathic System structures

		TPD % (n)	PD % (n)	p[1*]
Lips	Whistle	36.7 (11)	70.0 (14)	0.042*
	Left lateralization	36.7 (11)	50.0 (10)	0.393
	Right lateralization	36.7 (11)	45.0 (9)	0.572
	Vibration	30.0 (9)	60.0 (12)	0.045*
	Mentalis	23.3 (7)	20.0 (4)	1.000
	Inferior tonicity	20.0 (6)	35.0 (7)	0.312
	Posture	13.3 (4)	35.0 (7)	0.090
	Superior tonicity	10.0 (3)	20.0 (4)	0.494
	Symmetry	6.7 (2)	0.0 (0)	0.510
	Contraction	3.3 (1)	35.0 (7)	0.005*
	Stretching	3.3 (1)	10.0 (2)	0.556
	Protrusion	3.3 (1)	0.0 (0)	1.000
Tongue	Posture	50.0 (15)	45.0 (9)	0.738
	Vibration	43.3 (13)	75.0 (15)	0.042*
	Thinning	36.7 (11)	55.0 (11)	0.251
	Tonicity	30.0 (9)	40.0 (8)	0.333
	Smacking	13.3 (4)	15.0 (3)	1.000
	Lifting the tip	10.0 (3)	30.0 (6)	0.130
	Symmetry	6.7 (2)	0.0 (0)	0.510
	Internal lateralization	3.3 (1)	10.0 (2)	0.556
	Retraction	3.3 (1)	10.0 (2)	0.556
	External Lateralization	3.3 (1)	5.0 (1)	1.000
	Protrusion	0.0 (0)	5.0 (1)	0.400
	Widening	0.0 (0)	5.0 (1)	0.400
	Aspect	0.0 (0)	5.0 (1)	0.400
Cheeks	Inflating the left cheek	23.3 (7)	40.0 (8)	0.228
	Tonicity	16.7 (5)	10.0 (2)	0.821
	Posture	16.7 (5)	5.0 (1)	0.381
	Inflating the right cheek	13.3 (4)	35.0 (7)	0.090
	Inflar as duas bochechas	0.0 (0)	10.0 (2)	0.155
Jaw	Lateralization	26.7 (8)	30.0 (6)	1.000
Dental arch	Dental lack	70.0 (21)	85.0 (17)	0.317
	Bite	46.7 (14)	50.0 (10)	0.589
	Aspect	36.7 (11)	35.0 (7)	1.000
	Occlusion type	6.7 (2)	20.0 (4)	0.013*
Hard palate	Hard palate aspect	53.3 (16)	50.0 (10)	0.685
Soft palate	Soft aspect palate	3,3 (1)	0,0 (0)	1,000
	Uvula Posture	3,3 (1)	0,0 (0)	1,000

Fisher's Exact Test, $p<0.05$; * statistically significant difference.
Legend: TPD: Typical Phonological Development; PD: Phonological Disorders; n: number of subjects.

Table 2 – Distribution of alterations of the children with Typical Phonological Development and with Phonological Disorders in the evaluation of the Stomatognathic System.

	TPD	PD	p*
	% (n)	% (n)	
SUCTION			
Posture Mentalis	46.7 (14)	70.0 (14)	0.148
Tongue posture	36.7 (11)	10.0 (2)	0.050*
Posture of the lips	27.7 (8)	50.0 (10)	0.0134
CHEW			
Symmetry	23.3 (7)	15.0 (3)	0.0720
Bite	20.0 (6)	20.0 (6)	0.506
Masseter contraction	16.7 (5)	15.0 (3)	1.000
Movements	10.0 (3)	5.0 (1)	0.761
SWALLOWING			
Mentalis contraction	50.0 (15)	45.0 (9)	0.779
Lip action	50.0 (15)	35.0 (7)	0.387
Anterior tongue projection	20.0 (6)	20.0 (4)	1.000
Swallow	16.7 (5)	25.0 (5)	0.494
Salivation	16.7 (5)	0.0 (0)	0.075

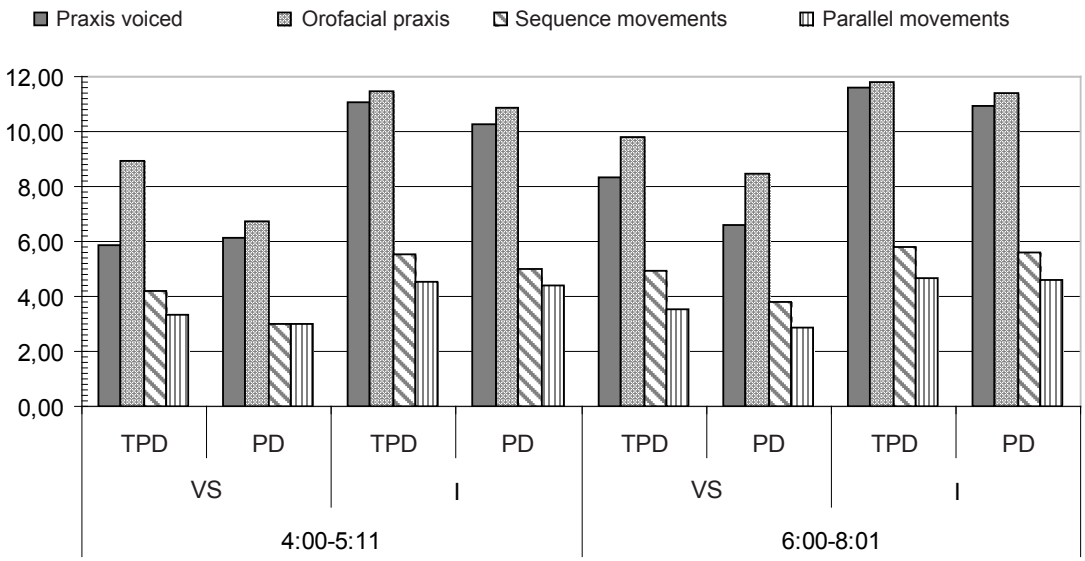
Fisher's Exact Test, p<0,05; *statistically significant difference
Legend: TPD: Typical Phonological Development; PD: Phonological Disorders; n: number of subjects.

Table 3 – Average or Standard Deviation of the 50 children with Typical Phonological Development and with Phonological Disorder for both conditions of solicitation: Verbal Solicitation and Imitation in the Test of Praxiss Evaluation[11].

VARIABLE	VERBAL REQUEST					IMITATION				
	TPD (N=30)		PD (N=20)		p[2*]	TPD (N=30)		PD (N=20)		p[3*]
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Praxis voiced#	7.27	2.28	6.45	1.93	0.195	11.37	0.96	10.70	1.22	0.036*
Orofacial praxis#	9.43	1.68	7.85	1.73	0.002*	11.67	0.66	11.20	1.06	0.060
Sequence movements+	4.63	1.22	3.50	1.15	0.002*	5.70	0.65	5.40	0.82	0.157
Parallel movements+	3.43	1.04	2.90	1.17	0.097	4.60	0.56	4.55	0.69	0.779

Legend: TPD: Typical Phonological Development; PD: Phonological Disorders.
SD = Standard Deviation; # maximum score = 12 points; + maximum score = 6 points; *statistically significant difference.
[*] T test for independent samples: p<0.05.

In Figure 1 it is observed the results obtained by age group for the different performed tasks, as after the Verbal Solicitation as after the Imitation of the task performed by the examiner. The children from 4:0 to 5:11, with TPD presented differences in the performance of the tasks after Verbal Solicitation and after Imitation, with better performance of them when performed after imitation. The averages for Verbal Solicitation of the children of the present research were a little lower than those presented by the children of an Italian research.



Legend: TPD: Typical Phonological Development PD: Phonological Disorders; VS: Verbal Solicitation; I: Imitation.

Figure 1 – Average of right answers obtained by 50 children with Typical Phonological Development and with Phonological Disorders per groups of tasks, through VS and I, in the Test of Praxis Evaluation[11], according to the age group.

DISCUSSION

After the analysis of the percentage of alterations presented by the children with PD and TPD, it is possible to verify that the children with PD presented more alterations than the children with TPD in the tasks related to labial mobility (contraction, vibration and whistle) and tongue vibration. These findings agree with studies[5,7,10-13] which refer that the speech alterations may be a consequence of SS tonicity and praxia problems, because of speech complex coordination and planning of lips and tongue movements to produce sounds, even if those alterations do not directly interfere in speech production.

Besides, it was also observed alterations in the type of mandibular arch occlusion and in the tongue posture during suction. Authors[4,5,8,9] refer that articulatory imprecision and alteration of the organs and SS functions may interfere in the speech acquisition and development, because there is a common neurophysical connection between speech planning and fine motor, which are altered in children with PD[2].

These results disagree with another study[31] which aimed at verifying the association between the abilities of tongue mobility and the /r/ in children with Phonological disorders. This study[31] did not find relationship between these variables. It suggests that, in the studied sample, the abilities of tongue mobility do not influence the correct production of /r/. The results also disagree with another study[32] which verified the influence of the tongue mobility skills for the linguodental phonemes, the research did not find significance in the results.

About the performance of the verbal and orofacial praxis, those presented lower percentage of alterations when performed after Imitation, for both groups of children, than when performed after Verbal Solicitation, only. These findings agree with another study[11], in which the imitation is equally better than the performance after Verbal Solicitationation. The authors observed, also, that the verbal control presents slower development than gestural imitation, preceding the speech grammar and lexical acquisition.

Studies [17,33] report that it is frequent to find alterations in one or another structure or SS functions in children with complaints of speech exchanges, and there are also studies [2,5,16] which refer that children with PD present more alterations in the abilities, in general, developed by the stomatognathic system than children with typical acquisition.

Studies[15,17,18] observe that children with praxis alterations present difficulties to perform specific and voluntary motor actions of the speech sounds, and it is related to the phono-articulatory production.

Inconsistent speech errors, imitation poorer than the spontaneous speech production, and gestural and oral-motor deficit are symptoms of speech apraxia of the development[17]. Those symptoms are common, even if the systems responsible for the

performance of the motor act are relatively intact and without significant intellectual deficit[2,15,16].

Other studies[5,23] refer relationship between the oral motor abilities and the language. Also, they report that more complex oral movements are more related to the language skills, because possibly they are more similar to speech. Thus, it is not possible to consider the interaction between the speech motor control and its production. With this knowledge and with the performance of more specific evaluations, it would be possible to explain the presented alterations, in order to develop therapeutic conduct developed for every case.

So, by obtaining more information about the motor activity involved in children's speech, as well as its impairments, it is possible to achieve more accurate intervention and in all altered aspects, with better results in the therapeutic process.

It is evidenced an association between the oral, verbal and motor praxis skills, with similar errors among them. Moreover, it is possible to observe that although the children of the present research presented only PD, without articulatory disorder, it is common for them to present alteration in the SS structures and/or functions, even if they are not the cause of the speech alterations, they only contribute and/or coexist with this fact.

So, the evaluation of the SS and of the speech related praxis are, in fact, important in the period of evaluation of the children, in order to guide the therapeutic process in an efficient and fast way.

CONCLUSION

The children with PD presented more alterations of the SS and of the orofacial praxis skills than the ones with TPD, mainly in relation to the lips and tongue abilities, which are related to speech. Besides, for both evaluated groups, there was better performance in the performance of the tasks when they were performed after the imitation of the task performed by the examiner than after Verbal Solicitation, for any age group.

So, the difficulties to perform the oral praxis abilities, as verbal as of the SS, are usually associated to the PD, and the quantity of presented errors is higher for this group than for the group with TPD. Moreover, the oldest children presented higher averages then the youngest ones, in both groups. Thus, it is evident that this is a not very researched field, and it is necessary to perform new research, which may bring more explanation and important information about this topic that is so relevant for human communication, as well as the intervention of the alterations.

RESUMO

Objetivo: verificar, bem como relacionar entre si, o desempenho de crianças com Desvio Fonológico e com Desenvolvimento Fonológico Típico na avaliação do Sistema Estomatognático e em testes de habilidades práxicas orofaciais avaliando suas habilidades práxicas orofaciais**. Métodos:** amostra constituiu-se de 50 sujeitos, com idades entre quatro e oito anos, com Desvio Fonológico e com Desenvolvimento Fonológico Típico. Avaliou-se a fonologia por meio do instrumento Avaliação Fonológica da Criança e a gravidade do desvio por meio do Percentual de Consoantes Corretas. Posteriormente, aplicou-se a Avaliação do sistema estomatongático e o *The Orofacial Praxis Test*, para avaliar as habilidades práxicas orofaciais. Os dados foram tabulados e submetidos a tratamento estatístico, considerando-se p<0,05. **Resultados:** com relação ao sistema estomatongático, observou-se diferença estatística entre os grupos apenas nas tarefas de assobio, contração e vibração de lábios e de língua, apresentando desempenho inferior as crianças com Desvio Fonológico. O mesmo foi observado quanto à postura de língua na sucção. As médias obtidas nas tarefas de habilidades práxicas orofaciais realizadas após Imitação foram melhores que após Solicitação Verbal, para todas as idades. Ainda, as crianças com menor idade apresentaram mais alterações que as crianças maiores, da mesma forma que as crianças com Desvio Fonológico apresentaram mais dificuldades que aquelas sem alterações de fala. **Conclusão:** as crianças com Desvio Fonológico apresentaram mais alterações do sistema estomatognático e das habilidades práxicas orofaciais que aquelas com Desenvolvimento Fonológico Típico, havendo melhora no desempenho com o avanço da idade e encontrando-se estas alterações relacionadas com as alterações de fala.

DESCRITORES: Sistema Estomatognático; Fala; Criança; Distúrbios da Fala; Transtornos da Articulação

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