Análise perceptivo-auditiva da estabilidade vocal de adolescentes em diferentes tarefas fonatórias****

Perceptual analysis of adolescents' vocal stability during different phonation tasks

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Abstract
Background: quality and frequency variability of adolescents' voice, during puberty, in different phonation tasks. Aim: to analyze the vocal stability of adolescents in three different phonation tasks using a voice perceptual analysis. Method: participants were male students (n = 46 individuals), ranging in age from 13 to 15 years, from a public school in Campinas - SP. Voice samples were recorded using a digital recorder in three different tasks: speaking a sustained vowel /a/, counting from one to ten, and reading. Three voice specialists evaluated stability by means of voice perceptual analysis. For the voice samples that were considered unstable, the Analogical Visual Scale (AVS) of 10cm was used to estimate the instability level, where zero means absence of instability and ten refers to maximum instability. Results: 78.3% of the adolescents presented vocal instability when speaking the sustained vowel, varying from one to nine in the AVS. Only one adolescent presented unstable voice when counting numbers (level = 1). Vocal instability was not observed during reading for any of the participants. Vocal stability varied significantly among phonation tasks and adolescents showed greater instability during the sustained vowel ($p<0,0001$; g.l = 2). Conclusion: counting numbers and reading do not detect vocal instability; the production of a sustained vowel demonstrated to be a better task.
Key Words: Adolescent; Voice Quality; Puberty.

Resumo
Tema: variabilidade de qualidade e frequência da voz de adolescentes, durante a puberdade, em diferentes tarefas fonatórias. Objetivo: analisar, por meio da avaliação perceptivo-auditiva, a estabilidade vocal de adolescentes em três diferentes tarefas fonatórias. Método: foram sujeitos do estudo 46 adolescentes do sexo masculino, com idade entre 13 e 15 anos, estudantes de uma escola estadual da cidade de Campinas - SP, onde foi realizada a coleta dos dados. As vozes foram gravadas em gravador digital, solicitou-se emissão sustentada da vogal /a/, contagem de 1 a 10 e leitura de parágrafo de um livro pré-estabelecido. A avaliação perceptivo-auditiva da estabilidade vocal foi realizada por três fonoaudiólogas especialistas em voz. Para vozes consideradas instáveis, utilizou-se uma Escala Visual Analógica de 10cm para marcação do grau de instabilidade, em que 0 significava estabilidade e 10 instabilidade máxima, podendo variar de 0 a 10. Resultados: na emissão da vogal sustentada 78,3% (n = 36) dos adolescentes apresentaram instabilidade vocal, em graus que variaram de 1 a 9. Apenas um adolescente apresentou voz instável, classificada como grau 1, durante a contagem de números e todos apresentaram voz estável durante a leitura. A ocorrência de estabilidade variou significativamente de acordo com a tarefa fonatória, havendo maior instabilidade na emissão de vogal sustentada ($p < 0,0001$; g.l = 2). Conclusão: as tarefas fonatórias de contagem de números e leitura não permitem inferir sobre a presença de instabilidade na emissão, o que deve ser avaliado na vogal sustentada.
Palavras-Chave: Adolescente; Qualidade da Voz; Puberdade; Voz

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Introduction

Voice is typically variable in quality and frequency during puberty1. Adolescents generally exhibit phases of vocal instability, especially during the voice change period l,2. Voice change may be defined as a set of changes in voice pattern that occurs between childhood and puberty3. The instability of emissions may also be related to certain weight ranges and sudden weight gain4.

Testosterone blood level, growth rate, and degree of pubertal development are routinely used to predict the onset of physiological change or to establish when it had occurred5-6. Vocal changes during adolescence should be evaluated by certain perceptual and acoustic parameters with the purpose of verifying the effects of the process of voice change on voice 7-8.

Voice can be divided into three phases during the vocal change period: the pre-change phase, which precedes the occurrence of voice change; voice change itself, specified by the period of vocal instability; and post-change, when the adolescent already exhibits adult vocal quality2. More evident vocal changes occurs in male adolescents from 13 to 15 years age 9, namely: reduction of fundamental frequency, prevalence of chest register, instability of emission, and hoarse, diplophonic, rough and/or breathy vocal quality 10. The changes can last from 6 months to 1 year and some adults remember the voice change period primarily by the presence of vocal fluctuations 11.

The aim of this study was to examine, through perceptual assessment of voice, vocal stability of male adolescents during puberty in three different phonatory tasks.

Method

This study was approved by the Ethics Committee of the Faculty of Medical Sciences of University of Campinas (protocol number 570/2003).

The subjects of this study, 46 male adolescents from a convenience sample, aged between 13 and 15 years and were students in sixth, seventh or eighth grades of a public school located in the city of Campinas. The Principal, representative of the institution, signed the Declaration of Consent agreeing to the procedures of the present study. The objectives of this study were explained and students were invited to participate. Students and their parents and/or guardians also signed a Term of Consent.

The study included male adolescent aged between 13 and 15 years and excluded adolescents who presented vocal complaints, neurological disorders, congenital syndromes, disorders of the upper and/or lower airways or who used medications to control them.

The voices of the adolescents were recorded on a Panasonic RR-US360 ® digital recorder in a school room with ambient noise of less than 50dB. Participants were instructed to stand up and to produce the vowel / a / sustained in its usual intensity; to speak the numbers one through 10; and to read a paragraph of a pre-established book. A PHILIPS SBC MD680 ® unidirectional microphone was used. The microphone was positioned at a distance of 5 cm from the mouth of the participant to record the sustained vowel, and at 10 cm for recording of connected speech. The 45 degrees angle was maintained during all recordings in order to reduce the articulation aerodynamic noise 12 -13.

The analysis of the vocal parameters stability and instability were performed through perceptual analysis by three Speech-Language Pathologists who were voice specialists. A visual analog scale (VAS) of 10cm in a straight line was used to mark the degree of instability. In the VAS, one end was represented by 0 (zero) - indicating vocal stability - and the other end by ten (10) - indicating maximal instability. The degree of instability varied from 1 to 10 according to the centimeters previously marked.

The beginning and end of emissions of vowel / a / were excluded from the samples because they usually exhibit irregular characteristics. The duration of the samples was standardized in three seconds.

The stability and instability analysis in different phonatory tasks was performed using descriptive statistic measures of average, minimum and maximum values.

The same procedure was used to analyze the degree of instability in the different tasks. In order to analyze whether the vocal instability differed among the phonatory tasks, the Pearson Chi-Square test was applied through the John's Macintosh program Project (JMP) of the Statistical Analysis System (SAS). The significance level adopted was equal to 0.05.

Results

Vocal instability occurred in 78.3% of the studied adolescents over the task of emission of

the sustained vowel / a / (Table 1). The degree of instability varied from 1 to 9 (Table 2).

Most adolescents who exhibited instability in the emission of the sustained vowel / a / (36.1%) were classified as degree one of EVA - which can be considered a mild instability - followed by degrees two (16.6%) and four (16.6%). It was observed that four adolescents (11.1%) were classified as degree nine, that is, exhibited emission instability close to maximum instability considered by the examiner. Only three adolescents (8.3%) were classified as degree three, two adolescents (5.5%) as degree six and one adolescent (2.7%) as degrees five and seven each. None of the participants were classified as degree eight or ten (Table 2).

In the phonatory task of counting numbers, of the 46 adolescents studied, only one (2.2%) showed instability during emission - considered as degree one, i.e. mild instability (Table 1).

In the phonatory task of reading a paragraph of a pre-established book, all adolescents (100%) exhibited stable emission (Table 1).

The Pearson Chi-square test showed that the occurrence of stability significantly varied among the different tasks and there was greater instability in the task of sustained vowel when compared to the other tasks ($p < 0.0001$, $df = 2$).

TABLE 1. Numeric and percentage distribution of perceptual analysis of vocal stability and instability on different phonatory tasks.

Task	Stable		Instable		Minimum Degree	Mean Degree	Maximum Degree
	N	%	N	%			
Sustained vowel /a/	10	21,7	36	78,3	1	3,27	9
Counting	45	97,8	1	2,2	1	1	1
Reading	46	100	0	0	0	0	0

TABLE 2. Numeric and percentage distribution of individuals with vocal instability and the degrees of instability during the emission of the sustained vowel /a/.

Instability Degree	N	%
1	13	36,1
2	6	16,6
3	3	8,3
4	6	16,6
5	1	2,7
6	2	5,5
7	1	2,7
8	0	0
9	4	11,1
10	0	0

Discussion

The gradual transition between childhood and adulthood occurs during adolescence 14. Thus, an adaptation to new anatomical conditions becomes necessary 15. With regard to voice, this adaptation occurs on a period that lasts from a few months to a year 10. Vocal change, as well as the sound of voice and the typical voice characteristics during this period, are related to the growth of the larynx, variation in the length and thickness of vocal folds 16-17, changes in secondary sexual characteristics 18 and in body mass index 19-20.

Detailed knowledge of typical vocal development is a prerequisite for the diagnosis and treatment of voice disorders among children and adolescents using methods that are appropriate for their age and developmental stage16.

In our study, we observed that the emission of a sustained vowel clearly showed the vocal instability. Therefore, this task can and should be used to investigate possible voice changes 21-22 and the ability of the individual to control the aerodynamic and myoelastic forces of larynx 23.

The counting numbers task provides data on the ability of the individual to control breathing and phonation during speech17. Thus, one can infer, based on our findings, that most adolescents studied (97.8%) had adequate glottal efficiency.

In relation to the task of reading a paragraph of pre-established text, we evidence the emission stability in all subjects studied. Boone and McFarlane17; Colton and Casper 24 consider the task of reading a standard text important for voice assessment. However, it is important to use different types of phonatory tasks for the perceptual assessment of voice 25-26 mainly to assess the stability of the emission because the alteration in this parameter may be unnoticed in automatic and connected speech tasks.

Although the vocal assessment needs different phonatory tasks in order to obtain reliable data regarding the voice quality of an individual, the sustained vowel emission task was the one that evidenced changes of vocal stability.

Conclusion

The analysis of voices of adolescents between 13 and 15 years of age allowed us to conclude that the sustained vowel reveals the vocal instabilities typical of the voice change period that are not revealed in connected speech tasks - whether in automatic speech (counting numbers) whether in reading a text. The instability, when present, was mild in most studied cases.

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