

A Summary of Speech Pronunciation Research based on the Electropalatograph

Yanhua Duan ^a, Xianghe Meng ^{b,*}

Key Laboratory of China's Ethnic Languages and Information Technology of Ministry of Education, Northwest Minzu University, Lanzhou 730030, China

^a 446549989@qq.com, ^{b,*} 554597360@qq.com

Abstract. This paper mainly introduces and summarizes the current status of electropalatograph research. The research on speech pronunciation based on the electropalatograph mainly uses the pronunciation physiology equipment—electropalatograph instrument to obtain the point-like image recording data when the tongue touches the upper palate during the process of speech pronunciation, and then carries out data analysis and modeling research. The electropalatograph mainly records the contact state of the tongue and palate, which can record and describe the process of speech pronunciation more accurately, objectively and scientifically. It can enrich the relevant theories of experimental phonetics and improve the traditional interpretation of speech pronunciation. Pronunciation mechanism provides reference data.

Keywords: Electropalatograph; Experimental Phonetics; Speech Pronunciation; EPG.

1. Introduction

When do people's tongue and palate touch when they pronounce? How much contact area does the tongue and palate have during pronunciation? And how does this contact change during successive pronounces? Such problems have always been important issues in experimental phonetics research. Electropalatograph (EPG) instrument can solve this kind of problem very well, so that researchers can easily carry out the study of speech pronunciation related to the EPG. The early electropalatograph instrument was mainly used for the diagnosis and auxiliary training of speech disorders, including cleft palate disorder, hearing disorder and dysarthria. Later, it was gradually applied to the research of experimental phonetics.

When using the electropalatography instrument to carry out the EPG research of a certain speech pronunciation, the specific use method is as follows: first, a false palate needs to be customized for the experimental speaker, usually a 62-point false palate is used. Electrodes were then placed on the false palate as shown in Fig 1. After the speaker wears the false palate, the electrical signal will change when the tongue contacts the false palate, that is, when the tongue touches the false palate, a dot-like image recording will be produced. Thus, the contact of the tongue and palate during pronunciation can be recorded in real time. The current EPG sampling rate can reach more than 100Hz, which can fully meet the requirements of speech research [1,2].

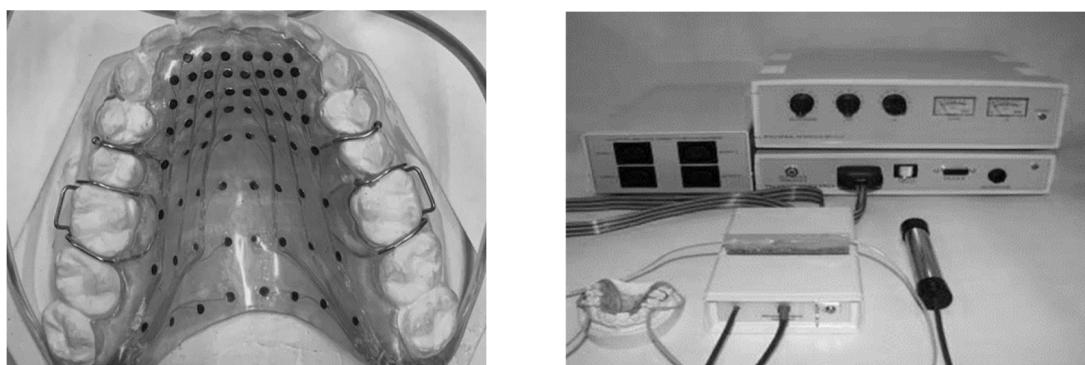


Fig 1. Electropalatograph instrument and its supporting equipment

The electropalatograph (EPG) is used to record the contact mode of the tongue and palate and the changes in the contact between the tongue and palate in the process of speech pronunciation, which can indirectly reflect the movement posture of the tongue during pronunciation and the movement characteristics in the time domain. Of all the linguistically meaningful and palatal-contact vocal segments that humans can produce, they include most consonants and non-low vowels. For example, in the process of pronunciation of common language, the pronunciation parts that EPG can record in real time mainly include three groups of apical sounds and two groups of lingual and facial sounds, which can record the pre-tongue, mid-tongue, back-tongue and front-of-tongue in Mandarin Chinese. The process of lingual-palatal contact between sounds and lingo-facial posterior sounds. Then, by extracting several palatal parameters of the maximum contact frame of the consonant holding segment, we quantitatively study the consonants of different pronunciation parts and pronunciation modes in Common Language [3].

2. Research Status

In this paper, the research literature in this field in recent years has been classified and researched, and two research directions have been summed up: the first is the speech pronunciation research that carries out dynamic EPG research for different languages. The types of languages are: Mandarin Chinese, English, Mongolian, Tibetan, Uyghur, Korean, Zhuang language, Miao language, etc. The second is to use the EPG to study the phenomenon of speech pronunciation from different phonetics perspectives. The research contents include: the influence of vowels on consonant coarticulation, the physiological characteristics of consonant pronunciation, the situation of coarticulation in disyllabic environment, the influence of consonants or vowels on preceding consonants, the influence of consonants by subsequent vowels, and the ways of pronunciation. and speech pronunciation sites to study the speech pronunciation characteristics of consonants, analysis of lingual alveolar fricatives, and other types of coarticulation studies.

Zheng Yuling and Zhu Siyu [4] carried out research on the dynamic electropalatography database of Mandarin speech, and established a large-scale database. It basically summarizes the whole picture of the Mandarin speech system. At the same time, the physiological characteristics of Mandarin speech were studied by using the dynamic electropalatography database, mainly to study the influence of vowels on the coarticulation of consonants, the influence of initials (consonants) or vowels on the preceding consonants, and the formation of stops and fricatives. The measurement of the holding time for a long period of time.

Hasiqimuge et al. [5] mainly collected Mongolian in the standard sound area and Horqin dialect area, recorded words, phrases and sentences, and established a library including sound library, text index library, palatal parameter library, and phonetic parameter library. A 5-part Mongolian dynamic electropalatograph database. Bao Guilan et al. [15] used a combination of physiological and acoustic, quantitative and qualitative analysis methods to systematically study the pronunciation sites of the palatal consonants of Mongolian standard sounds, and proposed the Mongolian consonant pattern.

Wu Han [6] carried out a study of English consonants based on EPG, which is to convert the numerical information of lingual and palatal contact into three important lingual and palatal contact indices: lingual and palatal contact area center of gravity index, lingual and palatal contact advance index and Tongue-palate contact neutrality index. Through the center of gravity index of the contact area of the tongue and palate, the overall influence degree and difference of the three different following vowels on the contact pattern of the tongue and palate of these English consonants are well described, and the occurrence of English consonants under the influence of the following vowels is more accurately described. Variation trend and range of lingual palate contact.

Bao Huaiqiao and Zheng Yuling[7] carried out a study on the EPG in Mandarin, mainly using indices such as contact area ratio, contact index (CA, CC, CP) and degree of constraint (CD) to study the physiological characteristics and characteristics of Mandarin consonant pronunciation. The case of coarticulation in a two-syllable environment. The research shows that the index mentioned in his

paper is very effective for describing the pronunciation position and pronunciation method of consonants; the changes of nasal finals in Mandarin are regular; the degree of constraint of consonant initials in coarticulation is also predictable.

Wang Jianbin[8] carried out a study on the pronunciation physiology of Tibetan Amdo consonants based on the EPG, mainly using electropalatograph technology to take the contact state of the tongue and palate during pronunciation of Tibetan Amdo dialect as the object of investigation and research. The use of software and electropalatograph instrument can record and describe speech more objectively and accurately, and analyze the contact parts of the tongue and palate and the complex dynamic changes in the pronunciation of single consonants and some polyconsonants in Amdo dialect from two aspects: static and dynamic. process revealed. Duan Yanhua[9] carried out a study on the pronunciation physiology of Mandarin Chinese consonants based on EPG, mainly from the two aspects of pronunciation method and pronunciation location to analyze the pronunciation characteristics of Mandarin Chinese consonants. Contact area, gingival area contact area, hard palate area contact area, soft palate area contact area, anterior palate contact area, posterior palate contact area, anterior tendency index, neutral tendency index, posterior tendency index and other data to analyze the pronunciation characteristics of consonants.

Luo Yu[3] carried out a research on the pronunciation position and coarticulation of consonants based on EPG. The research objects are the influence of followed vowels on the coarticulation of consonants in the pronunciation of Zhuang language in Menggong Township, Guigang, and the tongue when pronouncing Miao consonants in Pingshang District. The contact status of the palate mainly analyzes the specific parts of the contact between the tongue and palate during the pronunciation of consonants in Miao language and the coarticulation of Zhuang language. The consonant pronunciation characteristics of the Miao language and the Zhuang language are analyzed in detail. Effects on lingual palatal contact when a consonant is followed by a different vowel.

Li Yinghao et al. [10] carried out research on the coarticulation of Mandarin Chinese based on EPG, mainly using the EPG of 62 electrodes to analyze the coarticulation phenomenon of Mandarin Chinese. The results of speech pronunciation physiology analysis showed that the coarticulation of the speech segments in Mandarin is related to the requirements of the segments to the lingual speech pronunciation actions, and it is also related to the degree of fusion of the lingual actions of the adjacent segments. The situation between syllables. Li Yinghao et al. [11] carried out EPG and acoustic analysis of lingual alveolar fricatives in Korean, mainly using EPG (EPG) physiological phonetic and acoustic methods to analyze the pronunciation physiology of loose and tight fricatives in Yanbian Korean, China Mechanisms and Acoustic Characteristics. Aizezi Abulimiti[12] carried out research on Uyghur consonant coarticulation based on EPG.

3. Application Prospect

The original intention of the invention of the EPG is for the language rehabilitation training of children with cleft palate after surgery. The tongue and palate contact model obtained from the EPG study can be applied to the teaching practice in the language rehabilitation of children with cleft palate. At the same time, the tongue and palate contact model need the characteristics of different specific languages, because the pronunciation of different languages will be very large. difference. The study of EPG can be helpful for the treatment of speech dysphonia, which is related to the abnormal movement of the tongue. In traditional treatment, it is difficult for patients to directly understand the continuous contact state of the tongue and palate in the process of normal speech pronunciation, but the use of EPG can make the contact state of the tongue and palate difficult to describe clearly in words. Become visualized, researchers can compare and analyze the contact data of the tongue and palate during the normal speech pronunciation process with the contact data of the pathological tongue and palate, and present it in a graphical way to help people with speech and speech pronunciation disorders understand the correct pronunciation part and method, to develop correct pronunciation habits [14].

With the development of technology, the cost of artificial palate production is getting lower and lower, which promotes the research of EPG. The data of the electropalatograph can not only be used for the study of speech movements in phonetics, but also for the modeling of speech application systems, which has a wide range of application prospects. The model established with false palate data can not only be used for speech teaching and vocal music teaching, but also for language rehabilitation training for children with cleft palate. In linguistic research, the data generated by false palate has very important theoretical significance for the study of coarticulation and speech enhancement [13], and also provides practical and effective theoretical basis for coarticulation for speech synthesis, speech recognition, etc. In addition, it can also provide experimental reference data for the use of computer software to simulate the dynamic process of tongue and palate contact during speech pronunciation. A quantitative scientific study of tongue-palate contact in a language.

4. Summary

The advantage of the electropalatograph is that it can collect dynamic speech pronunciation movements, and can collect a large number of real-time, and can also collect at the same time with speech, which is very beneficial to the study of the relationship between pronunciation movements and speech. The disadvantage is that people have to make a false palate suitable for a specific speaker in advance, so data cannot be directly collected during fieldwork. Dynamic electropalatography recording of tongue-palate contact state can record and describe language more objectively and accurately, and enrich the theory and improve traditional speech interpretation. The research on speech pronunciation based on EPG is based on traditional phonetics and modern phonetics, using the physiological instrument--electropalatograph to carry out more accurate and scientific research, in order to further study the pronunciation mechanism of a certain language It provides reference data, and can also enrich and supplement other researchers' experimental phonetics related theories on the pronunciation of a certain language.

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