

# The Lip Position Analysis of the Main Consonant /w/ in Tibetan Xiahe Dialect

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**Abstract**—Tibetan belongs to the main branch of Tibetan branch of the sino-tibetan language family .In China,Tibetan can be divided into Weizang, Kang and Amdo dialect branch. Xiahe dialect, which belongs to Tibetan Amdo dialect, is a typical language without tones. In its phoneme system,there exists consonant clusters. With the object of the consonant clusters that end with /w/ in Xiahe dialect, this paper aims at systematically analyzing the labial positions of these syllables. With the help of the combination of MATLAB, Audition and VirtualDub software, the author analyzes the videos (avi format). So the conclusions drawn from the study have great significance for the preservation of consonant clusters as well as the construction of the labial positions in Xiahe dialect.

**Keywords**—Consonant cluster; Inside lip height ;Outer lip width

## I. INTRODUCTION

The combination of two or three consonants is called a consonant cluster[1].The consonant cluster is very different from compound vowels, each consonant has its own pronunciation process,and there are obvious tone jumps during the process. Compared with standard Chinese ,Xiahe dialect better retained the consonant clusters,which is an important linguistic phenomenon. At present,the domestic researches on Tibetan consonant clusters mainly focus on phonemics and acoustic level, such as Hua Kan (1983) several special initial consonant changes in Amdo Tibetan language ,Kong Jiangping (1991) the acoustic analysis on fricative initials in Daofu Tibetan language,but few on lip position or physiological level.

Historically,the gradually reduce of consonant clusters is a general trend during the development process of Tibetan language. This process does not only influence the changes of rhyme and tone of voice, but also the configuration.So the study of consonant clusters is a noteworthy subject to explore Tibetan dialect and the history of Tibetan voice, and even the grammar history [2]. The consonant clusters that end with /w/ in

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Xiahe dialect mainly are: [hw]、 [ w]、 [kw].This paper mainly focus on consonant clusters that end with /w/ in Xiahe dialect.Combined the change of the lip position with the change of speech in Audition software,we made a deep research on the inside lip height and the outer lip width.

## II. RESEARCH METHOD

Parameter extraction is a very important part in the process of lip research.Here,we use the 2-dimension lip processing platform to extract the parameters.This platform was designed by Matlab software under the Windows system .

Liew's algorithm (Liew, Leung, & Lau, 2000) uses Lip width ( $w$ )、 Upper lip height ( $h1$ )、 Lower lip height ( $h2$ )、 Philtrum indentation ( $xoff$ )、 Lower lip arc ( $yh$ )、 Head tilt angle( $qx$ )and Lip migration degree ( $wz$ ) to construct the lip position,as shown in the left figure.

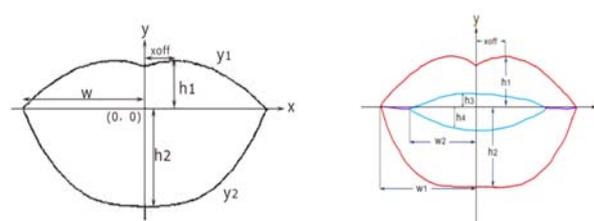


Fig. 1.The comparison between Liew's lip model and our's

We use manual annotation to construct the lip position,as shown in the right figure.By contrast,it is not hard to find that by using our lip model ,we can easily get the changes of both the inside lip and outer lip.During the experiment,we also find that the inside lip height ( $h3+h4$ ) and the outer lip width ( $2*w1$ ) are very important to the construction of lip position,so in this paper we choose the two parameters as reference.At the same time,in order to have a better analysis ,the consonant clusters we chose are all followed by the vowel [a].

### III. DATA ANALYSIS

With the help of MATLAB, Audition and VirtualDub software, we analyze the videos (avi format). Analysis processes are as follows.

#### A. Consonant cluster [hw]

We choose the Tibetan words ཅལལ. It can be seen from Fig.2: The outer lip begins to change at about the 4th frame(120ms), that means the starting of the pronunciation. At about the 9th frame(320ms), the inside lip starts to change, at the 10th frame(360ms), the inside lip cracks, and then expanding. At the 11th frame(400ms), the inside lip height reaches its peak, and it is the first time that the inside lip height reaches its peak. From the 12th frame(440ms) on, the inside lip height starts to decrease while the outer lip width still increases, the inside lip returns to its initial state at the 18th frame(640ms). During this period (from the 11th frame to the 18th frame), the outer lip corners keep shrinking while the outer lip outline keeps expanding, finally forming the lip-rounding state. From the 19th frame(720ms) on, the inside lip height and the outer lip width start to increase again, and the inside lip height reaches its another peak at the 22th frame(840ms), then it starts to shrink. At the 26th frame(1000ms), the inside lip returns to its initial state, and the outer lip stop changing at the 30th frame(1160ms), and the whole pronunciation finished.

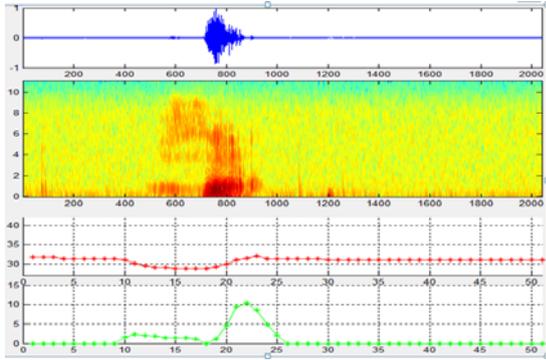


Fig. 3. The change on oscillogram, sound spectrogram, inside lip height and outer lip width of [hwa]

#### B. Consonant cluster [fw]

We choose the Tibetan words ཅལལ. It can be seen from Fig.2: The outer lip begins to change at about the 20th frame(760ms), that means the starting of the pronunciation. At the 10th frame(360ms), the inside lip cracks, and then expanding, at the same time the out lip starts to shrink. At the 23th frame(880ms), the inside lip height reaches its peak, and it is the first time that the inside lip height reaches its peak. From the 24th frame(920ms) on, the inside lip height starts to decrease while the outer lip width still increases, the inside lip returns to its initial state at the 27th frame (1040ms). During this period (from the 23th frame to the 27th frame), the the outer lip corners keep shrinking while the outer lip outline keeps expanding, finally forming the lip-rounding state. From the 28th

frame(1080ms) on, the inside lip height and the outer lip width start to increase again, and the inside lip height reaches its another peak at the 33th frame(1280ms), then it starts to shrink. At the 40th frame(1560ms), the inside lip returns to its initial state, and the outer lip stop changing at the 42th frame(1640ms), and the whole pronunciation finished.

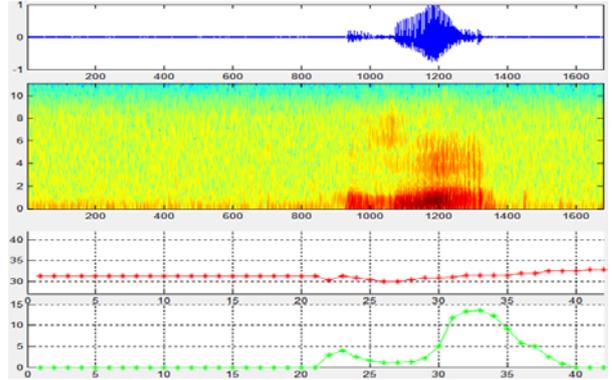


Fig. 3. The change on oscillogram, sound spectrogram, inside lip height and outer lip width of [kwa]

#### C. Consonant cluster [kw]

We choose the Tibetan words ཀལ. It can be seen from Fig.3: The outer lip begins to change at about the 7th frame(240ms), at this time, the out lip corners start shrinking while the out lip outline starts expanding, that means the starting of the pronunciation. At the 11th frame(400ms), the inside lip cracks, and then expanding, at the same time the out lip starts to shrink. At the 13th frame(480ms), the inside lip height reaches its peak, and it is the first time that the inside lip height reaches its peak. From the 14th frame(520ms) on, the inside lip height starts to decrease while the outer lip width still increases, the inside lip returns to its initial state at the 21th frame (800ms). During this period (from the 13th frame to the 21th frame), the outer lip corners keep shrinking while the outer lip outline keeps expanding, finally forming the lip-rounding state. From the 26th frame(1000ms) on, the i inside lip height and the outer lip width start to increase again, and the inside lip height reaches its another peak at the 30th frame(1160ms), then it starts to shrink. At the 34th frame(1320ms), the inside lip returns to its initial state, and the outer lip stop changing at the 38th frame(1480ms), and the whole pronunciation finished.

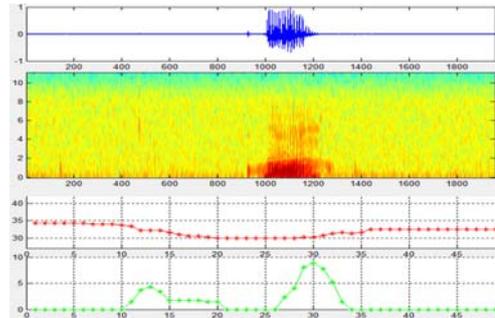


Fig. 3. The change on oscillogram, sound spectrogram, inside lip height and outer lip width of [kwa]

## VI. CONCLUSION

In Xiahe dialect, the existence of consonant clusters that end with /w/ is a special phenomenon. These special consonant clusters are [hw], [fɰw], [kw]. /w/ is very different from other consonants. More specifically, /w/ is neither a vowel nor a consonant, it is a sound that between the two kinds of sounds. When pronouncing it, we need to keep the lips lip-rounding, and the tongue position is very high, the inside lip height is the lowest. So, /w/ has a very big influence on the initial consonant and the rear vowel when pronouncing. This influence can be easily seen on the change of lip positions. Compared with the other two kinds of consonant clusters in Xiahe dialect, only the inside lip height of the consonant clusters that end with /w/ have two peaks. The first peak appears at pronouncing /w/, the second peak appears at pronouncing /a/, and the second peak is much higher than the first one.

We can see from the above three pictures that at the beginning of the speech, the outer lip changes earlier than the inside lip while at the end of the speech, the inside lip returns to its initial state earlier than the outer lip. There is a law in this process: When pronouncing [hwa], the outer lip changes at the 4th frame while the inside lip changes at the 9th frame, the inside lip stops changing at the 26th frame while the outer lip stops changing at the 30th frame. At the beginning and end of the syllable, the outer lip changes 5 frames earlier than the inside lip while it stops 4 frames later than the inside lip; When pronouncing [fɰwa], the outer lip changes 2 frames earlier than the inside lip while it stops 2 frames later than the inside lip; When pronouncing [kwa], the outer lip changes 4 frames earlier than the inside lip while it stops 4 frames later than the inside lip.

Consequently, the time the outer lip starts changing takes than the inside lip are almost the same as the time the inside lip stops changing takes than the outer lip. There is a close corresponding relation between them.

We can also see from the above three pictures that along with the increasing of the inside lip height, the outer lip width is overall in a small state, there is a negative relationship between them. Besides, there exists a transition between the two peaks, in this transition the inside lip does not completely close, and this transition is relatively very long, that means the process /w/ transitioning to /a/ is very smooth, and the transition of the entire syllable is very natural.

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## REFERENCES

- [1] LUO CHANGPEI, WANG JUN, GENERAL LINGUISTICS, PP. 121, 2002.
- [2] HUA KAN, THE COMPARISON OF CONSONANT CLUSTERS BETWEEN XIAHE AND MAQU TIBETAN, *JOURNAL OF NORTHWEST UNIVERSITY FOR NATIONALITIES (PHILOSOPHY AND SOCIAL SCIENCE)*, VOL. 04, PP. 292-311, 1984