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ORIGINAL RESEARCH

# Comparison of the Anterior Tooth and Lip Esthetic Characteristics of Hani and Han Youth in China When Speaking

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**Objective:** This study aims to measure and analyze the lip and tooth dynamic esthetic characteristics at rest and during speech in order to provide a reference for its esthetic design and restoration among the Hani and Han populations in Yunnan Province, China.
**Methods:** Subjects of Hani and Han ethnicity in Yunnan were selected using multistage stratified sampling and inclusive criteria. The lip and tooth dynamic esthetic characteristics of the subjects at rest and during the pinyin pronunciation of "me", "yi", "fu", and "si" were recorded using digital photography and analyzed with computer software.
**Results:** No statistical difference was detected between the Hani and Han groups in the upper central-incisor display, when pronouncing the pinyin "yi". Furthermore, there were no statistical differences in lip dynamic esthetic parameters between the Hani and Han groups, except for the distance between the upper and lower lips when pronouncing "si". There were three kinds of correlation between the upper central-incisor edge and lower lip: separation, contact, and overlap.
**Conclusion:** The display of upper central incisors and the mouth width of Hani people are larger than those of Han people when at rest. When the pinyin "si" is pronounced, the display of upper central incisors and the upper–lower lip distance of Hani people is less than that of Han people due to labial muscle movement.
**Keywords:** Hani, Han, pronunciation, lip and tooth aesthetics, digital videography

## Introduction

Determining how to restore the natural tooth–lip relationship and the dynamic esthetics of the maxillofacial region of patients is a common challenge for all dentists and surgeons in the field of dental implants, esthetic restoration, and maxillofacial surgery.[1,2] The tooth–lip esthetic relationship is vividly demonstrated when people smile and talk. That is the reason why smile esthetics have become a focus for the study of maxillofacial esthetics.[3–10] Some studies have revealed that only considering the tooth–lip relationship in relation to smiling leads (oral) esthetic design in the wrong direction, while the characteristics of patients during normal speech could provide important information for esthetic treatment.[11–18] There are few studies of tooth–lip esthetics when speaking, and most of these studies have focused on the oral esthetic parameters of the English pronunciation of "M", "E", "F", and "S"; dynamic esthetic parameters based on the pronunciation of minority-group languages have never been reported.[11,17]

There are 56 ethnic groups in China. The Han ethnic group is the most populous, while the other ethnic groups form minorities. Yunnan Province is rich in minority ethnic groups, and the Hani people, with a population of 1.63 million, is the largest unique minority group in Yunnan, frequently living in compact communities. The present study investigated the tooth–lip dynamic esthetic characteristics of the Hani and Han groups while speaking in Mandarin.

Tooth–lip relationships while speaking and smiling are important aspects of facial esthetics. However, few studies have focused on tooth–lip relationships during speech. The aim of the present study was to evaluate and compare the normal range and distribution of anterior-tooth and lip esthetic parameters as well as the tooth–lip position relationship during relaxation and speech in the Hani and Han ethnic groups.

## Materials and Methods
### Subjects
The present study was conducted on 298 subjects (132 Han and 166 Hani) randomly selected from among the Hani and Han people living in Hong-he Prefecture and Pu-Er City in Yunnan Province. The included Hani subjects required an ancestry bloodline of at least three generations. Among these 298 subjects, 102 were male (age range: 18–72 years old), while 196 were female (age range: 18–57 years old).

The inclusion criteria for these subjects are as follows: 1) no repair or restorative treatment to the anterior teeth; 2) optimal spacing between the teeth, neither narrow nor wide; 3) no tooth decay; 4) no gum or periodontal disease; 5) no excessive wear to the occlusal surfaces of the teeth; 6) a good tooth midline position, teeth arranged in an orderly manner, and no history of orthodontic treatment.

The study was explained to each participant and/or to the subject's parent or guardian, and all agreed to participate in the study. *A signed consent form was received from all subjects, and the project was approved by the Ethics Committee of Kunming Medical University.

### Methods
The videographic records of these 298 subjects were captured using a digital video camera (SONY video recorder, HDR-CX900E, Sony Corporation, Japan) to record the tooth–lip dynamic relationship of subjects when they were at rest watching relaxing videos, and when they were pronouncing words supplied by the surveyor. Video editing software (Adobe

Premiere Pro CS6, version 6.0; Adobe, San Jose, CA, USA) was used to export the single-framed image of subjects at rest with their head upright and their mouth and lips relaxed and when they were pronouncing the words (resolution: 1920 × 1080). Image editing software (Adobe Photoshop CS6, version 6.0; Adobe, San Jose, CA, USA) was used to measure the pixel value of different parameters in the images, and VirtualBox software and a ratio scale of the face were used to obtain the actual value of the parameters.

## Measurement and Calculation of Parameters
All subjects underwent pronunciation training with the same surveyor and a pre-test of pronunciation before the real measurements were taken.

The subjects were asked to pronounce the following in pinyin: 1) "me" (the English pronunciation is/'mɜː/); 2) "yi" (the English pronunciation is/'iː/); 3) "fu" (the English pronunciation is/fuː/); and 4) "si" (the English pronunciation is/'s/).

Using linear measurements, the lip and dental esthetic parameters were recorded and measured when the subjects were at rest and when they pronounced the pinyin "me", "yi", "fu", and "si".

The lip and anterior dental esthetic parameters were measured as follows (Figure 1):

1. Upper labial height: the vertical distance between the lip peak and stomion superius (Figure 1A).
2. Mobility of the upper labial height = the upper labial height when pronouncing the pinyin "me" /the upper labial height at rest × 100%.
3. Outer intercommissural width: the distance measured between the right and left outer commissure (Figure 1B).
4. Mobility of the intercommissural width = the intercommissural width when pronouncing the pinyin "me" /the intercommissural width at rest × 100%.
5. Upper central-incisor display: the distance between the edge of the upper central incisors and lower margin of the upper lip (Figure 1C).
6. Interlabial gap: the distance between the upper-lip lower margin and lower-lip upper margin (Figure 1D).

### Statistical Analysis
An independent two-sample *t*-test was used to compare the esthetic measurements of these different ethnic

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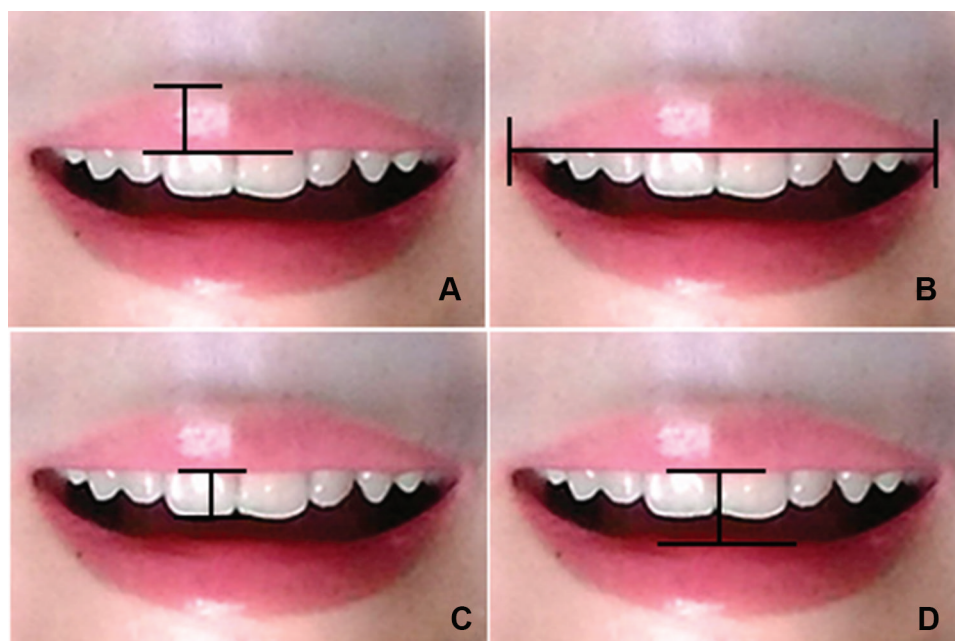
**Figure 1** Quantitative indicators. (**A**) Upper labial height; (**B**) outer intercommissural width; (**C**) the upper central incisors display; (**D**) interlabial gap.

groups. The $X^2$-test was used to analyze the distance relationship between the edge of the upper anterior teeth and the superior border of the lower lip. SPSS 19.0 statistical software was used, and the significance level was α = 0.05.

## Results
### The Upper Central-Incisor Display

Statistical differences were found in the upper central-incisor display between the Hani and Han ethnic groups when they were at rest (*P = 0.029) and when pronouncing the pinyin "me" (*P = 0.004) and "si" (*P = 0.001). However, there was no statistical difference in the upper central-incisor display between these two ethnic groups when pronouncing the pinyin "yi" (Table 1).

**Table 1** The Display of Upper Central Incisors (mm, Mean±SD)

|  | Hani | Han | t | P |
|---|---|---|---|---|
| Rest position | 0.73±0.16 | 0.30±0.10 | 2.203 | 0.029 |
| "me" | 4.84±0.16 | 3.51±0.10 | −2.870 | 0.004 |
| "yi" | 3.12±0.43 | 3.55±0.59 | −1.177 | 0.239 |
| "si" | 3.54±0.38 | 4.26±0.23 | −3.410 | 0.001 |

**Notes:** If P>0.05, there was no statistical difference in display of upper central incisors between Hani and Han people; if P<0.05, there was statistical differences.

### Lip Dynamic Esthetic Characteristics When Pronouncing the Pinyin "me"

There were statistical differences in the outer intercommissural width between the Hani and Han groups when at rest (*P = 0.001). However, there was no statistical difference in upper-lip height and the extent of mobility when pronouncing the pinyin "me" (Table 2).

### Tooth–Lip Dynamic Esthetic Characteristics When Pronouncing the Pinyin "yi" and "si"

There were no statistical differences found in the upper central-incisor display, interlabial gap, and the ratio of these two parameters between the Hani and Han groups when pronouncing the pinyin "yi", nor with the ratio of the upper central-incisor display to the interlabial gap when pronouncing the pinyin "yi". Statistical differences (*P = 0.001) were detected in the interlabial gap between the Hani and Han groups when pronouncing the pinyin "si" (Table 3).

### Tooth–Lip Dynamic Esthetic Characteristics When Pronouncing the Pinyin "fu"

There are three types of position relationship between the upper central-incisor edge and superior border of the lower lip: separate, contact, and overlap (Figure 2). The three

**Table 2** The Lip Dynamic Aesthetics Characteristics When Pronounce "me" (mm, Mean±SD)

| | | Hani | Han | t | P |
|---|---|---|---|---|---|
| Up lip height | Rest position | 8.28±1.69 | 8.78±1.77 | −1.773 | 0.078 |
| | "me" | 7.82±1.79 | 8.21±1.73 | −1.345 | 0.178 |
| | The extent of mobility | −11.54%±0.11 | −10.69%±0.11 | −1.437 | 0.126 |
| Mouth width | Rest position | 51.16±3.59 | 48.59±5.44 | 3.457 | 0.001 |
| | "me" | 52.24.±3.96 | 50.93±7.47 | 1.373 | 0.172 |
| | The extent of mobility | 5.04%±0.06 | 5.21%±0.05 | 1.373 | 0.172 |

**Notes:** If P>0.05, there was no statistical difference in display of upper central incisors between Hani and Han people; if P<0.05, there was statistical differences.

**Table 3** The Lip–Teeth Aesthetics Characteristics When Pronounce "yi" and "si" (mm, Mean±SD)

| | | Hani | Han | t | P |
|---|---|---|---|---|---|
| "yi" | The display of upper central incisors | 3.12±0.43 | 3.55±0.59 | −1.177 | 0.239 |
| | Upper-lower lip distance | 6.45±1.03 | 7.66±0.21 | −0.442 | 0.658 |
| | a/b | 0.51±0.18 | 0.50±0.20 | 0.335 | 0.723 |
| "si" | The display of upper central incisors | 3.54±0.38 | 4.26±0.23 | −3.410 | 0.001 |
| | Upper-lower lip distance | 6.72±0.12 | 8.04±0.16 | −3.401 | 0.001 |
| | a/b | 0.56±0.16 | 0.50±0.21 | 1.874 | 0.063 |

**Notes:** If P>0.05, there was no statistical difference in display of upper central incisors between Hani and Han people; if P<0.05, there was statistical differences.

types of relationship in the two ethnic groups are presented in Table 4. The $X^2$-test demonstrated no statistical significance in these position relationships between the Hani and Han groups ($P > 0.05$).

# Discussion
## The Significance of Dynamic Esthetic Characteristics During Pronunciation

As important vocal organs, the dynamic esthetic characteristics of lips and teeth during pronunciation play significant roles in guiding the esthetic analysis of the maxillofacial region. Ackerman et al found that there were large differences in adult tooth–lip dynamic characteristics when speaking and smiling. Furthermore, they suggested the recording of anterior tooth display during speech and when smiling to conduct the esthetic analysis as part of the dynamic process.[13] Sackstein also noted that phonetic processes should be observed during the esthetic evaluation of anterior teeth.[14,15] Nevertheless, there are few studies on tooth–lip dynamic esthetics during pronunciation, and most of these studies have focused on evaluating oral esthetic indicators with the English pronunciation of "M", "E", "F", and "S".

## Selection Principle of Mandarin Pronunciation

The pinyin "me", "yi", "fu", and "si" were chosen in the present study to evaluate common indicators in oral esthetic restoration. The pinyin "me" is bilabial and has the largest extent of lip mobility of these four sounds. This mainly manifests as the change in thickness of the upper lip and the outer intercommissural width and influences the display of the anterior teeth; thus, such parameters are usually used to evaluate the extent of mobility of the lip and teeth and the length and display of the upper anterior teeth. The pinyin "yi" and "si" are double dentals and have the smallest distance between the upper and lower anterior teeth of the four sounds, and the extent of mobility of the upper and lower teeth does not influence the pronunciation. These two sounds have a stable position. When pronouncing the pinyin "yi" in the natural state, the ratio of the upper anterior-tooth display to the distance between the upper and lower lip can be indirectly used to evaluate the restoration length of the upper anterior teeth, while the pronunciation of the pinyin "si" can be used to evaluate the length of the teeth and the vertical distance. The pinyin "fu" is labiodental and mainly displays the upper incisors during pronunciation. Hence, the parameters mentioned

**Figure 2** Three kinds of position relations between upper central incisors edge and lower lip. (**A**) Separate; (**B**) contact; (**C**) overlap.

above can be used to evaluate the length and shape of the upper incisors and can be taken into consideration during restorative procedures. Meanwhile, the upper central incisors are close to the superior border of the lower lip. Hence, evaluating the position relationships between these two factors can be used to guide the position relationship of the upper central incisors to the lip and palate. According to the analysis of the above phonetic features, the present study was designed to evaluate certain tooth–

**Table 4** The Position Relation Between Upper Central Incisor Edge and Lower Lip [mm, n (%)]

|  | Hani | Han | t | P |
|---|---|---|---|---|
| Contact | 94 (35.21) | 70 (26.22) | 3.981 | 0.137 |
| Separate | 27 (10.11) | 18 (6.74) |  |  |
| Overlap | 26 (9.68) | 32 (12.04) |  |  |

lip esthetic indicators under different phonetic states, such as the anterior tooth display and the position relationship between the incisal margin and the upper and lower lip.

## Comparison and Clinical Significance of Tooth–Lip Dynamic Characteristics in Hani and Han Ethnic Groups During Pronunciation

The present study compared the tooth–lip dynamic esthetic characteristics of the Hani people, which is the largest unique minority group in Yunnan Province, and the Han people during the pronunciation of certain sounds. It was found that there were obvious statistical differences ($P < 0.05$) in the upper central-incisor display between the Hani and Han groups when they were at rest and when speaking, except for the pronunciation of the pinyin "yi", which is double dental and has the smallest distance between the upper and lower anterior teeth and a stable tooth–lip position relationship. Furthermore, there was no statistical difference in the extent of mobility of the lip and teeth between the Hani and Han groups when pronouncing the bilabial pinyin "me" ($P > 0.05$). However, the outer intercommissural width increased by approximately 5%, and the lip height decreased by approximately 11%. The extent of mobility of the lip and teeth has been seldom reported. When pronouncing the double dental "yi" and "si", there was no statistical difference between the Hani and Han groups in the ratio of the upper central-incisor display to the interlabial gap (a/b). These ratios were approximately 50%, which is similar to the research conducted by Fradeani, in which a/b was not less than 50%.[17] These two double-dental sounds can provide guidance on determining the restoration length of the upper anterior teeth. For the pronunciation of the pinyin "fu", there were three types of position relationship between the upper anterior-tooth edge and the superior border of the lower lip: more than half the subjects had an upper anterior-tooth edge parallel to or contact superior to the border of the lower lip, and a certain proportion of subjects had an upper anterior-tooth edge that was separate to or overlapping the superior border of the lower lip. These results can be used as a guide in the esthetic design of the length of the upper anterior teeth and their position in relation to the lip and palate.

A digital video camera and video editing software were used in the present study to conduct the dynamic analysis of the tooth–lip esthetic characteristics of the Hani and Han ethnic groups when producing certain Mandarin

sounds. The present study offers guidance to the esthetic design of oral restoration and fills the data gap on the tooth–lip dynamic esthetics of the Hani people. Further research is required, and it should focus on the tooth–lip dynamic esthetic characteristics of different age groups and bite types using 3D facial-imaging technology in order to achieve better esthetic outcomes during anterior-tooth restoration.

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## Disclosure

The authors report no conflicts of interest for this work.

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