

Short Communications**Study of relationship between clinical factors and velopharyngeal closure in cleft palate patients**

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**Abstract**

**BACKGROUND:** This study was carried out to analyze the relationship between clinical factors and velopharyngeal closure (VPC) in cleft palate patients.

**METHODS:** Chi-square test was used to compare the postoperative velopharyngeal closure rate. Logistic regression model was used to analyze independent variables associated with velopharyngeal closure.

**RESULTS:** Difference of postoperative VPC rate in different cleft types, operative ages and surgical techniques was significant ( $P=0.000$ ). Results of logistic regression analysis suggested that when operative age was beyond deciduous dentition stage, or cleft palate type was complete, or just had undergone a simple palatoplasty without levator veli palatini retropositioning, patients would suffer a higher velopharyngeal insufficiency rate after primary palatal repair.

**CONCLUSIONS:** Cleft type, operative age and surgical technique were the contributing factors influencing VPC rate after primary palatal repair of cleft palate patients.

**KEYWORDS:** Cleft palate; velopharyngeal closure; clinical factor; analysis.

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When adequate preoperative orthodontic treatment and successful well-timed surgery were put into use in recent decade, postoperative velopharyngeal closure (VPC) rate of cleft palate patients increased obviously.<sup>1-5</sup> However, velopharyngeal insufficiency (VPI) after primary palatal repair still remains a persistent problem which includes difficulties of patients' speech intelligibility and quality.<sup>6</sup>

According to the literature,<sup>7-9</sup> for achieving the best phonetic result after operation, the optimal time for primary palatal repair is 9-12 months old because the articulation does not begin to develop at that time. Moreover, many clinical reports indicated that younger cleft pa-

late patients had higher VPC rate after primary palatal repair than older patients, and the rate decreased obviously when operative age was over 2 years old.<sup>10,11</sup> Nevertheless, the optimal timing and techniques of cleft palate repair still remain controversial. Therefore, it is necessary to investigate the correlative clinical factors on velopharyngeal closure of cleft palate patients after primary palatal repair.

**Methods****Study approval**

The research protocol was approved by the Ethical Committee of Sichuan University. Patients and their parents provided written informed consent for the procedures.

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### **Patient selection criteria**

The whole data consisted of 276 patients who were enrolled from department of cleft lip and palate surgery, West China Stomatological Hospital, Sichuan University from 2002-2009. The selection criteria included non-syndromic cleft palate, no subnormal intelligence and dysacusia, undergone primary palatal repair and had a definite postoperative diagnosis and had alternative operation of any of 2 kinds of surgical techniques Sommerlad palatoplasty or 2-flap palatoplasty. All patients were examined by perceptual speech assessment, lateral cephalogram of nasopharyngography or nasopharyngeal fibroscope.

### **Cleft type**

According to Comprehensive Cleft Care,<sup>12</sup> 276 cleft palate patients were divided into 4 kinds of cleft types: bilateral complete cleft palate (BCCP), unilateral complete cleft palate (UCCP), incomplete cleft palate (ICP) and submucosal cleft palate (SMCP).

### **Operative age**

In order to investigate whether there was any difference in velopharyngeal morphological structure of cleft palate patients among different dentition stages, we took 6 and 12 years old as the age division. Operative age of these patients were divided into three stages: deciduous dentition stage (DDS), mixed dentition stage (MDS), and permanent dentition stage (PDS).

### **Surgical technique**

There were 2 kinds of surgical technique in 276 patients: Sommerlad palatoplasty<sup>13</sup> (palatoplasty with levator veli palatini retropositioning, SP) and 2-flap palatoplasty<sup>7</sup> (palatoplasty without levator veli palatini retropositioning, 2-flap).

### **Diagnostic criteria of VPC**

The diagnostic criteria included as the followings:<sup>14</sup> (1) the result of perceptual speech assessment indicated that patients without hyponasality or nasal emission and (2) the result

of lateral cephalogram of nasopharyngography indicated sagittal velopharyngeal complete closure. The diagnosis was VPC when the results of (1) and (2) were consentaneous. If the results of (1) and (2) were conflicting, nasopharyngeal fibroscope would be performed, and the final diagnosis would be according to the result of nasopharyngeal fibroscope.

### **Statistical analysis**

Independent variables included patient's gender, operative age, cleft type, and surgical technique. The data were analyzed using SPSS (version 13.0, SPSS Inc., USA). Chi-square test was used to compare the postoperative VPC rate.  $P < 0.05$  was considered significant. Multi-variable logistic regression was used in backward process (selection criteria:  $\alpha = 0.05$ ), and it was used for finding the odds ratio of different clinical factors with velopharyngeal closure.

## **Results**

### **General information**

It showed that the postoperative VPC rate of 276 patients was 73.19%. 145 (52.54%) were male patients and 131 (47.46%) were female. In cleft type, 47 (17.03%) were patients with BCCP, 124 (44.93%) were patients with UCCP, 84 (30.43%) were patients with ICP and 21 (7.61%) were patients with SMCP. Operative age was from 1 to 34 years old, average age was 10.7 years old, 128 (46.38%) were patients in DDS, 81 (29.35%) were patients in MDS and 67 (24.27%) were patients in PDS. In surgical technique, 167 (60.51%) were patients with SP and 109 (39.49%) were patients with 2-flap. General information are shown in Table 1.

### **Chi-square test**

It showed that the respective VPC rate of males and females was 71.72% and 74.81%, and there was no difference in different genders ( $P = 0.563$ ). In cleft type, the respective VPC rate of BCCP, UCCP, ICP and SMCP was 38.30%, 71.77%, 90.48% and 90.48%. There was significant difference in the four kinds of cleft types ( $P = 0.000$ ). We combined the data of BCCP+UCCP into CCP group and ICP+SMCP

**Table 1.** General information of 276 cleft palate patients

Factors	Patients	Velopharyngeal Closure Rate
Male	145	52.54%
Female	131	47.46%
Bilateral complete cleft palate	47	17.03%
Unilateral complete cleft palate	124	44.93%
Incomplete cleft palate	84	30.43%
Submucous cleft palate	21	7.61%
Deciduous dentition stage	128	46.38%
Mixed dentition stage	81	29.35%
Permanent dentition stage	67	24.27%
Sommerlad palatoplasty	167	60.51%
2-flap palatoplasty	109	39.49%

into ICP group, and the results showed that VPC rate of CCP group was 62.57% and VPC rate of ICP group was 90.48%; there was a significant difference in VPC rate between CCP group and ICP group ( $P=0.000$ ). In operative age, the respective VPC rate of patients in DDS was 92.19%, patients in MDS was 66.67% and patients in PDS was 44.78%, and the difference was significant ( $P=0.000$ ). In surgical technique, patients with SP achieved higher postoperative VPC rate than patients with 2-flap, 88.02% vs. 50.46%, respectively. There was significant difference in the two kinds of surgical techniques ( $P=0.000$ ). Results are shown in Table 2.

#### *Logistic regression analysis*

Results of multivariable logistic regression indicated that patient's gender was not the factor associated with VPC rate ( $P>0.05$ ), so gender was rejected. Results indicated that cleft type, operative age and surgical technique were the contributing factors for VPC rate of cleft palate patients after primary palatal repair ( $P<0.01$ ). It suggested that when operative age was beyond deciduous dentition stage, or cleft type was complete cleft palate, or just had undergone a simple palatoplasty without levator veli palatini repositioning, patients would suffer from higher VPI rate after primary palatal repair. Results are shown in Table 3.

**Table 2.** Chi-Square test of gender, cleft type, operative age, surgical technique and velopharyngeal closure

Factors	Velopharyngeal Closure	Velopharyngeal Insufficiency	$\chi^2$	P
Male	104	41	0.344	0.563
Female	98	33		
Bilateral complete cleft palate	18	29	45.276	0.000
Unilateral complete cleft palate	89	35		
Incomplete cleft palate	76	8		
Submucous cleft palate	19	2		
Deciduous dentition stage	118	10	52.864	0.000
Mixed dentition stage	54	27		
Permanent dentition stage	30	37		
Sommerlad palatoplasty	147	20	47.429	0.000
2-flap palatoplasty	55	54		

**Table 3.** Relationship between clinical factors and VPC rate by multivariable logistic regression

Factors	Beta coefficient	S.E.	Wald	P-value	Odds ratio	95% CI
Intercept	7.250	1.457	24.747	0.000		
Gender	-0.519	0.402	1.674	0.196	0.595	0.271-1.307
Cleft type	1.528	0.289	28.010	0.000*	4.610	2.618-8.120
Operative age	-2.234	0.334	44.872	0.000*	0.107	0.056-0.206
Surgical technique	-2.769	0.494	31.417	0.000*	0.063	0.024-0.165

\* P&lt;0.01

## Discussion

Many studies have investigated the relationship between clinical factors and velopharyngeal closure in cleft palate patients, but they have had inconsistent results.<sup>3,9-11,15-18</sup> Molsted<sup>18</sup> indicated that even in young cleft patients born with the same cleft type and treated by identical treatment procedures, the treatment outcome can differ very considerably, because a great variability in craniofacial form and cleft form was observed in cleft palate patients.

### Gender

Meskin<sup>19</sup> hypothesized that cleft palate was more common in females because the secondary palate of females fused later than males. Burdi<sup>20</sup> confirmed this hypothesis with histologically sectioned human embryos. Bicknell<sup>21</sup> found that male patients were more than female patients with the probability of secondary pharyngoplasty. However, others proposed contrary opinions. Pulkkien<sup>17</sup> considered that gender was not associated with velopharyngeal closure in cleft palate patients. LU<sup>11</sup> found that there was not significant difference of postoperative VPC rate between males and females. In the present study, we found no evidence for a relationship between patient's gender and postoperative VPC rate.

### Cleft type

LU<sup>11</sup> found that postoperative VPC rate of soft cleft palate and unilateral complete cleft palate were more common than hard and soft cleft palate and bilateral complete cleft palate. Wada<sup>22</sup> found that the width of velopharyngeal gap directly influenced postoperative VPC rate; wider velopharyngeal gap means higher

VPI rate after operation. In the present study, we found that cleft type and postoperative VPC rate were statistically associated. It showed that VPI was more likely to occur in BCCP. We speculated that such a lot inconsistent results may be due to different cleft palatal classification of the subjects who were investigated in the studies. Because detail of cleft type was just analyzed with position and length of cleft, the characteristics of velopharyngeal morphology in cleft palate patients were not taken into consideration.

### Operative age

There is a consensus about early surgical treatment of congenital cleft palate because the articulation does not begin to develop before 1 year old. Marrian<sup>10</sup> proposed that the optimal time for primary repair of cleft palate patients was 8-10 months old. Berkowitz<sup>3</sup> found that the best time to close the palatal cleft space was when the palatal cleft size was 10 percent or less of the total palatal surface area. The ratio generally occurs between 18 and 24 months old of patients. SHI<sup>23</sup> proposed that the optimal time for primary repair of cleft palate patients was 12-18 months old according to the relationship between operative age and maxillary growth and velopharyngeal function. In the present study, it was shown that postoperative VPC rate of DDS was more than that of MDS and PDS; it means that VPC rate would decrease when operative age increased. Although the optimal time for primary palatal repair was not consistent, many researchers consented that surgical treatment should be taken before 2 years old in order to close the palatal cleft space before the pathological arti

ulation begin to produce.<sup>5,13,19-21</sup>

### **Surgical technique**

It was a prevalent unambiguous opinion that there was a significant correlation between surgical technique and velopharyngeal closure.<sup>9-11,24-27</sup> Wu<sup>28</sup> explored the mechanism of VPI after primary palatal repair by nasopharyngography. They found that the main reason for VPI was that soft palate could not completely contact with posterior pharyngeal wall in sagittal direction. They emphasized the significance of levator veli palatini retropositioning and recovery of velar activity. Trier<sup>29</sup> analyzed the difference of postoperative velopharyngeal closure between Von Langenbeck with intravelar veloplasty (IVV) group and Von Langenbeck without intravelar veloplasty (non-IVV) group. They found that the postoperative VPC rate of IVV group was more than that of non-IVV group. Hence, they emphasized the significance of levator veli palatini

retropositioning. Lin<sup>30</sup> found that the postoperative outcome of combined levator retropositioning and pharyngeal flap was better than that of double-opposing Z-plasty. LU<sup>31</sup> reported the role and detail of surgical technique according to Sommerlad palatoplasty in clinical cases. They considered that Sommerlad palatoplasty could increase the postoperative VPC rate of patients. In the present study, we compared Sommerlad palatoplasty with 2-flap palatoplasty. It showed that VPC rate of SP was more than that of 2-flap in cleft palate patients, especially in complete cleft palate of old cleft palate patients.

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### **Conflict of Interests**

Authors have no conflict of interests.

### **Authors' Contributions**

QCH, QZH and BSH were responsible for the conception and design of the study. QCH and G ZH performed the data analysis. All authors participated in interpretation of the findings. QCH, QZH, HY and TM drafted the manuscript. BSH revised and commented on the draft. All authors read and approved the final version of the paper. All authors confirmed that the content has not been published elsewhere and does not overlap or duplicate their published work.

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