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Three Dimensional Assessment of the Pharyngeal Airway in Individuals with Non-syndromic Cleft Lip and Palate

Ruxandra Vatav*

Faculty of Medicine, Department of Morpho-Functional Sciences, "Grigore T. Popa Lasi" University of Medicine and Pharmacy, Lasi, Romania

Review Article

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***For Correspondence**
Ruxandra Vatav, Faculty of Medicine, Department of Morpho-Functional Sciences, "Grigore T. Popa Lasi" University of Medicine and Pharmacy, Lasi, Romania

Email: ruxandravatv@gmail.com

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Abstract

Introduction: Children with cleft lip and palate (CLP) are known to have airway problems. Cone beam computed tomography (CBCT) is frequently used in surgery treatment planning in patients with cleft lip and palate (CLP). The purpose of this study was to analyze and compare 3D the pharyngeal airway volumes of cleft palate patients with normal individuals using CBCT

Materials and methods: The sample group included 30individuals (15 with cleft lip and palate subjects and 15healthy subjects). The pharyngeal airway was three-dimensionally assessed, segmented and their volume was calculated. The differences between the control and cleft groups were calculated using ANOVA.

Results: No statistically significant Individuals with CLP did not exhibit a total airway volume smaller than the non-CLP controls.

Conclusion: 3D imaging using CBCT and Romexis software is reliable for pharyngeal airway volume. The present study showed that the pharyngeal airway is not compromised in CLP individuals.

INTRODUCTION

The most common congenital abnormality is the cleft and palate (CLP) which affects the jaw and face. CLP are frequently associated with nasal abnormalities such as septal deviation, nostril atresia, turbinate hypertrophy, maxillary constriction, vomerine spurs, and alar constriction [1-5]. These abnormalities are attributed in part to the congenital defect itself and partly to the surgeries done to repair the oro facial defect [6-10]. Collectively, the nasal abnormalities tend to reduce the dimensions of the nasal cavity and lower airway function [6-11]. Previous studies have shown that 3D imaging using CBCT is a simple and effective method to accurately analyse the airway. Recently, numerous studies have been performed using CBCT, for assessing the airway in relation with facial morphology in individuals with sleep apnea [12,13]. At present, few CBCT studies devoted to the airway of individuals with CLP have been published; despite the frequently occurring airway problems in such subjects [2-5]. The present study compares the volume of the pharyngeal airway in patients with cleft lip and palate to patients without cleft, by means of CBCT images.

MATERIALS AND METHODS

Intertwining A retrospective study was developed on subjects recruited from the Plastic Surgery Clinic, "St. Mary" Emergency Hospital for Children, Iasi. The experimental group included 30 individuals (15 with cleft lip and palate and 15 healthy subjects).

The exclusion criteria were:

- History of treatment for sleep-disordered breathing, including tonsillectomy, adenoidectomy, or recurrent tonsillitis
- Frequent colds (6 or more per year)
- History of dysphagia and continuous positive airway pressure therapy

A further exclusion criterion for the control groups included any type of syndrome. The pharyngeal airway was segmented and the volume was rendered in a multiplanar reconstruction (MPR) mode. The threshold tool was used to select the pharyngeal airway space. The threshold was defined by the Measure Cube Tool, to include the pharyngeal airway. The 3D Region Growing function was used to create a 3D displaying the pharyngeal airway space from each region of interest. The volume (cm^3) was determined from the total airway segmentation. The airway was further segmented into three sections: nasopharynx, oropharynx

and hypopharynx. The superior border of the nasopharynx was defined as the posterior choana and inferiorly as to the horizontal line along the hard and soft palates. The oropharynx was defined superiorly by the soft palate and inferiorly by the vallecula. The hypopharynx was defined superiorly by the hyoid bone and vallecula and inferiorly by the junction of the larynx and oesophagus. All volumetric values obtained were tabulated, and Student t-test was performed to comparethe pharyngeal airway volume between the cleft and the non-cleft group.

RESULTS

The final sample consisted of 30 CBCT images, including 15 control subjects and 15 individuals with cleft lip and palate (13 UCLP and 2 BCLP). As a result, a total number of 30 pharyngeal airways were evaluated. The airway volumes were not significantly different. The nasopharynx showed an average volume of 6.40 cm^3, with a standard deviation of 1.2 cm^3 in the juvenile CLP group and an average volume of 4.24 cm^3, with a standard deviation of 1.8 cm^3, respectively, in the juvenile control group. The nasopharynx showed an average volume of 9.75 cm^3, with a standard deviation of 1.3 cm^3 in the adolescently group, and an average volume of 3.83 cm^3 with a standard deviation of 1.7 cm^3, respectively, in the adolescent control group. The oropharynx showed an average volume of 5.00 cm^3, with a standard deviation of 1.5 cm^3 in the juvenile CLP group, and an average volume of 8.57 cm^3 with a standard deviation of 2.1 cm^3, respectively, in the juvenile control group. The oropharynx showed an average volume of 6.19 cm^3 with a standard deviation of 1.9 cm^3 in the adolescent CLP group and an average volume of 10.72 cm^3 with a standard deviation of 2.3 cm^3, respectively, in the adolescent control group.

More specifically, the CLP and control groups were assessed based on age. The juvenile males with clefts had an average airway volume of 5.4 cm^3 with a standard deviation of 2.1 cm^3, whereas the juvenile control males had an average volume of 6.1 cm^3, with a standard deviation of 4.1 cm^3. The juvenile females with clefts had an average airway volume of 5.6 cm^3 with a standard deviation of 2.1 mm, while the juvenile control females had an average airway volume of 6.3 cm^3, with a standard deviation of 2.3 mm. The adolescent males with clefts had an average airway volume of 8.4 cm^3 with a standard deviation of 1.1 cm^3, and the adolescent control males showed an average volume of 9.1 cm^3 with a standard deviation of 2.3 cm^3. The adolescent females with clefts had an average airway volume of 8.6 cm^3 with a standard deviation of 1.1 mm, and the adolescent control females had an average airway volume of 9.3 cm^3, with a standard deviation of 1.3 mm.

DISCUSSION

The goal of the study was to develop a reliable 3-D analysis to measure certain characteristics of the pharyngeal airway in children with CLP, and to compare the findings with a non-CLP control group, matched as to age and sex. The present study attempted at elucidating the volumetric characteristics of the subjects, as well as at comparing these findings with previous reports that had used different methodologies to assess this anatomic structure. The hypothesis on which the present study is based is that children with CLP had smaller pharyngeal airways, compared to toes from the non-CLP control group. Our data evidenced no significant difference in pharyngeal airway volume in CLP children, comparatively with non-CLP children. However, this was only a retrospective study with sample size limited to a small number of previously obtained scans of children with CLP. The respiratory cycle was not controlled during the scans. Respiration is a dynamic action that may not be accurately depicted in a static 3-D image.

CONCLUSION

Utilizing SPA skills in among the patients without CLP or pharyngeal airway was larger in the adolescent control than in the juvenile control group, but no significant differences were observed between the CLP groups. Thus, the narrow pharyngeal airway in patients with CLP might result in a functional impairment of breathing in adolescent, rather than in juvenile patients. Cone beam computed tomography can be regarded as equivalent to CT with regard to the diagnostic information provided for CLP patients, yet with a considerably shorter investigation time and lower purchase costs, as well as lower radiation exposure.

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