

The Influence of the Respiration Disturbances on the Growth and Development of the Orofacial Complex

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ABSTRACT

The disturbances of orofacial functions lead to abnormal growth and development of the orofacial complex. The aim of the study was to determine the prevalence of incompetent lip seal and respiration disturbance, and to improve the understanding of correlation between incompetent lip seal and morphological malocclusions. In the sample of 84 children (45 girls and 39 boys, aged 8.96 ± 0.66 years) a very high prevalence of the incompetent lip seal was found (35.72%). The study cast analysis was performed. The prevalence of the morphological malocclusion was significantly higher in the incompetent lip seal group ($p < 0.001$). There were also differences in types of malocclusions. The most frequent malocclusion found in incompetent lip seal was Class II/1 malocclusion (53.3%). In the competent lip seal group this malocclusion was determined in only 15.57% ($p < 0.001$). Narrower upper dental arches, higher palate ($p < 0.05$) and larger overjet ($p < 0.001$) were found in incompetent lip seal group.

Key words: incompetent lip seal, growth and development, morphological malocclusions

Introduction

The principal physiologic functions of the oral cavity are respiration, suckling, swallowing, mastication and speech. All these functions are balanced; the disturbance of one oral function leads to an abnormal growth and development of bone structures and soft tissues of the craniofacial complex. What is the influence of nasal respiration on the growth and development of orofacial system and on the development of occlusion? This question has been intriguing for a lot of authors for the last 100 years. The first notes originate from the year 1870; Meyer found that children with impaired nasal respiration had hearing and health problems¹. Two years later narrower upper dental arches in the mouth breathers were determined by Tomes². The deformities as narrow upper dental arch, longer maxilla in sagittal plane, posterior cross bite, larger overjet, higher palate and posterior rotation of mandible were observed in children by many investigators^{3–6}. Large adenoids, deviations of nasal septum, and allergic inflammations of nasal mucosa were meant to be reasons of incompetent lip seal in many studies^{7–9}.

Deformation of bone structures of craniofacial complex were observed in cases with reduced air flow through nasal air way, but the significant correlation between the volume of the air and facial deformities has never been proved¹⁰. Fränkel made a better understanding of the idea that abnormal oral and nasal function, which can be observed as an incompetent lip seal, is one of the most important etiologic factors of morphological malocclusions. Fränkel advocated the importance of competent lip seal which is obligatory for the normal tongue posture and so the balance between buccal and tongue muscles can be established¹¹.

The following three contacts are important for normal growth and development of oral and nasal cavity: competent lip seal, contact between tip of the tongue and lingual surfaces of upper central incisors and the contact of soft palate with tongue base.

When the competent lip seal cannot be observed, tongue posture is on the floor of oral cavity (»depression of the tongue«) and there is only force of buccal muscles

applied on the maxilla. The upper jaw is narrowed in medial plane. The rotation of mandible is downward and posterior.

The influence of nasal obstruction on the growth and development of orofacial complex was first statistically proved by Linder Aronson¹². The growth of maxilla, dental arches and the growth of mandible normalized after adenotomy in the children who had had total nasal obstruction.

The incompetent lip seal was determined in 39.6% children who visited the first year of primary school by Rejc Novak, Šalehar, Sušec Michieli and co-workers¹³. The prevalence of morphological malocclusion was significantly higher in this group of children than in group with competent lip seal ($p < 0.001$).

The aims of our study are to determine the prevalence of incompetent lip seal in our population, and to improve the understanding of correlation between respiration disturbances and incompetent lip seal and morphological malocclusions.

Subjects and Methods

The sample of 84 children, 45 girls and 39 boys (aged $8.96 \text{ years} \pm 0.66$) was constituted by random selection from the list of children who visited the first year of primary school in the region of city Ljubljana.

The methods included interview, clinical examination of craniofacial complex, study cast analysis and statistics.

No previous orthodontic treatment was also obligatory to participate in the study. The parents gave their consensus that the children can indeed take part in this research.

According to clinical examination the subjects were divided into two groups: the competent lip seal group and incompetent lip seal group (Figure 1). The children were observed when they came into the dental office and while being on the dental chair as well. All children were examined twice. Children with incompetent lip seal closed their mouth with difficulties, the contra-

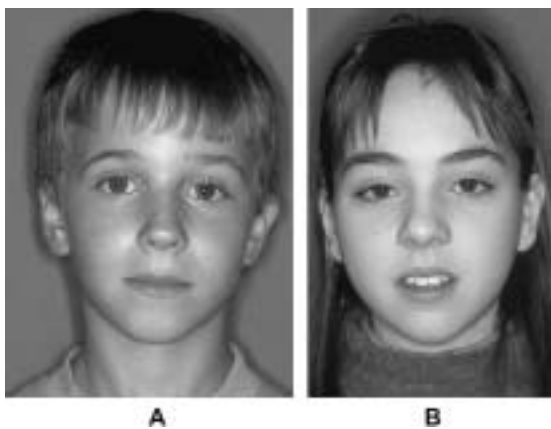


Fig. 1. Competent (A) and incompetent lip (B) seal.

ctions of m. orbicularis oris and m. mentalis could be observed. Study casts were obtained in all subjects.

The following measurements on study cast were performed: anterior and posterior width of upper and lower dental arch, anterior and posterior height of upper and lower dental arch, height of hard palate, overjet and overbite (Figure 2, 3).

Korkhaus three-dimensional ruler (accuracy 0.1mm) was used to measure transversal widths and heights of dental arches (Dentaurum, cat. number: 028-353-00, 11th edition).

Overjet was measured by the ruler (Dentaurum cat. Number: 044-730-00, 11th edition) and overbite was determined by the Korkhaus diagnostic set (Dentaurum, cat. number: 029-360-00, 11th edition).

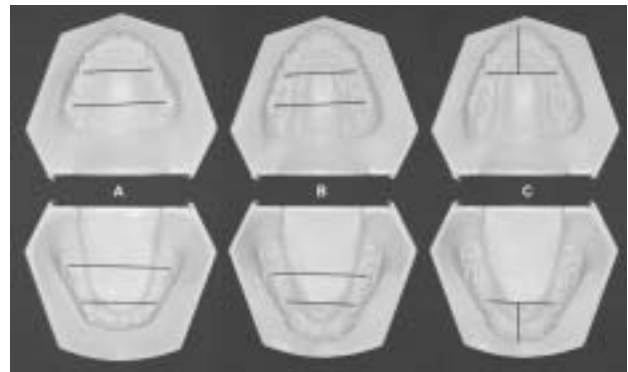


Fig. 2. Study cast measurements: anterior and posterior width of upper and lower arch in mixed (A) and permanent dentition (B), anterior and posterior height of upper and lower arch (C).



Fig. 3. Study cast measurements: height of hard palate (A), overjet (B) and overbite (C).

The Angle classification was used to diagnose the morphological malocclusions:

- normal occlusion: normal first molar relationship and the line of occlusion is smooth,
- Class I malocclusion: normal first molar relationship but line of occlusion is incorrect because of malposed teeth, rotations or other causes,
- Class II malocclusion: lower molar is distally positioned relative to upper molar, line of occlusion is not specified:
 - Class II/1: with protrusion of upper incisors
 - Class II/2: with retrusion of upper incisors,
- Class III malocclusion: lower molar mesially positioned relative to upper molar, line of occlusion is not specified (Figure 4).

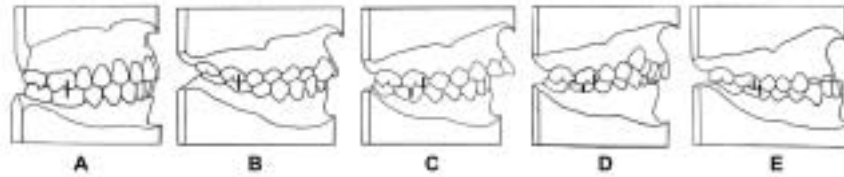


Fig. 4. Angle classification: normal occlusion (A), Class I malocclusion (B), Class II/1 malocclusion (C), Class II/2 malocclusion (D), Class III malocclusion (E).

Results

The study cast measurements of both groups were compared. Differences between both groups were found in most measurements (Table 1).

In the group with incompetent lip seal smaller values of dental arch widths were observed. The only exception was posterior width of lower dental arch. Larger values of dental arch heights were found in the incompetent lip seal group with the exception of the posterior height of lower dental arch. The differences were not statistically significant.

The larger palate height ($p < 0.005$) and the bigger overjet ($p < 0.001$) were observed in the incompetent lip seal group. The prevalence of malocclusion was significantly higher in incompetent lip seal group (93.33%) than in the group of children with competent lip seal (61.12%, $p < 0.001$). There are also differences in types of malocclusions. The most frequent malocclusion found in the incompetent lip seal group was Class II/1 malocclusion (53.3%). In a group with normal lip posture the Class II/1 malocclusion was determined in only 16.67% ($p < 0.001$). Because of low prevalence of Class II/2 and Class III malocclusions the statistical characteristics were not calculated. The prevalence and the structure of observed malocclusions are shown in Table 2.

Discussion

The results of our study show a high prevalence of incompetent lip seal among subjects in the study. The influence of respiratory disturbance on the prevalence and on the structure of malocclusions was proven.

Reinicke and co-workers in their sample of children aged 7.5–16 years found 29% children with incompetent lip seal¹⁴. In our study the percentage of children with inappropriate lip posture was higher. The difference could be due to different age interval of participants in study. Cordasco et al. in his epidemiological research observed 45.5% of school children with open mouth posture¹⁵.

The larger values of palate height in the incompetent lip seal group were also found by Galvez and Methenitou¹⁶. Difference in the values of overjet in patients with normal lip seal and patients with open mouth posture were also found by Reinicke et al.¹⁴. Children with incompetent lip seal had larger measurements of overjet.

A sample of the Japan study from 2001 consisted of the children aged 7–14 years. The authors studied the differences in morphological malocclusions in lip seal group and in incompetent lip seal group¹⁷. The distance between upper and lower lip at rest was measured. In the evaluation of the degree of lip seal, there was no statistical difference between subjects with malocclusion

TABLE 1
STUDY CAST MEASUREMENTS IN COMPETENT AND INCOMPETENT LIP SEAL GROUP

Measurement	Competent lip seal				Incompetent lip seal				p
	\bar{X}	SD	min	max	\bar{X}	SD	min	max	
Upper dental arch									
Anterior arch width (mm)	35.3	2.3	31.5	42.0	35.2	2.7	31.5	43.5	ns
Posterior arch width (mm)	45.5	2.7	35.5	52.5	45.4	2.4	39.0	51.0	ns
Anterior arch height (mm)	18.0	1.3	15.5	21.0	18.2	2.3	14.5	22.5	ns
Posterior arch height (mm)	32.9	1.8	29.5	37.0	34.0	2.8	29.0	40.0	ns
Lower dental arch									
Anterior arch width (mm)	35.5	2.3	31.0	42.6	34.5	1.5	32.0	37.5	ns
Posterior arch width (mm)	47.0	2.6	43.0	54.0	47.1	1.9	43.0	51.0	ns
Anterior arch height (mm)	16.2	1.1	15.0	19.5	15.9	1.5	13.0	19.0	ns
Posterior arch height (mm)	30.6	2.1	23.0	34.5	31.3	2.2	28.0	38.0	ns
Palate height (mm)	13.4	1.5	11.0	19.0	14.1	1.3	11.0	16.0	0.05
Overjet (mm)	3.0	1.2	1.0	6.0	4.5	1.7	1.5	8.5	0.001
Overbite (mm)	3.4	1.4	1.0	9.5	3.2	0.9	1.0	5.5	ns

TABLE 2
THE PREVALENCE AND THE STRUCTURE OF OBSERVED OCCLUSIONS

Occlusion	Competent lip seal		Incompetent lip seal		p
	N	%	N	%	
Normal occlusion	21	38.88	2	6.67	0.001
Class I	19	35.19	12	40.00	ns
Class II/1	9	16.67	16	53.33	0.001
Class II/2	4	7.41	0	0.00	/
Class III	1	1.85	0	0.00	/

and those with normal occlusion. It is a prove that causes for morphological malocclusions in the children with open mouth posture are a caudal tongue posture, the pressure of buccal muscles on the upper jaw and rotation of mandible backward and downward. Within the group with malocclusions, however, there were significant differences in overbite ($p < 0.001$) and overjet ($p < 0.001$). The authors of this study suggested a need not only to correct morphological malocclusions but also to treat an incompetent lip seal.

The purpose of the study of Ueda and co-workers in 2002 was to clarify the factors effecting lip seal in adults with malocclusion. Sixty-three malocclusion patients aged 20–27 years were randomly selected and compared with fourteen normal occlusion controls aged 22–26 years old. The subjects were divided into a good seal group and a poor lip seal group. The results showed that there was no poor lip seals in normal occlusion subjects. Significant differences were observed for tongue thrust ($p < 0.05$) and mouth breathing ($p < 0.05$) between the good lip seal group and poor lip seal group of malocclusion subjects. Also the authors of this research advocated that adults with poor lip seal should be treated their functional malocclusion prior to morphological one¹⁸.

What could be done? The education of the parents is very important. They should be well informed during the pregnancy in maternal schools what to do to enable

the normal growth and development of child's orofacial complex. The preventive of incompetent lip seal should be stressed out. They should be thought how to imply their knowledge to the children¹⁹.

The role of pediatrician and pedontologist is very important in preventing the open mouth posture. If the respiration disturbance is already present it needs to be treated carefully, the pediatrician, otholaringologist, alergologist, pedontologist and orthodontist should cooperate: they are supposed to diagnose and treat incompetent lip seal so soon as possible. The preventive programme was established and very well realized in the region of city Ljubljana, Maribor and Celje. Because of the high prevalence of open mouth posture and morphological malocclusions the role of preventing the respiration disturbances is very important.

In conclusion, the prevalence of incompetent lip seal was very high in our sample, with 35.72% of children that had open mouth posture. The correlation between incompetent lip seal and the prevalence of malocclusions was proven ($p < 0.001$). The structure of malocclusions was also significantly different in an incompetent lip seal group ($p < 0.001$). The cooperation of pediatrician, otholaringologist, alergologist, pedontologist and orthodontist should prevent the respiration disturbance. If incompetent lip seal is present, it needs to be diagnosed and treated as soon as possible.

REFERENCES

1. MEYER, W.: Adenoid vegetations in the nasopharyngeal cavity, their pathway, diagnosis and treatment. In: *Med. Chir. Trans.* (London, 1870). — 2. TOMES, S. C., *Month Rev. Dent. Surg.*, 1 (1872) 2. — 3. RICKETTS, R. M., *Am. J. Orthod.*, 54 (1968) 495. — 4. OBRAZCOV, J. L., S. N. LARIONOV, I. V. VIŠNJAKOVA, *Stom. Moskva*, 65 (1986) 52. — 5. LIMME, M., *Acta Oto. Rhin. Laryng. Belg.*, 47 (1993) 263. — 6. OULIS, C. J., G. P. VADIAKAS, J. EKONOMIDES, J. DRATSA, *J. Clin. Pediatr. Dent.*, 18 (1994) 197. — 7. O'RYAN, F. S., *Am. J. Orthod.*, 82 (1982) 263. — 8. RAULT-ROMMET, D., *Act. Odontostom.*, 15 (1985) 529. — 9. KLEIN, J. C., *Arch. Otorlaryngol. Head Neck Surg.*, 112 (1986) 843. — 10. HARTGERING, S. V., P. S. VIG, *Angle Orthod.*, 59 (1989) 17. — 11. FARČNIK, F. M.: Zdravljenje malokluzij s Fränklovimi regulatorji

funkcije. (Slovensko ortodontsko društvo, Ljubljana, 1996). — 12. LINDE ARONSON, S., *Br. J. Orthod.*, 6 (1979) 59. — 13. REJC NOVAK, M., M. ŠALEHAR, M. SUŠEC MICHIELI, D. ŠALEHAR, In: *Zbornik*. (10. Derčevi pediatrični dnevi, Ljubljana, 1987). — 14. REINICKE, C. H., N. OBLJOU, J. TRÁNKMANN, *Kieferorthop.*, 11 (1997) 191. — 15. CORDASCO, G., G. L. O. GIUDICE, E. DOLCI, U. ROMEO, G. LAFRONTE, *Stom. Mediterranea*, 9 (1989) 173. — 16. GALVEZ, J., S. MENTHENITOU, *J. Pedond.*, 13 (1989) 133. — 17. YATA, R., E. MOTEGI, K. UEDA, T. TORIKAI, M. HARAZAKI, Y. ISSHIKI, *Bull. Tokyo Dent. Coll.*, 42 (2001) 73. — 18. UEDA, K., E. MOTEGI, R. YATA, T. TORIKAI, M. HARASAKI, H. YAMAGUCHI, *Bull. Tokyo Dent. Coll.*, 43 (2002) 89. — 19. REJC NOVAK, M., T. MOKOREL, M. SKET: Moj otrok ima zdrave zobe (Ministrstvo za zdravstvo Republike Slovenije, Ljubljana, 1994).

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UTJECAJ RESPIRACIJSKIH SMETNJI NA RAST I RAZVOJ OROFACIJALNOG KOMPLEKSA

S A Ž E T A K

Poremećaji orofacijalnih funkcija vode u nepravilan rast i razvoj orofacijalnog sistema. Svrha rada je ustanoviti učestalost respiracijske smetnje i inkompetentne usnice, te doprinijeti objašnjenju moguće povezanosti između inkompetentnih usnica i morfoloških malokluzija. Kod uzorka 84 djece (45 djevojčica i 39 dječaka, prosječne starosti 8,96 godina \pm 0,66) ustanovljena je visoka učestalost inkompetentnih usnica (35,72%). Urađena je analiza studijskih modela. Učestalost morfoloških malokluzija bila je statistički viša u grupi inkompetentnih usnica ($p < 0,001$). Nađene su također i razlike u strukturi malokluzija. Kao najčešća ortodontska anomalija kod inkompetentnih usnica ustanovljena je malokluzija Klasa II/1 (53,33%). Nalaz te anomalije kod kompetentnih usnica iznosi samo 16,67% ($p < 0,001$). U grupi ispitanika s inkompetentnim usnicama nađeni su uži gornji zubni lukovi, više nepce ($p < 0,05$) i veća sagitalna stepenica ($p < 0,001$).