

論文内容要旨

Upper airways and sleep-breathing changes in skeletal
Class II children post-functional appliance therapy.

(機能的矯正装置による治療後の骨格性 II 級患児における
気道および睡眠呼吸機能評価)

主指導教員：谷本 幸太郎教授

(医歯薬保健学研究科 歯科矯正学)

副指導教員：香西 克之 教授

(医歯薬保健学研究科 小児歯科学)

副指導教員：上田 宏 准教授

(医歯薬保健学研究科 歯科矯正学)

Cynthia Concepcion Medina

(医歯薬保健学研究科 医歯薬学専攻)

[Introduction] Proper sleep is highly related to proper breathing patterns, if these patterns deviate many developmental complications may derive becoming a catalyst for serious decrease of cognitive ability. This is rather relevant when considering sleep-breathing in children; lack of proper sleep and/or the presence of sleep breathing problems may cause a decline in the development of the child's intellectual and social abilities. One of the ways sleep-breathing becomes improper is due to collapsibility of the upper airways.

The tendency for upper airway collapse is increased when patients have an anatomic imbalance of the upper airway in which the amount of soft tissue inside the craniofacial bony enclosure (e.g., tongue) is excessive relative to the size of the craniofacial bony enclosure (e.g., maxilla, mandible). But since these are growing children, oropharyngeal collapsibility is inferred to be lesser than in adults. Nonetheless, it is our hypothesis that the oropharyngeal crowding levels of skeletal Class II children could be slightly larger than that of the skeletal I children. Also, the hyoid bone position had been examined in response to mandibular advancement in subjects with mild and moderate obstructive sleep apnea (OSA), this is due to its importance in maintaining the airways from collapsing backwards and preserving the airway space open for proper air passage.

Developmental issues that dentists can diagnose and treat during childhood include mandibular deficiencies that can be ameliorated with simple orthopedic appliances during a relatively brief time. By advancing the mandible forward during orthopedic therapy with the FKO activator there is the possibility to influence the structures that affect the upper airways to widen thus favoring a better sleep-breathing pattern for children undergoing this therapy.

[Objective] Therefore, the aim of this study is to confirm if besides the intended inducement of development of the mandible the FKO may also help improving healthy sleep breathing patterns in children.

[Materials/Methods] For this, 39 children, 20 for test group (age 10.9 ± 0.9 ; BMI 16.2 ± 1.4 ; skeletal Class II), 19 for control group (age 9.8 ± 1.4 ; BMI 17.6 ± 2.1 ; skeletal Class I), for the test group the requirements are patients currently undergoing FKO therapy, overall healthy and have no previous history of sleep-related child breathing disorder volunteered for this study.

This research study was divided into several sections, first the Mallampati score (MS) enables us to instantaneously evaluate the state of crowding in the oropharyngeal region caused by a large tongue and/or a small craniofacial bony enclosure. In this part of the research procedure, the MS and tonsillar grade score were used to evaluate the oropharyngeal crowding of the tested subjects.

To confirm in a physical tangible way that the changes are indeed happening, three lateral cephalometric radiographs were required from the patients, twice without insertion of the FKO pre- and post-treatment and once with the FKO inserted. These analyses were divided further into different areas of interest relative to their influence on the upper airways.

In this case, we examined skeletal Class II children and compared the results to those of skeletal Class I children to determine the differences in position of the hyoid bone in different craniofacial patterns.

Also, the upper airways were further evaluated in two categories, a linear anteroposterior analysis that included three sections, the superior palatal airway space SPAS, middle airway space MAS and inferior airway space IAS; also, the total area was calculated by dividing the air passage into two delimited zones, the Oropharynx, and the Hypopharynx.

As a method of assessing the changes of breathing patterns during functional orthopedic therapy, the patients were asked to use a portable sleep monitor (BRIZZY Nomics®, Liege, Belgium) twice, once without using the FKO to check normal breathing parameters and the second time with the child wearing the FKO to confirm whether sleep-breathing improves. A third time was asked for the subject patients when FKO therapy was finished. For control group, only one time was required to compare. This portable sleep monitor works with midsagittal sensors which are positioned one in the chin and the other on the forehead; these sensors measure the jaw movement by electromagnetism. On this study, the following indicators of sleep severity were assessed:

- Respiratory disturbance index RDI, or apnea hyperpnoea index, is the number of obstructive, central and mixed events/hour of sleep
- sleep fragmentation index, ARL or number of arousal or discontinuity per hr. of sleep
- Cumulative time in respiratory effort. All period of abnormal respiratory effort expressed as a percentage of the total sleep time.

This monitor also provides valuable information about a patient's obstructive, central and mixed events, which can help determine if the patient, in this case children suffer from sleep related breathing disorders (OSAS). Even though these are all generally healthy children, there is some sleep-breathing interruption to be expected. Respiratory events quantify how many times these interruptions happen and if they are less when wearing the FKO.

[Results] From all these tests, several insights into how beneficial the FKO is for the children that receive this myofunctional therapy were understood:

1. Oropharyngeal crowding as assessed with the MS and tonsillar grade does not seem to be a big issue on these children and there seems to be no significant difference between both control and test group.
2. The hyoid bone, takes a more anterior position when the FKO is inserted thus increasing the size of the lowest section of the upper airways.
3. The overall area and the anteroposterior width of the upper airways are increased when the FKO is inserted, and this widening is kept even after treatment.
4. From the sleep monitor a better and more sound sleep patterns are confirmed when the FKO is inserted, also this improvement is maintained after removal of said appliance.

[Conclusion] To conclude it can be said that the FKO not only provides a harmonious occlusion and proper development of the mandible, but it also helps improve the quality of sleep-breathing through widening of the upper airways and reducing the number of disordered breathing events in children that undergo this kind of orthopedic therapy.