Obstructive Sleep Apnoea

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Introduction

The word apnoea is derived from Greek word means without breathing. Guilleminault et al[1] (1976) first described sleep apnoea syndrome. Sleep apnoea is of three types:- obstructive, central and mixed.

Obstructive sleep apnoea(OSA)is defined as cessation of airflow with persistant respiratory effort, due to collapse of the upper airways. Central apnoea is a cessation of airflow with no respiratory effort due to a short withdrawal of the central nervous drive to the respiratory muscles. Mixed apnoea is central apnoea passing into obstructive apnoea.

OSA is by far the most common sleep related breathing disorder, affecting 2% to 4% of middle-aged men and 1% to 2% of middle aged women in western population[2].In men aged 60 years and older, the prevalence is 30% to 60%[3].

OSA is characterized by loud snoring, arousal, sleep fragmentation, intermittent hypoxaemia and day time sleepiness. OSA results in oxygen desaturation and arousal from sleep, thus bringing about a constellation of signs and symptoms related to oxygen desaturation and sleep fragmentation. The reduced blood oxygen saturation may give rise to hypertension, cardiac arrhythmia,nocturnal angina, and myocardiac ischemia. The impaired sleep quality leads to excessive daytime sleepiness, deterioration of memory and judgement, altered personality, and reduced concentration.

Pathophysiology of OSA involved factors that relate to the anatomical dimensions of the upper airway, upper airway resistance and upper muscle activity during sleep. Therefore, upper airway morphology is often measured in investigations of upper airway mechanics and OSA pathophysiology. The upper airway has been categories into three anatomical regions: the nasopharynx(the area behind the nose and above the soft palate); the oropharynx (the area from soft palate to upper border of the epiglottis), which is subdivided into the retropalatal area(behind the palate) and the retroglossal area (behind the tougue). Most authors agree that there are craniofacial morphological and postural characteristics in patients with OSA such as a reduced posterior airway space, an abnormally long soft palate, a low position of hyoid bone and an extended head posture[4,5].

Cephalometric analyses of the cervical vertebral column area have previously been performed on profile radiographs. It was found that the horizontal and vertical dimensionsof the first cervical vertebra (C1), atlas, were associated with head posture, cranial base angulation, and mandibular shape and growth[6]. Also, posture of the head and neck was associated with factors such as craniofacial morphology including the cranial base[5], upper airway base[8], to some extent occlusion[9], and temporomandibular disorders[10]. Many cross-sectional studies agree on a relationship between extended head postures and craniofacial structures. In subjects with extended head posture, increased anterior facial height, reduced saggital jaw dimensions, and a steeper inclination of the mandible were generally observed[6].

Cephalometric studies of the cervical vertebral column area have also been performed on patients with obstructive sleep apnoea. Most of these studies agree that patients with obstructive sleep apnoea have an extended head posture[11].

Accordingly, associations have been reported between head posture and craniofacial morphology, between head posture and OSA, and between morphological deviations of the cervical vertebral column and craniofacial syndromes and cleft lip and/or palate[12]. The aim of the article is to summarize recent studies on morphological deviations of the cervical vertebral column and the associations with the craniofacial skeleton and head posture in nonsyndromic patients and in patients with obstructive sleep apnoea and to elucidate the aetiology behind the associations as well as clinical implications of the results.

Definition of Morphological Deviations of The Cervical Vertebral Column

The cervical vertebral column morphology of the upper five cervical vertebrae on a lateral skill radiograph is divided into two main categories: "fusion anomalies" and "posterior arch deficiency"according to Sandham.[13]

Fusion anomalies are fusion(fig1),block fusion (fig 2)and occipitalization(fig3). Fusion is defined as the fusion of one unit with other at the articulation facets ,neural arch ,or transverse process .Occipitalization is defined as the assimilation ,either partially or completely, of the atlas with the occipital bone . The definition of block fusion has been modified according to Sonnesen and Kjaer[14] defined as fusion of more than two units at the vertebral bodies , articulation facets ,neural arch , or transverse processes.

Posterior arch deficiency (fig 4)consist of partial cleft and dehiscene according to Sandham[11] .Partial cleft is defined as failure to fuse of the posterior part of neural arch . Dehiscence is defined as failure to develop of part of vertebral unit .

Association Between Cervical Vertebral Column Morphology & Craniofacial Morphology

Sonnesen et al[14] have recently described morphological deviations of the cervical vertebral column in healthy subjects with neutral occlusion and normal craniofacial morphology and in patient with severe skeletal malocclusion traits such as skeletal deep bite , skeletal open bite , skeletal maxillary overjet , skeletal mandibular overjet. It was found that morphological deviations of the cervical vertebral column such as fusion occurred significantly more often in patients with severe skeletal malocclusion traits when compared to controls .Fusion is the control groups occurred in 14-21percent and fusions were always seen between the second and third cervical vertebrae. Fusion of the cervical vertebral column in the severe skeletal malocclusion groups occurred in 41-61 percent. In the deep bite group, the open bite group and in horizontal maxillary overjet group fusion were always seen between the second and third cervical vertebrae .The same pattern was seen in the control group. The pattern of fusion in the mandibular overjet group differed from that of the control group as not only fusion occurred between the second and third cervical vertebral but also block fusion between the second, third and fourth cervical vertebrae and occipitalization occurred. These findings indicate an association between fusion of the cervical vertebral column and severe skeletal malocclusion.

A series of recent studies have focused on the association between morpho-logical deviations of the cervical vertebral column and the cranio-facial morphology in adult patients with severe skeletal malocclusion traits. These studies revealed that fusion of the cervical vertebral column had the closest association with craniofacial morphology .Significant association between fusion and a large cranial base angle, between fusion and retrognathia of the jaws, and between fusion and inclination of the jaws were found in patients with severe skeletal malocclusions.

Association Between Cervical Vertebral Column Morphology & Head Posture

An association between posture of the head and neck and the cervical vertebral column morphology has recently been demonstrated by Sonnesen et al[14] .In individual with neutral occlusion and normal craniofacial morphology, the cervical lorodosis was significantly more curved and the inclination of the upper cervical column was more backwards in individual with fusion than in individuals without fusion. These finding indicate an association between fusion of the cervical column and posture of the neck.

Association Between Cervical Vertebral Column Morphology & Sleep Apnoea

A study of Sonnesen et al[15] on cervical vertebral column morphology in patients with OSA founds a 46-percent (N=42) prevalence of fusion anomalies in the cervical vertebral column. The deviations occurred significantly more often in patients with OSA and at a lower level in the cervical vertebral column compared to controls. Fusion anomalies occurred as fusions either between the second and third vertebrae, or between the fourth and fifth cervical vertebrae. Block fusions occurred as fusions either between the second, third, or fourth vertebrae, between the second, third, fourth, and fifth vertebrae, or between the third, fourth, and fifth vertebrae. Occipitalization occurred in combination with fusions, block fusions or as a single deviation.

The results of the studies on subjects with neutral occlusion and patients with severe skeletal malocclusions suggest that fusion of the cervical vertebral column is associated with occlusion, craniofacial morphology, and head posture. Furthermore, a different morphological pattern of the cervical vertebral column was found in patients with OSA.

Discussion

Associations between craniofacial morphology and head posture and between head posture and obstruction of the upper airways seen in patients with OSA have previously been demonstrated. Recent findings have established associations between craniofacial morphology including the cranial base and fusion of the cervical vertebral column, between head posture and fusion of the cervical vertebral column and between patients with OSA and fusion of the cervical vertebral column.

An explanation for association between fusion of the cervical column and a large cranial base angle could be found in the early embryogenesis. The notochord develops in the human germ disc and determines the development of the cervical vertebrae, especially the vertebral bodies, and also the basilar part of occipital bone in the cranial base. The para-axial mesoderm forming the vertebral arches are remaining parts of the occipital bones is also formed from notochordal inductions. Therefore, a deviation in the development of the notochord may influence the surrounding bone tissue in the vertebral column as well as in the posterior part of the cranial base. It can be observed on postnatal profile radiographs that the bone tissue formed around the notochord is the vertebral bodies and the basilar part of the occipital bone. The shared origin of the vertebral column and the posterior part of the cranial base supports the new hypothesis that associations between the cervical vertebral column and the cranial base exist.

The association between fusion of the cervical column and the craniofacial morphology could also be explained by the early embryogenesis. It is known that the neural crest cell migrate to the craniofacial area before the notochord is surrounded by bone tissue and disappears. The jaws, including the condylar cartilage, develop from ectomesenchymal tissue derived by the neural crest. In the first branchial arch the neural crest cells migrate from the neural crest towards the mandible, followed by the cells to the maxilla and lastly by the cells to the nasofrontal region. Therefore, it is understandable that a deviation in the amount or timing of migrating maxillary and mandibular cells may influence the craniofacial development. The precise signaling from the notochord to the neural crest followed by bilateral cell migration to the craniofacial area is still unknown. Signalling during early embryogenesis between the notochord, para-axial mesoderm, the neural tube and the neural crest may explain the association between the cervical vertebral column, cranial base, and craniofacial development.

The study on patients with obstructive sleep apnoea found that the prevalence of fusion anomalies of the cervical vertebral column occurred significantly more often in patients with OSA and at a lower level in the cervical vertebral column compared to controls. These deviations in prevalence and pattern of the cervical vertebral column may prove a factor in the pathogenetic background of sleep apnoea and thereby contribute to the diagnosis and treatment of patients with OSA.

Conclusion

It is suggested that dentists look at the cervical vertebral column area and register any deviations in the cervical vertebral column morphology and head posture. These registrations may prove useful when considering diagnosis and evaluating etiology, especially in patients with severe skeletal malocclusions and OSA.

References

References are available on request at editor@healtalkht.com

Fig. 1

Fig. 2

Fig. 3

Fig. 4