CASE REPORT

Dramatic dilatation of the upper airway secondary to a Valsalva manoeuvre in a lateral cephalometric teleradiograph of a child

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Radiographs are routinely used by orthodontists for the planning of treatment for their patients and they can, in some cases, play a decisive role in the early diagnosis of some unexpected medical or surgical disorders. This report presents the case of a substantial dilatation of the upper airway in a 10-year-old girl, which was attributed to a forced Valsalva manoeuvre. The diagnosis was confirmed upon repetition of the teleradiograph with the mouth open.

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Introduction

Although volumetric tomography is gaining rapid acceptance in orthodontics, it is expected that, in assessing malocclusions, orthodontists will continue to routinely study lateral teleradiographs of the cranium for at least the next few years.¹ The main use of this projection is to obtain cephalometric tracings that aid in determining the skeletal component of malocclusion and its impact on the facial profile. In addition, analysis of cervical vertebral maturation using lateral cephalometric radiography² is an alternative to the traditional method based on hand–wrist radiography for studying growth stages. Lateral teleradiographs also provide two-dimensional (2D) anatomical images of the upper airway, and several systems have been developed to obtain measurements of hypopharyngeal structures,³ although they have inherent shortcomings and are used infrequently.

In clinical practice, orthodontists interpret a large number of lateral teleradiographs, some of which may reveal atypical or pathological images. However, since clinicians tend to focus on anatomical landmarks that are necessary for cephalometric diagnosis or for establishing patient growth stage, abnormal findings detectable in teleradiographs may, at times, be overlooked or misinterpreted. Compounding this is the fact that dental education does not always offer in-depth training on radiographic pathology of the head and

neck, despite the advantageous position dentists enjoy for the detection of disorders in these areas.

Case report

A 10-year-old girl presented at the Orthodontic Unit of the Fundación Jiménez Díaz (Madrid, Spain) with a moderate malocclusion. Her parents reported no significant medical history. A lateral cephalometric radiograph obtained as part of conventional diagnostic records showed dramatic dilatation of the upper airway extending vertically from the skull base to the epiglottis with posterior displacement of the spine (Figure 1). The team of orthodontists, struck by the highly abnormal air density image, consulted a radiologist with expertise in head and neck pathology, who explained the finding as secondary to a non-pathological forced Valsalva manoeuvre in a patient with hyperdistensible tissues. The key to this diagnosis was that the epiglottis remained closed. The patient was referred to an ear, nose and throat specialist to rule out a stricture in the inferior airway or other anatomical changes. The results from a fiberoptic examination were normal. To confirm the diagnosis, a second teleradiograph was obtained, for which the patient was instructed to remain with her mouth slightly open while breathing slowly. As a result, the upper airway fully recovered its normal morphology (Figure 2).

In a subsequent conversation, the parents informed the orthodontist that the patient had a habit of making

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Figure 1 The lateral teleradiograph depicts an enormous air pouch in the superior airway. Maximum AP (anteroposterior) diameter is over 7 cm and the craniocaudal extension between the nasopharynx and hypopharynx is also augmented. The air density is striking due to the filter used to increase the attenuation of the facial soft tissues. The spine is abnormally curved with a kyphosis, giving the impression of an expansile mass. The submandibular soft tissues bulge outward. The child appears in an uncomfortable position, forcing the head forward. The air collection is most likely attributable to a forced Valsalva manoeuvre. The key to accurate diagnosis is that the epiglottis remains closed

“strange gestures with her neck” in situations of stress or anxiety, which could be interpreted as repeated Valsalva manoeuvres.

Discussion

The Valsalva manoeuvre is performed by forcibly exhaling against the closed airway. First described by the 17th century physician and anatomist from Bologna, Antonio Maria Valsalva,⁴ the technique can be used as a method of equalizing pressure between the ear and the outside environment in circumstances of changes in pressure, for example in aviation or when diving. In medicine, the Valsalva manoeuvre is also used as a test of cardiac function through stimulation of the autonomic nervous system.⁵

Performing a forced Valsalva manoeuvre may cause unusual symmetrical expansion of the hypopharynx,

Figure 2 A second radiograph was performed with the mouth slightly open, and the child was instructed to breathe slowly. The attenuation filter was not used, thus giving the film a more homogeneous density. The cervical spine is now well aligned and the pre-vertebral soft tissues are smooth, measuring between 2 mm and 4 mm. The epiglottis is vertical and open. The nasopharynx is visible and its contour is normal for a 10-year-old (not expanded by air as in the first radiograph). The hypopharynx now has a maximum AP diameter of 15 mm

which can be associated with some posterior displacement of the cervical spine. When undergoing radiographic exams children are clearly instructed not to move or breathe; however, under the supervision of parents and technicians many children adopt “military postures” by stiffening the body in non-anatomical positions and thus altering the relationships of the cranium and spine in the lateral teleradiograph. In this patient, the possibility that the head was positioned further forward may have contributed to kyphosis.

The radiological differential diagnosis included some congenital or acquired malformations potentially manifesting themselves as expansions of the upper airway and, therefore, exhibiting air density. Such conditions should include laryngocele; Zenker or pharyngo-oesophageal diverticulum; and pharyngocele. Laryngocele is a rare benign dilatation of the laryngeal saccule that may extend internally into the airway or externally through the thyrohyoid membrane.⁶ Zenker or pharyngo-oesophageal diverticulum is a pouch that protrudes

posteriorly above the upper oesophageal sphincter in Killian's triangle.⁷ Zenker diverticulum, laryngocele and saccular laryngeal cysts are situated lower in the neck. Pharyngocele can be demonstrated by way of a Valsalva manoeuvre, but occurs most commonly in elderly patients.⁸

The dramatic functional expansion of the upper airway experienced by the patient should lead us to rule out Ehlers–Danlos⁹ and other syndromes associated with some degree of connective tissue hyperelasticity, though this child did not exhibit any phenotypic abnormalities or articular hypermobility. In this case, it is possible that the habit of performing spontaneous Valsalva manoeuvres may have led to greater distensibility of the hypopharyngeal tissues, with subsequent recovery of normal baseline anatomy. This phenomenon

is similar to the extreme expansion of the cheek musculature of some trumpeters.

In conclusion, orthodontists must be acquainted with the radiographic anatomy of the head and neck and should be familiar with atypical or pathological images that may be revealed in radiographs obtained as part of conventional orthodontic records. Uncommon findings must be consulted with a radiologist with expertise in head and neck imaging. Proper recognition of artefacts and technical malpositioning may avoid unnecessary exams and additional exposure to radiation.

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