Paediatric Sleep-Disordered Breathing and Orthodontics

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Dr Vandana Katyal

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Dedication

This thesis is dedicated

to my

Mother

Vijay Katyal

(3rd Sep 1953-31st Jul 1998)**.**

It was your love of children's welfare instilled in me that ignited the spark for this project.

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Overview

The format of this current thesis is represented by 3 papers that have been accepted for publication by peer-reviewed orthodontic journals. Following is an outline and a summary of the 3 presented papers:

Paper 1: **Paediatric sleep-disordered breathing due to upper airway obstruction in the orthodontic setting: a review**

This is a narrative literature review of the topic. Accepted for publication in the Australian Orthodontic Journal.

The essential feature of paediatric sleep-disordered breathing (SDB) is increased upper airway resistance during sleep presenting clinically as snoring. Paediatric SDB is a continuum ranging from primary snoring (PS), which is not associated with gas exchange abnormalities or significant sleep fragmentation, to obstructive sleep apnoea (OSA) with complete upper airway obstruction, hypoxaemia, and obstructive hypoventilation. Adenotonsillar hypertrophy, obesity and craniofacial disharmonies are important predisposing factors in the development and progression of paediatric SDB. Clinical symptoms are manifold and domains affected include behaviour, neurocognition, cardiovascular morbidity and quality of life. Overnight polysomnography is the current diagnostic gold standard method to assess SDB severity while adenotonsillectomy is the recommended first line of treatment. Other treatments for managing paediatric SDB include nasal continuous airway pressure, the administration of nasal steroids, dentofacial orthopaedic treatment and surgery. However, there are insufficient long-term efficacy data using dentofacial orthopaedics to treat paediatric SDB. Further studies are warranted to define the characteristics of patients who might benefit most from orthodontic treatment.

Paper 2: **Craniofacial and Upper Airway Morphology in Paediatric Sleep Disordered Breathing (SDB)- A Systematic Review and Meta-analysis**

Published in the American Journal of Orthodontics and Dentofacial Orthopaedics.

This study is a systematic review of the published literature with the results of the primary studies combined by meta-analyses in order to elucidate the nature of the association between craniofacial disharmony and paediatric SDB. Citations to potentially relevant published trials were located by searching Pubmed, Embase, Scopus and Cochrane Central

Register of Controlled Trials. Children with OSA and PS show an increased weighted mean difference (WMD) in ANB angle of 1.64° (95% CI 0.88 – 2.41, $p < 0.0001$) and 1.54° (95% CI 0.89 – 2.20, $p < 0.00001$), respectively in comparison to the controls. Increased ANB was primarily due to a decreased SNB angle in children with PS by 1.4° (95% CI -2.58 to -0.23, $p = 0.02$). Children with OSA had a PNS–AD1 distance reduced by 4.17 mm (WMD) (95% CI -5.85 to -2.50, $p < 0.00001$) and a PNS–AD2 distance reduced by 3.12 mm (WMD) (95% CI -4.56 to -1.67, $p < 0.0001$) in comparison to the controls. There is statistical support for an association between craniofacial disharmony and paediatric SDB. However, an increased ANB angle of <2° in children with OSA and PS, in comparison to the controls, could be regarded as of marginal significance. There is strong support of a reduced upper airway width in children in OSA as shown by reduced PNS–AD1 and PNS–AD2 distance.

Paper 3: **Craniofacial and Upper Airway Morphology in Paediatric Sleep-disordered Breathing and Changes in Quality of Life with Rapid Maxillary Expansion**

Accepted for publication in the American Journal of Orthodontics and Dentofacial Orthopaedics.

The aim of this study was to evaluate the prevalence of children at risk for SDB, as identified in an orthodontic setting by validated screening questionnaires, and to examine associations with presenting craniofacial and upper airway morphology. A further aim was to assess the change in the SDB-related quality of life (QoL) for affected children undergoing a rapid maxillary expansion (RME) to correct a palatal crossbite and/or widen a narrowed maxilla. 78 subjects were grouped as high risk (HR) or low risk (LR) for SDB based on the scores obtained by completing a validated 22-item Paediatric Sleep Questionnaire (PSQ) and the OSA-18 QoL questionnaire. Ten children who underwent RME were followed longitudinally until removal of the appliance (T2) approximately 9 months later with a repeat OSA-1 8 QoL questionnaire. All data were collected blinded to the questionnaire results. Children at high-risk for SDB are characterised by reduced SDB-related QoL, reduced nasopharyngeal and oropharyngeal sagittal dimensions, the presence of a palatal crossbite and reduced dentoalveolar transverse widths in the maxillary and mandibular arches. No sagittal or vertical craniofacial skeletal cephalometric predictors were identified for children at high-risk for SDB. In the short-term, RME might aid in improvement of SDB-related QoL for children with a narrow maxilla in the milder end of the SDB spectrum.

Statement of Purpose

The objectives of the thesis were to:

1. Conduct a systematic review of published literature and meta-analysis of the results of the primary studies to answer the nature of the association between craniofacial disharmonies, upper airway morphology and paediatric SDB.
2. Using screening questionnaires, estimate the prevalence of SDB in the paediatric orthodontic population and its association with SDB-related quality of life, facial, dental and airway characteristics as seen in a clinical screening examination or on lateral cephalograms and dental casts.
3. Report changes in health-related quality of life in children with suspected SDB diagnosed with dentoalveolar or skeletal crossbites and undergoing a rapid maxillary expansion procedure to widen a narrowed maxilla.

Significance to the Discipline

This thesis will aid in:

1. Providing a thorough understanding of the associations between paediatric SDB and craniofacial/upper airway morphology.
2. Establishing a screening standard for the general dental practitioner, orthodontist and paediatric specialists for early diagnosis of paediatric SDB. This in turn increases cost-effectiveness of health care utilisation.
3. Estimating efficacy of rapid maxillary expansion in the treatment of paediatric SDB. This might provide alternatives to primary treatments and/or enhance interdisciplinary treatment planning for the children suffering from SDB.
4. Establishing referral protocols and pathways between the Orthodontic Unit, Adelaide Dental Hospital, Adelaide and Sleep Disorders Unit, Women's & Children's Hospital, Adelaide to improve interdisciplinary communication for children suffering from SDB.
5. Establish limitations of current thesis for future research directions.