Abstract

**Background:** The central nervous system initiates chewing and biting behaviours, while the peripheral sensory receptors embedded in various orofacial structures (e.g. masticatory muscles, temporomandibular joint, and periodontium) are responsible for refining those behaviours. During growth, the orofacial structures are subject to significant developmental alterations, which can pose substantial difficulties to sensorimotor regulation of the behaviours of biting and chewing. In spite of this, the development of such behaviours in healthy children has been inadequately investigated.

**Objectives:** The overall objective of the current PhD thesis is to investigate the age-related changes of the orofacial sensorimotor control of biting and chewing behaviours in well-controlled and standardized studies of healthy children. More specifically, Study II focuses on oral force control task of unpredictable load changes, Study III focuses on food biting manoeuvre task, while Study IV focuses on chewing behavioural task of food of varying hardness. The work also seeks to distinguish key moments in the process of development and establish how and when “adult-like” biting and chewing behaviours are acquired.

***Study I*** involved a systematic review of age-related changes in jaw sensorimotor control and objective parameters of chewing, revealing that, as the orofacial structures developed, there was a progressive transformation in chewing parameters (e.g. maximum voluntary bite force, jaw muscle activity, and jaw kinematics), which depended primarily on the status of dentition. The meta-analysis undertaken indicated that it was during the late-mixed to early-permanent dentition phases that the “adult-like” control of the above-mentioned parameters was acquired. Several studies were formulated to assess this observation through comparative analysis of healthy children and adults regarding biting and chewing behaviours. Each study employed healthy children in the age range 3-17 years old, who were allocated in the same number into five age groups corresponding to the five phases of tooth eruption, namely, primary dentition (3-5 years), early-mixed dentition (6-8 years), late-mixed dentition (9-11 years), early-permanent dentition (12-14 years), and late-permanent dentition (15-17 years). The control group used for comparative purposes consisted of healthy adults aged between 18 and 35 years old.

***Study II*** involved a standardised force control task, which the participants (65 children and 13 adults) had to perform using their front teeth. The task was designed to explore the age-related changes in oral motor control strategies that children and adults used after unpredictable load changes. To that end, four loads were presented in a sequential and non-sequential pattern, with measurement of the front tooth forces during the activities of pulling and holding. According to the findings, children in all groups resembled adults in their ability to undertake unpredictable oral motor tasks.

Using 65 children and 13 adults, ***Study III*** involved a typical food holding-and-splitting task to gain insight into the age-related changes in oral fine motor control during food biting manoeuvres. The task entailed the participants gently holding a food morsel against a force transducer between two antagonist central incisors for an interval of 3-4 seconds and then split it. Unlike the adults, higher forces of greater variability were employed by the children with primary to early-permanent dentition (3-14 years) in the phase of food holding, whereas food splitting was lengthier in children with primary and early-mixed dentition (3-8 years) compared to adults.

Sixty children and ten adults were employed in ***Study IV*** to determine how chewing behaviour was affected by food of varying hardness. This involved recording the jaw kinematics and jaw muscle activity associated with the masseter muscle whilst the participants ate three soft and three hard viscoelastic test food models. Unlike adults, children with primary and mixed dentition (3-11 years) exhibited a significant increase in tooth occlusal duration at the end of the chewing sequence when they ate hard food. Meanwhile, no adaptation in jaw muscle activity to food hardness was observed in children with primary to early-permanent dentition (3-14 years) by comparison to adults. Children with late-permanent dentition (15-17 years) did not display such discrepancies as adult-like jaw kinematics and jaw muscle activity were attained by that stage.

**Conclusion:** The studies conducted in this doctoral thesis suggested that young healthy children were capable of basic biting and chewing behaviours, but they differed from adults in terms of biting force control and adaptation of jaw kinematics and jaw muscle activity when they chewed food of varying hardness. Taken together, such discrepancies could reflect age-related development of oral sensorimotor control of chewing and biting behaviours. Complete development of orofacial structures must occur before an adult-like biting and chewing behaviour is attained.