Introduction

The masseter, temporalis, medial pterygoid and lateral pterygoid are paired muscles based around the temporomandibular joint (TMJ). They are involved in movement of the mandible. The masseter, temporalis and medial pterygoid are involved in elevation of the mandible (jaw closing) and the lateral pterygoid is involved in depression of the mandible (jaw opening). These muscles are mainly innervated by the mandibular branch (V₃) of the trigeminal nerve – CN V [1]. Whilst these muscles are conventionally known as “the muscles of mastication” the masseter, temporalis and pterygoids are also involved in articulation (production of speech). The aim of this poster is to determine whether these muscles are, indeed, muscles of mastication or muscles of speech.

Mastication

The masseter, temporalis and pterygoids are involved in elevating and depressing the mandible during mastication. They are essential to prepare food for swallowing. Salivation aids this process. Mastication also involves accessory muscles such as facial, suprahyoid and infrahyoid muscles and the tongue [1,4]. The ability of the tongue and cheeks to manipulate food within the oral cavity is also important for mastication [4]. A central pattern generator (CPG) in the brain stem seems to be essential for mastication and is most likely responsible for the rhythmic patterns of jaw opening and jaw closing seen in mastication [4].

Control of mastication also involves sensory feedback. The taste and texture of food influence mastication and stimulated chewing experiments suggest that sensory receptors in the lips, oral mucosa, muscles and periodontal ligaments give feedback that influences factors such as velocity and force of muscle movement [4,5]. Therefore, the pattern generated by the CPG is influenced by the physical characteristics of food [5].

Speech

Speech involves movement of the mandible using the “muscles of mastication” [6]. Electromyographic studies have shown that the masseter, temporalis and pterygoids are active during speech [7]. Whilst the masseter, temporalis and pterygoids are important in speech there are many other muscles that assist speech production. These include the diastagistic which elevates the larynx, the sternothyroid that depresses the thyroid cartilage (Adam’s apple) and the thyrohyoid involved in elevating the thyroid cartilage [1]. Other suprahyoid and infrahyoid muscles are also involved as well as the tongue and facial muscles.

Methods

Primary and secondary resources were used. Key terms were searched using Google, Google Scholar, PubMed and the University of Liverpool Library website. These terms included “muscles of mastication”, “muscles of speech” and “jaw movement”. The most relevant search results were read in depth. An anatomy textbook [1] was used to gain a basic foundation of knowledge on the masseter, temporalis and pterygoid muscles. It was difficult to find relevant and recent resources comparing the use of these muscles in mastication and speech. Many resources seemed to focus on movement of the jaw as a whole, rather than the actions of individual muscles.

Results

Broca’s speech area and motor cortices are very important in the production of speech [8]. It is thought that CPGs are also involved in control of speech [5].

Jaw movement in mastication & speech

Many stimulated chewing and speech experiments have been conducted to study the movement of the mandible. Experiments suggest similarities in the movements involving opening and closing the mandible during both mastication and speech [9]. However, other studies show that there are differences. For example, the amplitude of movement of the mandible is greater in mastication (see figure 4) but the movement during speech is faster [10,11].

Evolutionary theories suggest that the increase in bone density of the human mandible is due to the acquisition of capacity for speech [6]. This may be because speech produces high frequency and low magnitude strains on the mandible in comparison to mastication [6].

Discussion and Conclusions

Although the masseter, temporalis and pterygoids are conventionally known as the “muscles of mastication” it is clear that these muscles are also very important for movement of the jaw during speech [6,7]. However, there are many other muscles involved in both speech and mastication, such as the tongue. Studies on jaw movement suggest that there is greater amplitude of movement during mastication compared to speech [10,11]. Does this imply that the masseter, temporalis and pterygoids are more important for mastication?

Studies show that neural circuits involved in control of mastication also control movements of the face and oral cavity during speech [5]. This suggests an interaction between the control systems of mastication and speech. Whilst some experiments suggest that there are different patterns of muscle activity in jaw movement during mastication and speech [9], others suggest that there are different patterns of muscle activity [11].

It would be interesting to see how disorders such as fatigue and TMJ disorders affect the use of these muscles in mastication and speech but more studies are needed in this area [12].

Conclusions

It is clear that the masseter, temporalis and pterygoid muscles are essential for both mastication and speech. They are important for movement of the jaw, which is needed in both processes. However more experiments and studies are needed to compare the use of these muscles in mastication and speech. Further studies are also needed to show how their control systems interact.

References