REFLEX CONTROL OF HUMAN JAW MUSCLES BY PERIODONTAL MECHANORECEPTORS

A thesis submitted

for the degree of

DOCTOR OF PHILOSOPHY

The Department of Physiology

The University of Adelaide

by

Jun Yang D.D.S., M.D.S. (Beijing)

October, 1999

CONTENTS

ABSTRACT

It is well known that a brisk tap stimulus applied to the tooth induces a reflex inhibition of the jaw closing muscles. In contrast, the presence of reflex excitation is more controversial. In one study, where the reflex excitation of the jaw closing muscles could be recorded using a push stimulus on a tooth, the likelihood for eliciting an excitatory reflex response was about 40% (Brodin *et al.*, 1993b). In order to determine what factors affect the outcome of the reflex response of the jaw closing muscles to periodontal mechanoreceptive stimulus, in this study, the reflex responses of the human masseter were investigated by applying force using different stimulus profiles. It was shown that when the force profile had little or no fast component, the likelihood of eliciting an excitatory periodontal masseteric reflex increased. It is concluded that the shape of the stimulus profile, the location of the stimulating probe and the presence of preload are the main factors that determine the excitatory reflex response of the jaw closing muscles.

In contrast to the large number of studies using surface electromyography (SEMG) of the masseter (Van Der Glas & van Steenberghe, 1981,1988; Van Der Glas *et al.*, 1985; Bonte *et al.*, 1986; Bonte & van Steenberghe, 1989,1991; van Steenberghe *et al.*, 1989,1991; Brodin *et al.*, 1993b; Louca *et al.*, 1996a), the reflex changes in the bite force induced by a tooth stimulus have not been studied systematically. To determine whether the masseter muscle represents the effective changes in bite force in response to a tooth stimulus, the SEMG of the masseter and the bite force were recorded

simultaneously. The results showed that the pattern of reflex response in bite force was different from that in the SEMG of the masseter. Therefore, the reflex change in the masseter muscle does not give a good representation of reflex changes of bite force in humans. This result suggests that the net response of all jaw muscles is best expressed by the averaged bite force.

The distribution of periodontal mechanoreceptor input to various-sized motoneurons in the human masseter has not previously been studied. In this study, the reflex responses of different-sized single motor units (SMUs) to tooth stimulation were investigated. In the human masseter, the SMUs of larger size were found to have more excitatory and less inhibitory reflex responses than those of smaller size. The finding demonstrates that the inputs from the periodontal mechanoreceptors are not distributed equally to the masseteric motoneurons.

The results of these studies support the theory that the periodontal mechanoreceptors can induce both excitatory and inhibitory reflexes on the jaw closing muscles. The excitatory reflex becomes dominant when a smooth force is applied with preload. Care should be taken when using SEMG of the masseter to indicate the reflex response of all jaw muscles. The finding of periodontal mechanoreceptor input favouring the larger SMUs in the masseter suggests that, during normal chewing, the excitatory periodontal mechanoreceptor input may help the jaw closing muscles develop fast and powerful forces to overcome food resistance.