available at www.sciencedirect.com

ScienceDirect

journal homepage: www.intl.elsevierhealth.com/journals/arob

Differences between inhibitory jaw reflexes evoked by stimulation of tooth pulp and across the adjacent alveolar process in man

Nadia Gardner, James P. Newton, Andrew G. Mason, Samuel W. Cadden*

Oral Neurophysiology Research Group, The Dental School, University of Dundee, Dundee DD1 4HN, Scotland, United Kingdom

ARTICLE INFO

Article history:
Accepted 29 November 2007

Keywords:
Jaw reflex
Pulp
Transalveolar
Periodontium
Nerves
Latency

ABSTRACT

Objective: In humans, stimulation of nerves in or around teeth can evoke inhibitory jaw reflexes. Previous studies had suggested that there may be subtle differences in the timings of the responses. The aim of the present study was to investigate this by comparing reflexes evoked by electrical stimulation of a tooth and of the adjacent tissues in individual subjects.
Design: Experiments were performed on 9 volunteers (3 male, 6 female). EMG recordings were made from the masseter muscle ipsilateral to the stimuli, whilst the subjects maintained a steady level of activity in the muscle. Reflexes were evoked by applying stimuli to an incisor tooth (pulpal stimuli) or across the adjacent alveolar process (transalveolar stimuli), using bipolar electrodes.
Results: Two inhibitory responses were evoked in most (8/9) subjects. The first occurred at a shorter latency after transalveolar than after pulpal stimulation (12.3 ± 0.5 ms vs 19.4 ± 1.5 ms; $P = 0.0014$, paired t-test). For technical reasons, it was not possible to make such comparisons for the second inhibitory responses in all the subjects. In 5 subjects where such a comparison was possible, the mean latency of the transalveolar-evoked response was again shorter than that of the pulpal-evoked response (56.4 ± 2.8 ms and 58.8 ± 5.3 ms, respectively), but this difference was not significant ($P = 0.5$).
Conclusions: It appears that inhibitory jaw reflexes evoked from around the teeth are faster than those from the dental pulp. This observation could be due to differences between the peripheral afferent and/or the central pathways mediating the reflexes.

1. Introduction

It is well known that stimulation of nerves in and around the mouth can reflexly inhibit activity in jaw closing muscles (for recent reviews see refs. 1–3). In this respect, the reflexes evoked by stimulating nerves in and around teeth often appear similar. However, closer inspection of previous reports (e.g. refs. 4,5) suggest that there may be subtle but significant differences in the timings of these responses. This is particularly true when stimuli are delivered to the pulp using bipolar[4] as opposed to monopolar electrodes (e.g. refs. 4,6)—as circuits created by monopolar electrodes are more likely to result in stimulus spread to, and nerve activation within, the adjacent periodontal tissues.[7,8] However, to the best of our knowledge, no previous studies have directly compared the reflexes evoked from these different tissues by recording these responses in the same subjects. The aim of the present study was therefore to do this and compare inhibitory jaw reflexes evoked by bipolar electrical stimulation of a tooth and the adjacent periodontal tissues (mucosa, periodontal ligament and possibly alveolar bone).

* *Corresponding author*. Tel.: +44 1382 740972; fax: +44 1382 225163.
E-mail address: a.g.mason@dundee.ac.uk (A.G. Mason).
0003–9969/$ – see front matter
doi:10.1016/j.archoralbio.2007.11.013

2. Methods

2.1. Subjects

Experiments were performed on 9 volunteer subjects (3 male, 6 female; age range 19–22 years). The experimental procedures were approved by the Tayside Committee on Medical Research Ethics and therefore were performed in accordance with the ethical standards laid down in the Declaration of Helsinki. Each subject gave written informed consent. All the subjects were dentate and had no known history of craniomandibular disorders.

2.2. Recording techniques

Electromyographic (EMG) recordings were made using a pair of silver/silver chloride disc electrodes placed with their centres approximately 20 mm apart, on the skin overlying the masseter muscle (ipsilateral to the test stimuli—see below; Fig. 1A). The electrodes were held in place with adhesive discs and a conductive gel was used to achieve electrical contact (contact area: 12.6 mm^2 per electrode). The EMG signals were amplified (×20,000) and filtered (high pass: 100 Hz; low pass: 1500 Hz) using isolated amplifiers and filters (NL820 and NL125, Neurolog, Digitimer, Welwyn Garden City, UK). The high pass was set at 100 Hz to minimise the inclusion of low frequency signals arising from distant muscles, or possibly movement artefacts. The signals were recorded on to magnetic tape for later off-line digitisation and analysis (see below). A muting device in the amplifier was activated for a 2.5 ms period starting 0.5 ms before each electrical stimulus (see below) to eliminate, or at least minimise, stimulus artefacts.

2.3. Visual feedback

In order that the reflexes studied under the different stimuli conditions were all obtained against similar levels of background activity in the masseter muscle, the subjects were provided with visual feedback of their EMG signals. This was achieved by allowing the subject to view an oscilloscope placed in front of them, that displayed an EMG signal which

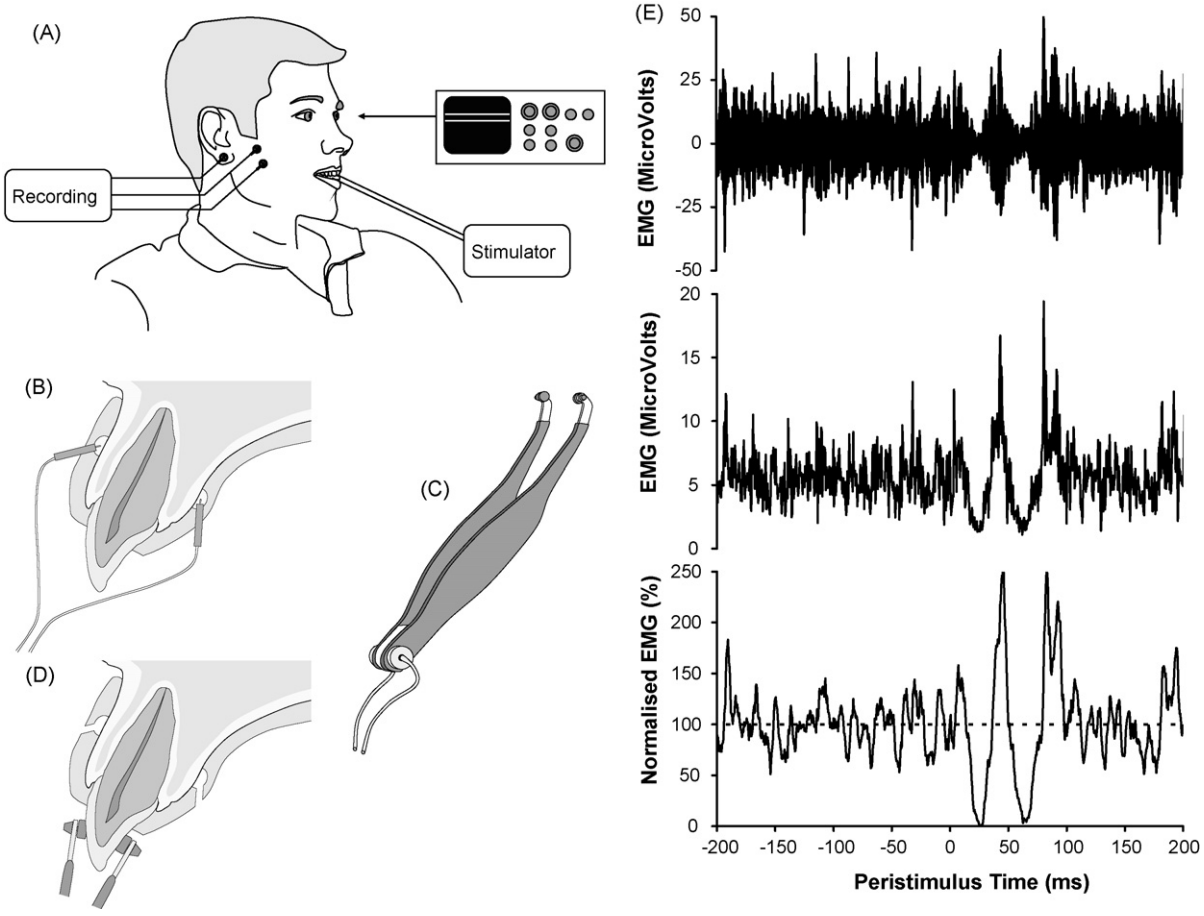

Fig. 1 – (A) Experimental set up—recording, stimulus and visual feedback. (B) Section through tooth, supporting tissues and mouthguard to illustrate the electrode positioning for bipolar transalveolar stimulation. (C) Modified college tweezers for the delivery of bipolar pulpal stimuli (after the technique described by Matthews et al.[7]). (D) Section through tooth, supporting tissues and mouthguard to illustrate the electrode positioning for bipolar stimulation of the pulpal tissues. (E) An example of recordings from an active jaw closing muscle showing a response to intra-oral electrical stimuli to illustrate the analysis sequence used (from top to bottom): raw superimposed EMGs; averaged EMGs; smoothed and normalised after noise subtraction to the mean level in the 200 ms prior to the stimulus.