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Jaw-stretch reflex is weaker in patients after orthognathic surgery

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ABSTRACT

Objectives: The jaw-stretch reflex (JSR) was studied in both patients and healthy participants in order to investigate the possible long-term impact of orthognathic surgery on the motor function of the masticatory system.

Design: JSR was measured in patients before surgery (PC), 1 year after surgery (PS) and in healthy controls (HC) ($N = 31$ in each group). JSR was evoked by a standardized stretch device and recorded bilaterally from masseter and anterior temporalis muscles using surface electromyography (EMG).

Results: The peak-to-peak amplitude (which was normalized to pre-stimulus EMG activity) of JSRs in PC and PS were significantly smaller than in HC ($P < 0.001$; $P < 0.001$). The onset latency in PS was significantly longer compared with HC ($P < 0.05$). The duration of JSR in PS was significantly longer than in HC and PC ($P < 0.001$; $P < 0.05$).

Conclusion: Patients with dentofacial deformities are characterized by reduced JSR amplitude. The delayed onset and elongated duration of JSR might be potential indicators of a long-term surgical impact on the motor function of the masticatory system.

1. Introduction

The jaw-stretch reflex (JSR) is a short-latency monosynaptic reflex serving to maintain posture and to fine-tune the voluntary movements of the mandible.[1,2] JSR is described as the brisk twitch of the jaw-closing muscles as a response to a sudden stretch of the muscles. The major receptors to the stretch are the muscle spindles which are composed of intrafusal muscle fibres and embedded in the bulky extrafusal muscle fibres of the jaw-closing muscles. When stimulated, the muscle spindle afferent signals are transmitted to many α-motor neurons innervating the extrafusal muscle fibres via the brain stem trigeminal motor nucleus and a brief synchronous activation of the jaw-closing muscle motor units ensues.[1] The evaluation of JSR can provide essential information on the

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motor control of the muscular performance. JSR can be evoked by tapping on the chin with a tendon hammer in a clinical setting. More accurately, JSR can be induced by a standardized jaw-stretch device which has been intensively used to study JSR and allows a high degree of control with the stretch stimulus.[3,4]

It has been suggested that several factors, such as background electromyography (EMG) activity and bite position, may affect JSR.[4] The presence of chronic orofacial painful conditions and experimental acute muscle pain has also been well documented to facilitate JSR.[5–7] The peak-to-peak amplitude of JSR has been observed to increase during pain condition. It has been suggested that the facilitation of JSR in pain condition serves as a protective function since it may reduce the jaw mobility, which as a result may reduce the muscle pain.[7–9]

However, so far no studies have reported JSR recordings in patients with dentofacial deformities or in patients after orthognathic surgery (OS). Compared with healthy individuals, patients with dentofacial deformities are characterized by disharmonious dental and skeletal structures. It has been reported that these patients tend to report more frequent headache and more pain in the orofacial region.[10,11] However, it is not clear whether the different anatomic structures and the presence of pain have certain influence on the JSR of these patients. OS aims to improve the occlusal relationship, the function of the masticatory system and the facial aesthetics in these patients. After OS inevitable changes of structures take place in various tissues of the masticatory system. In addition, a somatosensory function alteration in the trigeminal region is a common complication following OS.[10,12] It has been indicated that 15%–20% of patients reported ongoing pain 6 months to 1 year after OS.[13,14]

The aims of the present study were to investigate: (1) the influence of dentofacial deformities on JSR, (2) the possible long-term surgical impact of OS on JSR, and (3) the influence of pain on JSR.

2. Materials and methods

2.1. Participants

Thirty-one patients (16 women and 15 men, mean age 28.2 years) were recruited 1 year after OS, subsequently mentioned as the surgical patient group (PS). Thirty-one age- and gender-matched patients were recruited before OS and served as the patient control group (PC). Further, thirty-one age- and gender-matched healthy participants served as the healthy control group (HC).

All the patients were recruited from the Department of Oral and Maxillofacial Surgery, Aalborg Hospital, Denmark. Inclusion criteria for both PS and PC group: a developmental dento-skeleto-facial disharmony; complete dentitions (with the exception of premolars in some cases due to orthodontic treatment needs and with the exception of the third molars in some cases); aged between 18 and 40 years; scheduled for a combined orthodontic–orthognathic treatment. Exclusion criteria for both PS and PC group: A congenital anomaly (i.e., cleft lip and palate) or acute trauma; previous facial surgery; pregnant at baseline; a medical condition associated with systemic neuropathy (i.e., diabetes, hypertension, kidney problems). The types of dentofacial deformities were well-matched between PS and PC groups (Table 1). In the PS group, twenty patients had been treated with Le Fort I maxillary osteotomy (Le Fort I) in combination with bilateral sagittal split ramus osteotomy (BSSRO) and eleven patients had received single jaw surgery (six patients had undergone Le Fort I and five patients had undergone BSSRO). All PS patients had finished their orthodontic treatment and were without braces. All PC patients were in the stage before or just at the beginning of their orthodontic treatment, free of braces.

All healthy participants in the HC group were recruited among students at Aalborg University. Inclusion criteria for the HC group: complete dentitions (with the exception of third molars in some cases); Class I skeletal and dental relationships; aged between 18 and 40 years. Exclusion criteria for the HC group: Previous facial surgery; jaw muscle/temporomandibular joint (TMJ) pain, headaches, other symptoms of pain in the craniofacial region or other parts of the body during the past year; any jaw dysfunction (checked at the clinical examination and by means of the questionnaires Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD))[15]; pregnant at baseline; a medical condition associated with systemic neuropathy (i.e., diabetes, hypertension, kidney problems).

This study was approved by the local ethics committee (Project number: N-2008-0057) in accordance with the Helsinki Declaration II. Written informed consent was obtained from all participants before they were included in the study. All participants were identified by means of numbers only.

2.2. Self-reported pain and sensory testing

All patients were assessed using clinical examinations and the questionnaires RDC/TMD.[15] Further, they were diagnosed with a corresponding subtype of TMD when applicable. For patients with orofacial pain, the pain intensity of the last 6 months and at the time of the experiment was rated on a numerical rating scale from 0 to 10 where 0 was 'no pain' and

Table 1 – Numbers of patients with various subgroups of dentofacial deformities.

Group	Skeletal classification			Vertical morphology abnomality		Facial asymmetry
	Class I	Class II	Class III	Dolichofacial	Brachyfacial	
PS	2	18	11	8	2	3
PC	3	14	14	9	3	3

PC = patient control (patient before surgery); PS = surgical patient (patient 1 year after surgery).