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Functional analysis of the stomatognathic system in individuals infected with human immunodeficiency virus

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ABSTRACT

Purpose: To understand the effects of HIV type 1 on the function of the masticatory muscles. *Methods*: Sixty individuals were selected from both genders, aged between 22 and 57 years (mean 36.77 ± 9.33 years), and divided into two groups: Group HIVG, 30 individuals with HIV subtype 1, and Group CG, 30 healthy individuals (control group). The individuals were submitted to assessments of their masticatory muscle activity, biting strength and thickness of the masticatory muscles by means of electromyography, maximal molar bite force and ultrasound imaging, respectively. The resultant data were statistically analyzed by *t*-tests ($p < 0.05$). *Results*: The HIVG normalized EMG data from a mandibular rest position, protrusion, right and left laterality movement of the jaw showed that HIVG presented a relative increase in EMG activity compared to the CG. The HIVG had a lower masticatory cycle ability while chewing Parafilm M®, Raisins and Peanuts when compared to CG. During rest conditions, the ultrasound images showed a greater average muscular thickness in the right and left temporal region compared to CG. Upon maximal voluntary contraction, an increased average thickness was seen in the temporalis muscles and left sternocleidomastoid muscle when compared to the CG. *Conclusion*: Based on the results of this research, it can be concluded that individuals with acquired immunodeficiency syndrome showed muscular changes related to the stomatognathic system, especially concerning EMG activity and muscle thickness.

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1. Introduction

Acquired immunodeficiency syndrome (AIDS) is a complex, chronic disease caused by the human immunodeficiency virus (HIV). HIV is a lentivirus from the retrovirus family and can be classified as HIV type 1 (HIV-1) or HIV type 2 (HIV-2). The vulnerability of individuals to HIV type 1 represents a great challenge for public health, as HIV-1 can be transmitted through a variety of sexual behaviors (Barré-Sinoussi et al., 1983; Engelman and Cherepanov, 2012).

According to Tehranzadeh et al. (2004), the main muscle-related symptoms in AIDS patients are myalgia, muscular atrophy, polymyositis and pyomyositis. These muscular manifestations can occur months or years after the initial appearance of disease symptoms or may present as a single manifestation. Muscle atrophy can be caused by neurological changes, nutrition and/or infections and may occur at varying degrees. Approximately 35% of infected individuals experience arthralgia, which is typically caused by HIV seroconversion. In addition to musculoskeletal disorders, AIDS causes a range of rheumatic changes that may be associated with alterations in muscle function, including immunologically mediated changes, psoriasis, undifferentiated spondyloarthropathies, infectious arthritis and osteomyelitis, as well as alterations that may be a direct result of HIV interactions, such as pyomyositis, vasculitis and diffuse infiltrative lymphocytic syndrome.

To our knowledge, there are no previous reports on the effects of AIDS on the masticatory muscles. Thus, this study aimed to analyze these muscles in patients with AIDS who were receiving medication in order to establish parameters for comparison with

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healthy individuals. These results should provide healthcare professionals with a better understanding of the side effects of these medications on the masticatory muscles of individuals with AIDS.

The clinical evaluation of pain, the restriction of movement during the manipulation of musculoskeletal structures, the self-reporting of symptoms, and such techniques as electromyography, ultrasound and bite force can be used to analyze the tendons and joints in different anatomical regions to detect musculoskeletal changes and muscle disorders (Rosa et al., 2009). Therefore, the aim of this study was to analyze the electromyographic activity of the masseter, temporal and sternocleidomastoid muscles at rest and during right and left laterality; the protrusion and maximum voluntary contraction; the maximum molar bite forces (both sides); and the masticatory ability of AIDS patients currently taking medications.

2. Methods

This study was carried out at the Electromyography Laboratory of Prof. Dr. Mathias Vitti in the Department of Morphology, Physiology and Basic Pathology (USP) under the coordination of Prof. Simone Cecilio Hallak Regalo and in collaboration with Prof. Alcyone Artioli Machado, Head of the UETDI Department – Ribeirão Preto School of Medicine, University of São Paulo. Data were collected from the HIV group (HIVG) and the control group (CG) from February 2012 to March 2014. This study was approved by the Research Ethics Committee, process N. 01222712. 0.0000.5419. Participants were fully informed about the experiment and signed a Free and Informed Consent form in accordance with resolution 466/12 and the National Health Council.

2.1. Sample selection

Volunteers were selected based on inclusion and exclusion criteria obtained through anamnesis and clinical examinations. Anamnesis provided information about the patient's medical and dental history, presence of parafunctional habits, and possible clinical signs and symptoms of temporomandibular disorders. We selected a total of 60 individuals from both genders between 22 and 57 years of age (mean of 36.77 ± 9.33 years). The HIV-1 group consisted of 30 individuals with HIV subtype 1 (HIVG), and the control group consisted of 30 healthy individuals (CG).

The inclusion criteria for the HIVG included being a carrier of HIV-1, undergoing clinical treatment and medication through the administration of anti-retroviral drugs (minimal five years), lacking any neurological impairment except cerebral toxoplasmosis, having no signs or symptoms of orofacial pain, including the temporomandibular joint, and possessing a dental arcade composed of at least the incisors to first permanent molars, with no signs or symptoms of TMJ (RDC/TMD) (Table 1). The control group (CG) of 30 healthy individuals was comprised of students and/or staff members from different departments of the University with no signs or symptoms of TMJ (RDC/TMD) (Table 1). The HIVG and CG were paired with matching subjects (gender, age, weight, and height).

All individuals were assessed for masticatory muscle activity, biting strength and muscle thickness.

Table 1
Descriptive analysis of the patients with human immunodeficiency virus (HIVG) and control group (CG), for the following description: age, gender (Male "M" and Female "F"), temporomandibular disorder (TMD) and antiretroviral drugs (Lamivudina (3TC), Zidovudina (AZT) and Efavirenz (EFV).

Patient (n = 60)	Age (years)		Gender		Antiretroviral drugs		
	HIV	C	HIV	C	3TC	AZT	EFV
1	46	46	M		x	x	
2	36	38	M		x	x	
3	44	44	M		x	x	
4	39	35	M		x		
5	40	40	M		x	x	
6	44	41	M		x	x	x
7	42	46	M		x	x	x
8	43	47	M		x	x	
9	54	54	M		x	x	
10	57	57	M		x	x	x
11	35	34	M		x	x	x
12	32	34	M		x		
13	27	27	M		x	x	x
14	52	56	M		x	x	
15	32	29	M		x	x	x
16	50	47	M				x
17	43	39	M		x	x	x
18	45	44	M		x		
19	50	49	M		x	x	
20	50	48	M		x	x	
21	45	42	M		x	x	
22	43	42	F		x		
23	32	34	F		x	x	
24	29	32	F		x	x	x
25	31	33	F		x	x	
26	57	57	F		x		x
27	41	41	F		x		x
28	34	37	F		x	x	
29	39	38	F		x	x	x
30	29	27	F		x	x	

2.2. Electromyography (EMG)

Electromyography was conducted using surface active differential electrodes (two 10 mm-long × 2 mm-wide silver chloride bars 10 mm apart) with input impedance of 10^{10} Ω/6 pf, bias current input of ±2 nA, common-mode rejection ratio of 110 dB at 60 Hz and gain equal to 20×. For signal conditioning and data acquisition, a portable, high performance twelve channel data acquisition system (Myosystem-Br1 from DataHominis Tec. Ltda, Brazil) was used. The EMG signals were further amplified by 50× (total gain 1000×), bandpass filtered (20 Hz–1 kHz) and sampled at a frequency of 2 kHz with 16 bits resolution.

The data were visualized and processed using the program Myosystem I version 3.5, which enables the definition of processing windows and calculate various features, such as frequency spectrum, RMS and linear envelop.

The differential active electrodes were positioned in the ventral region of the masseter muscle, in the anterior portion of temporal muscle and 1.5–2.0 cm above the clavicle bone in the sternocleidomastoid muscle. The positions of the electrodes were determined according to Cram et al. (1998). The electrodes were adhered using adhesive bandage tape. A stainless steel circular electrode (3 cm in diameter) was fixed to the skin in the dorsum of the wrist and used as a reference electrode (ground electrode).

The EMG data were recorded while the individual remained seated upright with the soles of their feet resting on the ground, arms resting on their legs, and head parallel to the ground. To determine the clinical conditions of the jaw at rest, maximum protrusion and right and left laterality, each posture was maintained for 5 s, and maximum dental clenching was performed for 4 s (normalization factor) with Parafilm M® between the posterior teeth. Additionally, the electromyographic signals were acquired during habitual mastication with five grams of raisins and five grams of peanuts (10 s) and during the non-habitual mastication of an inert material (10 s), constituted by a sheet of paraffin (Parafilm M®) that had been folded (18 × 17 × 4 mm, weight 245 mg) and placed on both sides of the dental arches (Siéssere et al., 2009).

All electromyographic activity was normalized based on the maximum dental clenching with Parafilm M® between the

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