

Masticatory Muscle and Temporomandibular Joint Pain in Croatian War Veterans with Posttraumatic Stress Disorder

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ABSTRACT

The aim of this study was to investigate the prevalence and intensity of masticatory muscle and temporomandibular joint (TMJ) pain in Croatian war veterans with posttraumatic stress disorder (PTSD). The examined group consisted of 100 Croatian war veterans, in whom PTSD had previously been diagnosed. Patients were compared with 92 subjects who had not taken part in the war and in whom PTSD was excluded by psychiatric examination. The clinical examination consisted of palpation of the masticatory muscles, the prominent neck musculature, and TMJ. The examination technique used and the definition of items were previously tested for reliability and validity. 93% of the subjects with PTSD had masticatory muscle tenderness compared to 45.65% of the subjects in the control group ($\chi^2=51.46$, $p<0.0001$). The most frequent painful location in the subjects with PTSD was the left lateral pterygoid site in 88%, and in subjects of the control group the right lateral pterygoid site in 28.26% of cases. The most painful location in the PTSD group was the left lateral pterygoid site in 72%, and in the control group the left posterior digastric in 4.35% of cases. 58% of the subjects with PTSD had TMJ tenderness compared to 3.26% of subjects in the control group ($\chi^2=66.23$, $p<0.0001$). The most frequent painful location of TMJ in both groups was the left posterior capsule; in the PTSD group 38% and in subjects in the control group 2.17% of cases. The most painful location was the left posterior capsule in 28% of subjects with PTSD, while not one subject in the control group reported severe painful sensitivity. The very high frequency and intensity of pain in subjects with PTSD confirms the effect of stress on muscle and joint sensitivity, i.e. perception of pain.

Key words: masticatory muscle, temporomandibular joint, pain, PTSD, war, veterans

Introduction

The importance of psychological factors in the etiology of temporomandibular disorders (TMD) is still controversial^{1–3}. Without doubt there are complex pathways in the central nervous system which connect the limbic system and centres of motor activity, which lead to the transformation of emotional stimulus into motor response^{4–6}.

Subcategorization of TMD patients into joint related and muscle related groups reveals the influence of psychological factors, mainly with regard to muscular disorders^{7–9}. Results from many studies have indicated that stress causes an increase in muscle activity. Extensive re-

search has focused on the stress-induced motor responses of the masticatory muscles^{10–15}.

Previous investigations showed that the performance of a stressful task could induce abnormal contractions and prolonged hyperactivity in the human jaw muscles of both TMD patients and healthy subjects^{16–18}. Other evidence also suggests that the masticatory muscles may be particularly hyperactive in stressful conditions of longer duration¹⁹.

The assumption is that in posttraumatic stress disorder (PTSD) all the preconditions for the occurrence of muscular disorders are present. Posttraumatic stress dis-

order can be a brief reaction that follows soon after a traumatic experience or a chronic condition producing severe debilitation. Unlike the routine stresses experienced in life, this disorder results from an extreme, overwhelming, or catastrophic experience. The syndrome consists of intrusive memories, flashbacks, nightmares, avoidance of remembering an event, numbness, and hyperarousal. The disorder may be accompanied by depression, substance abuse, or anxiety. Symptoms may be mild or severe, and such people may become easily irritated or have violent outbursts. Ordinary events can serve as reminders of the trauma and trigger flashbacks or intrusive images. A flashback may cause the person to lose touch with reality and re-enact the event for a period of seconds or hours or, very rarely, days. A person who has a flashback, which can occur in the form of images, sounds, smells, or feelings, usually believes that the traumatic event is happening all over again²⁰.

Grah et al. found significantly lower platelet serotonin concentration in PTSD patients, in comparison to healthy control group²¹.

Because of neurotransmitter misbalance which accompanies PTSD, particularly adrenalin and noradrenalin, such a person is in a state of permanent, increased excitement, which among other things manifests with an increase in the tone of skeletal muscles^{22–24}.

Such provoked muscle tension is particularly intensively manifested in the muscles of the head and face, due to the fact that they are included in the physical manifestation of emotion. It has been demonstrated that stress induces an increase in electromagnetic activity, i.e. that stress which persists for several trials may induce tooth contact^{12,14}.

War veterans with PTSD, who had been exposed to combat related visual stimuli, showed significantly higher electromyographic values of head and facial muscles²⁵.

Changes in cerebral hemodynamics occur in PTSD patients. Dikanović et al. determined the effect of catecholamine levels on cerebral hemodynamics through significant association between elevated levels of stress hormones and increased mean blood flow velocity in the circle of Willis vasculature²⁶. Increased mean blood flow velocity in the circle of Willis vessels is a consequence of cerebral vasospasm, affecting muscles as well.

The aim of this study was to investigate the prevalence and intensity of masticatory muscle and temporomandibular joint (TMJ) pain in Croatian war veterans with PTSD.

Materials and Methods

The study included male subjects who had taken part in the war in Croatia, with a diagnosis of PTSD^{20,27}. The healthy normal control (HNC) group was comprised of male subjects. The subjects in the HNC group had not taken part in the war, and PTSD was excluded by a psychiatric examination. During the examination all the subjects were patients at the Clinic of Psychiatry of the

Medical faculty in Rijeka. Clinical examination was carried out in the Department of Prosthodontics, University of Rijeka, Medical Faculty, Rijeka, Croatia.

The clinical examination consisted of palpation of masticatory muscles, palpation of the prominent neck musculature, and TMJs. Palpation revealed sensitivity of the muscles and joint capsule. The subject was asked to explain whether he felt pain or merely pressure. The examination technique used and the definition of items were previously tested for reliability and validity^{28,29}.

In order to avoid the consequences of interrater reliability, all clinical examinations were performed by the same person.

All subjects were informed of the aims and procedures of research. Within the research, they are guaranteed in respect of their basic ethical and bioethical principles: personal integrity (independence, righteousness, well-being, and safety) as regulated by Nürnberg codex and the most recent version of Helsinki declaration. Only those subjects who gave a written permission in the form of informed consent were included.

Statistics

All analyses were performed with SPSS statistical software, version 10.0. Frequency was calculated for the variables whose values are expressed in categories. Testing of significance of the difference between groups was carried out by Pearson χ^2 -test.

Results

The study included 100 male Croatian war veterans (median=35 years, range=25–50) with a PTSD diagnosis. The HNC group had 92 male subjects (median=34 years, range=24–51).

Head and neck muscles were palpated at 18 locations bilaterally. Patient response was registered: no pain (0), moderate (1), or severe (2) pain. 93% of the subjects with PTSD had at least one muscular painful location compared to 45.65% of the subjects in the HNC group (Table 1).

TABLE 1
MASTICATORY AND NECK MUSCLE PAIN IN POSTTRAUMATIC STRESS DISORDER AND HEALTHY NORMAL CONTROL

Group	MNMP present (%)	MNMP absent (%)
PTSD	7	93
HNC	54.35	45.65

* $\chi^2=51.46127$, ** $p<0.00001$, PTSD – posttraumatic stress disorder, HNC – healthy normal control, MNMP – masticatory and neck muscle pain

Subjects in the PTSD group reacted painfully significantly more frequently to palpation of the muscles and TMJ, and more frequently gave answers 1 and 2 compared to the subjects in the HNC group, who more frequently gave the answer 0. The frequency of pain in palpated locations for both groups (Figure 1).

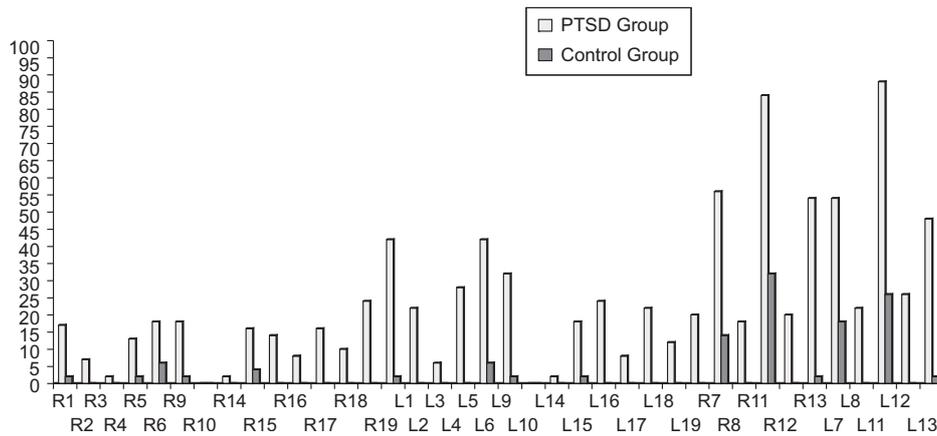


Fig. 1. The frequency of the occurrence of masticatory and neck muscle palpation tenderness. R – right, L – left, 1 – anterior temporalis, 2 – deep temporalis, 3 – middle temporalis, 4 – deep masseter, 5 – anterior masseter, 6 – inferior masseter, 7 – posterior digastrics, 8 – medial pterygoid, 9 – vertex, 10 – referent point, 11 – lateral pterygoid, 12 – medial pterygoid, 13 – temporal insertion, 14 – superior sternocleidomastoid, 15 – middle sternocleidomastoid, 16 – inferior sternocleidomastoid, 17 – insertion of trapezius, 18 – upper trapezius, 19 – splenius capitis.

The most frequent painful locations in the PTSD group were the left lateral pterygoid site in 88%, right lateral pterygoid site in 84%, and the left posterior digastric in 54% of cases, compared with the control group, where the most frequent painful locations were the same, although significantly more rarely, i.e. right lateral pterygoid site in 28.26%, left lateral pterygoid site in 26.08%, and left posterior digastric in 19.57% of cases. The intensity with which subjects reacted to palpation of the muscles and comparison between the groups (Table 2).

The most painful location in the PTSD group was the left lateral pterygoid site in 72% of cases, and in the HNC group the left posterior digastric in 4.35%. This was followed by the right lateral pterygoid site in 66%, left posterior digastric in 46%, and the right and left temporal insertion in 44% of the cases in the PTSD group. Other locations for subjects in the control group were insignificantly rarely sensitive. The TMJ was palpated on three locations, the posterior, lateral, and upper site. The joint was significantly more frequently sensitive in subjects with PTSD compared to subjects in the HNC group (Table 3).

The most frequent painful location in subjects with PTSD was the left posterior capsule in 38%, followed by the right posterior capsule in 36%, and most rarely painful the right lateral capsule in 18%. The joint was sensitive to palpation of the posterior capsule in only 2.17% of cases in the HNC group (Table 4).

Discussion

Consequences of exposure to war trauma present a public health problem in Croatian society predominately affecting families of Croatian veterans with post traumatic stress disorders³⁰. Correlation between PTSD and pain has been confirmed in numerous investigations^{31–35}. The American Psychiatric Association²⁰ defines PTSD as a form of pathological response to stress, in which the pa-

tient through intrusive thoughts and dreams regularly experiences the trauma suffered, and as a consequence, is in a state of permanent increased tension.

In their investigation, Carlson et al.²⁵ examined veterans with and without PTSD. They participated in an exploratory study of facial reactivity to neutral slides and to slides depicting unpleasant combat-related material that were previously determined to be emotionally evocative. It was found that the zygomaticus major (cheek), masseter (jaw), and lateral frontalis (forehead) muscles were especially reactive to the combat slides in the veterans with PTSD, suggesting the importance of facial emotional expression in this disorder²⁵.

In this study palpation was carried out on precisely determined anatomic locations, which included 18 symmetric points and one referent. Palpation of all points was carried out simultaneously on both sides apart from intraoral locations. The results show a significantly higher share of both frequency and intensity of pain during palpation of the muscles in the PTSD group compared to the HNC group.

Ninety-three percent of the subjects in the PTSD group had at least one painful location, compared to 45.65% in the HNC group. The difference is statistically significant. In an investigation of a student population Pullinger et al.³⁶ found muscular sensitivity in 33% of males.

In this investigation subjects in the PTSD group reacted painfully to 36 of the 38 possible locations, and to 15 in the HNC group. The most frequent painful locations for both groups were the same, in the PTSD group 84–88% of subjects reacted painfully to palpation of lateral pterygoideus, and in the control group 26.08–28.26%, posterior digastric in 54–56% of the PTSD group, and in 13.04–19.57% of the HNC group.

Subjects in the PTSD group also reacted intensely painfully to palpation of the temporal insertion on the

TABLE 2
POSITIVE RESPONSE RATE FOR PALPATION OF MASTICATORY AND NECK MUSCULATURE

Palpation sites	Right side						χ^2 p value	Left side						χ^2 p value
	PTSD (%)			HNC (%)				PTSD (%)			HNC (%)			
	0	1	2	0	1	2		0	1	2	0	1	2	
Anterior temporalis	66	<	16	97.83	2.17	0	32.2149; p<0.00001	58	24	18	97.83	2.17	0	43.2761; p<0.00001
Deep temporalis	86	6	8	100	0	0	13.893 p<0.0001	78	12	10	100	0	0	22.8593 p<0.00001
Middle temporalis	96	4	0	100	0	0	3.7582 p>0.05	94	2	4	100	0	0	5.6981 p>0.05
Deep masseter	74	12	14	97.83	2.17	0	22.409 p<0.0001	72	14	14	100	0	0	30.1581 p<0.00001
Anterior masseter	64	18	18	93.48	4.35	2.17	24.6452 p<0.00001	58	24	18	93.48	6.52	0	33.9701 p<0.00001
Inferior masseter	64	14	22	2.17	0	0	35.1172 p<0.00001	68	16	16	97.83	2.17	0	29.6704 p<0.00001
Posterior digastric	44	20	36	86.96	10.87	2.17	43.94897 p<0.00001	46	8	46	80.43	15.21	435	43.1914 p<0.00001
Medial pterygoid	82	10	8	100	0	0	18.2731 p<0.01	78	4	18	100	0	0	22.8593 p<0.00001
Vertex	100	0	0	100	0	0		100	0	0	100	0	0	
Lateral pterygoid	16	18	66	71.74	26.09	2.17	91.4056 p<0.00001	12	16	72	73.91	23.91	2.17	106.2147 p<0.00001
Medial pterygoid	80	2	18	100	0	0	20.5395 p<0.0001	74	8	18	100	0	0	27.6665 p<0.00001
Temporal insertion	46	10	44	97.83	2.17	0	63.3453 p<0.00001	52	4	44	97.83	2.17	0	54.5971 p<0.00001
Superior sternoclei- -domastoid	84	4	12	97.83	2.17	0	12.562 p<0.01	82	4	14	97.83	2.17	0	14.731 p<0.001
Middler sternoclei- -domastoid	86	4	10	100	0	0	13.893 p<0.001	76	6	18	100	0	0	25.2343 p<0.00001
Inferior sternoclei- -domastoid	92	4	4	100	0	0	7.68 p<0.05	92	6	2	100	0	0	7.68 p<0.05
Insertion of trapezius	84	6	10	100	0	0	16.058 p<0.001	78	12	10	100	0	0	22.8593 p<0.00001
Upper trapezius	90	4	6	100	0	0	9.7055 p<0.01	88	6	6	100	0	0	11.776 p<0.01
Splenius capitis	76	4	20	100	0	0	25.235 p<0.00001	80	4	16	100	0	0	20.5395 p<0.0001

PTSD – posttraumatic stress disorder, HNC – healthy normal control, 0 – no pain, 1 – moderate pain, 2 – severe pain

coronoid process in 48–54% of cases, anterior masseter in 36–42%, inferior masseter in 36–38%, and anterior temporalis in 34%.

Painful reactions were usually symmetrical. Statistically significant difference between the groups was present for almost all palpated areas, with the exception only of one point where subjects in the PTSD group rarely reacted painfully (4–6%). Although the locations on which subjects in both groups most frequently reacted were the same, subjects in the PTSD group showed significantly higher pain intensity. Of all the subjects in the control group, only 4.35% defined the pain as severe in the area of the left posterior digastric, and 2.17% the

right and left lateral pterygoideus and posterior right digastric.

TABLE 3
FREQUENCY OF THE OCCURRENCE OF
TEMPOROMANDIBULAR JOINT TENDERNESS TO PALPATION

Group	TMJTJ present	TMJTJ absent
PTSD	58	42
HNC	3.26	96.74

* $\chi^2=66.23441$, **p<0.00001, TMJTJ – temporomandibular joint tenderness or pain, PTSD – posttraumatic stress disorder, HNC – healthy normal control

TABLE 4
POSITIVE RESPONSE RATE FOR PALPATION OF TEMPOROMANDIBULAR JOINT CAPSULE

	Right						χ^2 ; p value	Left						χ^2 ; p value
	PTSD (%)			HNC (%)				PTSD			HNC (%)			
	0	1	2	0	1	2		0	1	2	0	1	2	
Lateral capsule	82	8	10	100	0	0	18.27310 p<0.0001	74	8	18	100	0	0	27.66651 p<0.00001
Posterior capsule	64	12	24	97.83	2.17	0	35.26035 p<0.00001	62	10	28	97.83	2.17	0	38.22425 p<0.00001
Superior capsule	70	10	20	100	0	0	32.71111 p<0.00001	74	6	20	100	0	0	27.66651 p<0.0000

PTSD – posttraumatic stress disorder, HNC – healthy normal control, 0 – no pain, 1 – moderate pain, 2 – severe pain

In the area of the right lower masseter, of the subjects in the PTSD group who reacted painfully, 61.1% had severe pain, in the right posterior digastric 64.3%, on the right lateral pterygoideus 78.6%, and in the right temporal insertion 81.5%, in the left posterior digastric 85.2%, in the left lateral pterygoid 81.8%, and in the left temporal insertion 91.7%.

Similar to the results of this investigation, lateral pterygoid and posterior digastric are mentioned in the literature as the sites of the most frequent pain^{36,37}. Sieber et al.³⁸ in an investigation of adolescent population carried out on a Danish population show that medial and lateral pterygoid and sternocleidomastoid were the most sensitive, and in a Swiss population temporal insertion, pterygoid and surface masseter.

Schiffman et al.³⁹ found most frequent sensitivity of the lateral pterygoid in 52–54% of cases, anterior temporalis in 36–43%, medial pterygoid in 32–40%, and deep masseter in 32–45% of cases. Posterior temporalis was less frequently painful, which corroborates our results.

Helkimo⁴⁰ determined that the most painful muscles on palpation were, in the following order: insertion temporalis, lateral pterygoideus, deep and surface masseter, and frontal temporalis. The least painful was deep temporalis, which agrees with our results.

Dworkin et al.⁴¹ confirmed that the most frequent painful location was lateral pterygoid, followed by temporal insertion on the coronoid process and deep masseter. Painfulness of lateral pterygoid varied from 44.7% in cases in the control group to 74.3% in the dysfunctional⁴¹.

In a male population aged 30 to 49 years, Salonen et al.⁴² found muscle sensitivity to palpation in 11–13% of cases, Agerberg and Bergenholtz⁴³ in 6.8–9.2% of cases,

and the most frequent painful location in this case was also the lateral pterygoid.

The results of an investigation by Vanderas⁴⁴ show that muscles were significantly more frequently sensitive to palpation in a group of subjects with unpleasant life experiences, i.e. in 67.6% of cases compared to 46.8% in a control group.

In this study, the joint was palpated on three locations (lateral, posterior, and superior site). The results showed significantly more painful reactions in subjects in the PTSD group. Fifty-eight percent of the subjects in the PTSD group had sensitive joints during palpation compared to only 3.6% of the subjects in the control group. Sieber et al.'s study³⁸ found sensitivity in 1.9–5.8% of cases during palpation of posterior and 8.1–36.9% during palpation lateral site. In the PTSD group severe pain prevailed in all palpated locations.

Pullinger et al.³⁶ found pain in 14% of subjects and Nourallah and Johansson⁴⁵ in 1%. Dworkin et al.⁴¹ compared patients with and without dysfunction and found symptomatic pains in 56.9% of cases and in healthy in 9.1%. Schiffman et al.³⁹ most frequently registered sensitivity of the lateral site in 19–30%, and less frequently of the superior site in seven to 14% of cases. Wanman and Agerberg⁴⁶ registered sensitivity to palpation of the joint in 6.2% of cases laterally and 2.1% posteriorly.

Vedolin et al. Determined that external psychological stressors have a potential impact on masticatory muscle tenderness⁴⁷.

Conclusion

The very high frequency and intensity of pain in subjects with PTSD confirms the effect of stress on muscle and joint sensitivity, i.e. perception of pain.

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BOLNA OSJETLJIVOST ŽVAČNIH MIŠIĆA I TEMPOROMANDIBULARNIH ZGLOBOVA U VETERANA DOMOVINSKOG RATA U HRVATSKOJ S POSTTRAUMATSKIM STRESNIM POREMEĆAJEM

SAŽETAK

Cilj ovog istraživanja je bio utvrditi pojavnost i intenzitet bolnosti žvačnih mišića i temporomandibularnih zglobova (TMZ) u veterana Domovinskog rata u Hrvatskoj s posttraumatskim stresnim poremećajem (PTSP). Ispitivana se skupina sastojala od 100 hrvatskih veteran s prethodno postavljenom dijagnozom PTSP-a. Ispitivana se skupina uspoređivala sa skupinom od 92 ispitanika koji nisu sudjelovali u Domovinskom ratu i u kojih je PTSP isključen psihijatrijskim dijagnostičkim postupcima. Klinički su palpirani žvačni mišići, vratna muskulatura i TMZ. Tehnika koja je korištena prethodno je testirana u smislu vrijednosti i pouzdanosti. U 93% ispitanika s PTSP utvrđena je mišićna osjetljivost u usporedbi s 45,65% kontrolnih ispitanika (hi kvadrat 51,46, $p < 0,0001$). Najčešće mjesto bolne osjetljivosti bio je lijevi pterigoideus lateralis u 88% slučajeva, u kontrolnoj desni pterigoideus lateralis u 28,26%. Najbolnija lokacija u ispitivanoj skupini bio je lijevi pterigoideus lateralis u 72% slučajeva, u kontrolnoj lijevi stražnji digastricus u 4,35%. 58% PTSP ispitanika imalo je osjetljivost TMZ u usporedbi s 3,26% ispitanika kontrolne skupine (hi kvadrat 66,23, $p < 0,0001$). Najčešća bolno područje TMZ u obje skupine bio je lijevi stražnji zid; u PTSP grupi 38%, u kontrolnoj 2,17%. Najbolnije područje bio je lijevi stražnji zid i to u 28% PTSP ispitanika, dok nitko od ispitanika kontrolne skupine nije bol zgloba opisao kao jaku. Visoka pojavnost i intenzitet boli u ispitanika s PTSP ukazuju na utjecaj stresa na mišićnu i zglobnu osjetljivost, odnosno na doživljaj boli.