ORIGINAL ARTICLE

Long-term effects of splint therapy in patients with posttraumatic stress disease (PTSD)

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Abstract

Objectives The aim of a pilot study was to clarify the question of whether mouth opening restrictions in patients with PTSD by means of splint therapy (st) show long-term therapeutic effects in the case of functional disorders.

Material and methods In 31 of 36 inpatients (soldiers, average age 37.1 ± 7.3 years, 26.7 ± 2.1 teeth) with confirmed posttraumatic stress disorder, chronic pain intensity ≥ 6 (visual analogue scale 0 to 10), the mouth opening was determined, and the functional status (RDC-TMD) was recorded. All participants received a splint that was worn at night. A control of the therapeutic effect of the splint occurred after 6 weeks, 3, 6, and 12 months.

Results The mouth opening initially had an average of 30.9 ± 6.5 mm (median 31 mm). The pain intensity (PI) was reported to be on average VAS 8.3 ± 0.9, the chronic degree of pain according to von Korff was 3.9 ± 03. Six weeks after the st ($n = 31$), the average mouth opening was 49.5 ± 6.3 mm (median 51.5). PI was given as VAS 2.3 ± 1.1 on average. After 3, 6, and 12 months, 24, 15, and 14 subjects could be interviewed regarding PI. Based on the last examination date of all subjects, the average PI was given as 1.1 ± 0.9 (median 1).

Conclusion The presented data show that the therapeutic short-term results achieved by means of a splint remain valid on the long term despite continued PTSD.

Clinical relevance The presented study shows that patients will benefit in the long term from a splint and remain symptom-free, even if this mental illness persists.

Keywords CMD · Splint therapy · PTSD · Bundeswehr soldiers

Introduction

The finding that orofacial dysfunctions are more likely to be triggered and maintained by systemic, metabolic, structural, traumatic, and psychosocial causes than by occlusal factors is particularly reflected in recent research on this disease [1]. However, it should be noted that splint therapy is the first choice for diagnosed muscle and/or temporomandibular joint diseases [2]. This is associated with high costs for the social insurance provider as well as for those affected. Against this background, the question arises as to whether clinically measurable apparent relief after splint therapy is based on veritable therapeutic effects or only on placebo effects. In the case of the latter, it would be expected that relief would be given in the short term, but that it would abate significantly after 3 months. This is supported by the results of a meta-analysis by Kuzmanovoc Pficer et al. [3]. The authors show that the positive short-term effects (up to 3 months) of splints are significant, whereas these effects did not persist on the long-term when compared to presently accessible data about control groups. Studies by Ficnar et al. [4] and Weggen et al. [5] distinguish functional from dysfunctional pain and could demonstrate that the effect of splints on proven chronification, as defined by pain duration and psychosocial

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factors, diminishes or is comparable to the effects of physiotherapy and medication. This raises the question as to whether it is more appropriate for chronic complaints, at least in cases with a clear psychosocial component of the disease, to forego the short-term effects of a splint therapy and to invest in adequate psychotherapy at an early stage.

Aim of the study

It should be verified if a splint therapy with high psychosocial stress and chronic pain as well as functional limitations in the form of a limited mouth opening has long-term effects. Outcome variables were mouth opening and pain intensity (visual analogue scale range 0–10).

Material and method

Initially, 36 inpatient Bundeswehr soldiers (Department of Mental Health of Division VI Psychiatry of the BwZKrh Koblenz) with posttraumatic stress disorder diagnosed by a specialized psychiatrist after up to 17 foreign missions (at least 1 year)(trauma event: median 3.8 ± 3.4 years; average age 37.1 years ± 7.6 years, BMI 26.5 ± 3.6, 27 smokers) were examined. Participants received cognitive processing therapy in 90-min group sessions of 6 participants and 90–120-min sessions for two individual with two psychotherapists during 9–12 weeks with at least 18 total sessions [6].

Of these, 31 subjects (traumatic event median 3.5 ± 3.1 years, average age 37.1 ± 7.3 years, BMI 26.8 ± 3.7, 24 smokers, one to 17 foreign missions, average 4.7 ± 4, 5 confirmed PTSD diagnosis for an average of 4.6 ± 3.1 years (median 3.5 years)) fulfilled the required inclusion criteria of at least grade 3 chronic pain according to von Korff's chronic pain scale [7]. Pain sensation was of at least 6 on an initial examination visual analogue scale from 0 to 10. The myogen restricted oral opening was of less than 40 mm, which was also subjectively rated as restricted, and pain in mandibular movements experienced as impaired, as well as attrition, which averaged one third of the clinical crown height [8]. All subjects were examined for RDC/TMD [9, 10]. On this basis, the presence of a myogenic CMD requiring treatment was determined. The degree of attrition was determined according to the criteria of Wetselaar et al. [8]. All clinical examinations were performed through a calibrator calibrated for pressure measurements and repeat measurements. The course of pain was recorded over the entire study period using a visual analogue scale. All study participants received an occlusal splint with an increase up to 3 mm [11]. The splint was made on the basis of alginate models after habitual bite-taking and an arbitrary facebow transfer from a cast plastic in the form of a modified Schulte-type interceptor in the upper jaw [12].

Subjects were invited to follow-up visits 6 weeks, 3 months, 6 months, and 12 months after splint insertion and regular nocturnal usage. In the course of these examinations, the mouth opening was checked again after 6 weeks and each subject filled out a visual analogue scale at each follow-up appointment. The exclusion of the presence of muscle and joint diseases was based on the RDC TMD. A Friedman test was applied in order to make this statement. $P < 0.0001$ (LOCF, CC).

Results

Initial examination before splint therapy

Before the splint therapy, the mouth opening was on average 30.9 ± 6.5 mm (median 31 mm, minimum 16) (Fig. 1).

The pain intensity was reported to be on average VAS 8.3 ± 0.9, the chronic degree of pain after von Korff [6] was 3.9 ± 03 (28 times grade 4) (Fig. 2), which indicates a high load and chronicity. The value of attrition was on average 4.4 ± 0.5 (median 4.3). One subject had an attrition index of 3, with a pain intensity of VAS = 10 and a mouth opening of 16 mm, as well as a chronic pain index of 4. In this case, it could be stated that the orofacial dysfunction was due less to grinding jaw movements than to mere compression of the teeth without lower jaw movement.

After 6 weeks ($n = 31$), the average mouth opening was 49.5 ± 6.3 mm (median 51.5, minimum 38 mm) (Fig. 3), pain intensity was given as VAS 2.3 ± 1.1 on average (Fig. 2). A test person indicated an intensity of 6 in the VAS. The initial mouth opening in this case was 19 mm, the value after 6 weeks improved to 40 mm.

The increase in mouth opening was significant (< 0.05) and averaged 19.3 ± 9.3 mm (median 20) (Fig. 3).

After 3, 6, and 12 months, 24, 15, and 14 subjects could be interviewed regarding pain intensity (Table 1).

A deterioration of the mouth opening was not described by the subjects in the context of the re-evaluation after 3, 6 and 12 months.

The subject, who after 6 weeks in the VAS still indicated an intensity of 6, felt the pain after 3 months with the same intensity. Only after 6 months the situation improved to VAS 4 and after 12 months to VAS 2 (Fig. 2).

Pain intensity and mouth opening correlate negatively (Spearman's correlation, BL = − 0.488, after 6 weeks − 0.477; significance level $p < 0.01$ (two-tailed)).

Drop-out

Looking at the subjects who could not be re-examined in the course of the study, it can be seen that after 3 months, those 7 subjects who had VAS = 1 after 6 weeks no longer appeared. One of these subjects reappeared at 6 and 12 months with the first follow-up (after 6 weeks) remaining unchanged. All subjects who did not appear after 3 months had a mouth opening of at

Fig. 1 The mouth opening in mm of the incisal edge distance before splint therapy (*n* = 31)
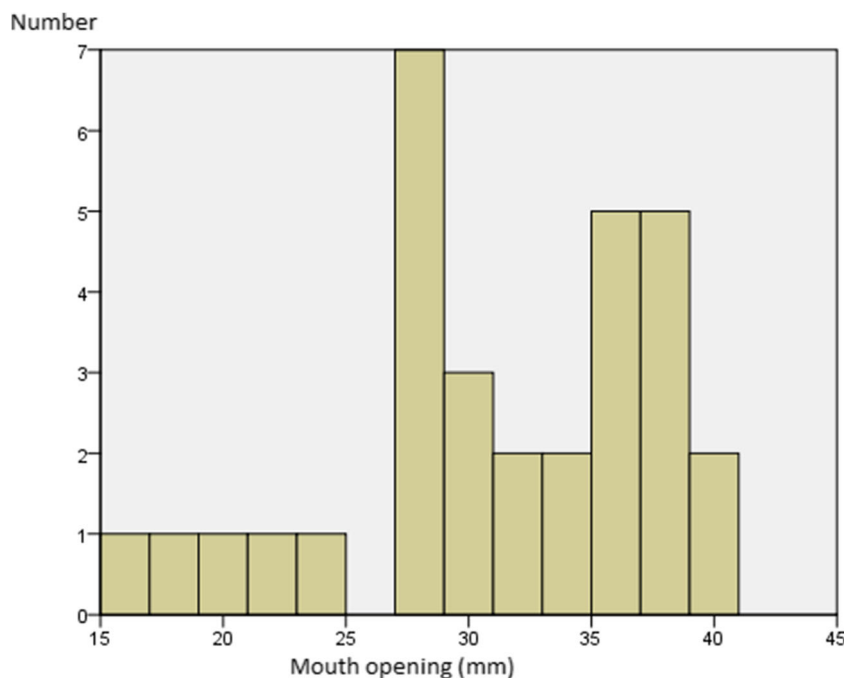
least 38 mm (average 42 mm) after 6 weeks. According to von Korff, 5 subjects initially had the chronic pain grade 4 [6]. After 6 months, another 10 subjects did not appear. These had a mouth opening of at least 50 mm after 6 weeks (average 53.1 mm), 7 subjects showed the value 0 on the VAS after 3 months. Three had the value 1. After 12 months, another subject did not appear with a mouth opening of 53 mm at 6 weeks and VAS from 1 at 3 and 6 months.

Mean values and medians resp. in this context are used to render the results more tangible and to give the reader an impression of the issue. In the case of *n* = 31, the variables mouth opening, visual analogue scale, chronical pain, and attrition index are not normally distributed (Shapiro-Wilk test: $p < 0.001, p = 0.046, p < 0.001, p =$

Fig. 2 The pain intensity before splint therapy as estimated by the subjects (*n* = 31) using a visual analogue scale from 0 (no pain) to 10 (worst pain imaginable), 6 weeks after the start of the splint therapy (*n* = 31), 3 months after the start of the splint therapy (*n* = 24), 6 months after the start of the splint therapy (*n* = 15), 12 months after the start of the splint therapy (*n* = 14)

0.009). In the case of *n* = 14 (Complete Case Analysis), the visual analogue scale is not normally distributed ($p = 0.035$), whereas the mouth opening ($p = 0.820$) and the attrition index ($p = 0.207$) are normally distributed, and thus mean values and medians provide a legitimate description of the case (mouth opening: 28.62 mm ± 6.8, median 29; attrition index: 4.4 ± 0.66, median 4.3). Chronical pain is constant at 4 in the CC analysis.

Discussion

The results of the presented study show that the symptoms of myogen restricted mouth opening and pain in chronified stage and diagnosed chronic PTSD which are subjectively experienced as being the strongest could be treated by splint therapy in the short term (results after 6 weeks) and the long term (results after 12 months). It is unlikely that the effects of a splint therapy come from the removal of occlusal disorders, as these, if present, were already eliminated by attrition, which was noted in all subjects, before the onset of splint therapy. It can be assumed that the change brought by the splint alone causes effects in the sense of a reorganization of functional processes [13], which results in a relief of damaged structures [14]. In this case, however, it would be expected that after the established restructuring of the new functional patterns, there would be a risk that complaints would reappear in this new position, especially in the context of severe psychological stress and thus prevent positive long-term effects. The lack of such recurrences was explained by the fact that the splints were worn for a maximum of 8 h during the night and therefore there was always a change in the functional patterns and, given the severity of the
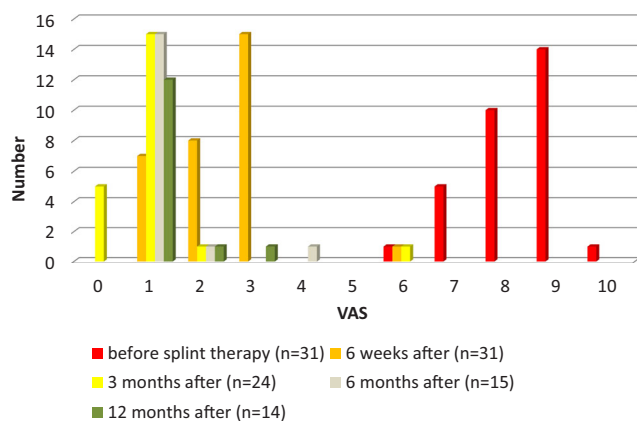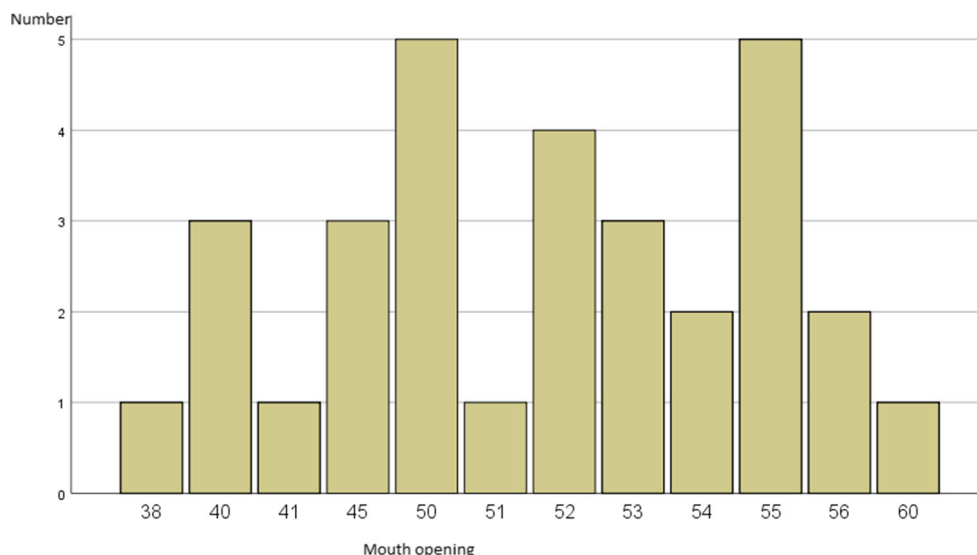
Fig. 3 The mouth opening in mm of the incisal edge distance 6 weeks after the start of the splint therapy ($n = 31$)

PTSD, it could not be ensured that the splints were always worn reliably so that one could assume that there was a rather intermittent mode of support, the benefits of which Manfredini et al.[10] and Matsumoto et al. [15] pointed out.

It cannot be ruled out that the splint therapy was found to have a placebo effect [16, 17], as all the examined subjects experienced the appreciation expressed in the study, the resulting significance of their own person, and the affection as thoroughly positive. In the case of sole placebo effect, however, it would be expected that these effects diminish, and complaints reappear with decreasing attention by the examiner.

Limitation of the study

Only 14 subjects could be followed over the entire period. This corresponds to a drop-out rate of 55%, which is considered to be high. However, looking at the individual cases, it becomes clear that these subjects are exclusively those who had no more distressing CMD symptoms the last time they were examined and who always had the option that they could come back in

Table 1 Average values on the visual analogue scale after 3, 6, and 12 months.

		VAS after 3 months	VAS after 6 months	VAS after 12 months
N	Valid	24	15	14
	Missing	7	16	17
Average		.96	1.27	1.21
Median		1.00	1.00	1.00
Hour variance		1197	.799	.579
Minimum		0	1	1
Maximum		6	4	3

case of another deterioration. The key messages and analyses do not differ. This applies to their mean values, complete case analysis (CC, $n = 31$) and last observation carried forward (LOCF, $n = 14$). It cannot be ruled out that ongoing PTSD therapy has led to the reduction of symptoms. On the other hand, an inclusion criterion was that the disorder had existed for at least 1 year, and the subjects were diagnosed on average 4.6 ± 3.1 years before the start of the study, which allows a chronic disorder to be assumed that usually needs an average treatment of more than 36 months because war veterans seem to be a group of patients that benefit only moderately or not at all from medication [18–21].

Sherman [22][2] uses the available literature on controlled studies to examine the empirical evidence for the effectiveness of psychotherapeutic treatment in PTSD. He was able to include 11 war trauma studies and 6 non-war-related trauma studies, totaling 690 patient treatments from 17 studies. Sherman found a significant efficacy of psychotherapeutic interventions in PTSD, which remained stable at follow-up examinations.

Although most studies on cognitive-behavioral procedures are available, it cannot be concluded that a method of treatment is superior. Rather, it can be assumed that all treatment approaches contain common and effective elements of treatment. The efficacy of psychotherapeutic treatment in posttraumatic disorders can be confirmed [23].

This suggests that within the first 6 weeks of study, this disorder was highly likely to persist and the improvement in orofacial symptoms cannot be attributed to effects of the PTSD therapy. The follow-up examination at 12 months included 15 (42% of 36) subjects who could not be permanently discharged from inpatient PTSD therapy due to the severity of the disorder and a not yet successful therapy. After several weeks of individual therapy interruptions, these patients were repeatedly hospitalized for several weeks after the first 3 months. For these subjects, it can be stated that PTSD therapy could not have a decisive influence on the long-term effects of the splint therapy.

Conclusion

The presented study shows that patients with severe mental illness and painful craniomandibular dysfunction, even if this mental illness persists, will benefit in the long term from an occlusal splint and remain symptom-free.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All human examinations described in this study were conducted with the consent of the responsible ethics committee of the Rhineland-Palatinate Medical Association (Landesärztekammer Rheinland-Pfalz), in accordance with national law and in accordance with the 1975 Helsinki Declaration (as revised). The study is registered with the processing number 837.068.14 (9307-F-) dated 26.03.2014.

Informed consent All patients included in the study have signed a consent form.

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