



Original Research Article

Coping, Trigger Points and Ability to Work in Patients after Whiplash Injury: A Prospective Longitudinal Pilot Study

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ABSTRACT

Background: Chronification mechanisms after Whiplash injuries, leading to Whiplash associated disorder (WAD) are not yet fully understood. Psychological and physical factors such as coping strategies and persistence of myofascial trigger points (TPs) might be of importance. The aim of the study was to investigate the influence of illness behaviour on the improvement of health and functioning in patients with a WAD.

Methods: In a prospective longitudinal study in- and outpatients were tested within 6 months after acute whiplash trauma and at follow up (FU) one year after their injury. Coping styles were assessed with the Freiburg Questionnaire of Coping with Illness (FQCI). Use of medical support and the improvement of health were evaluated with the Freiburg Complaints List (FCL) and by assessing the ability to work. Pain intensity was measured with a Numerical Rating Scale (NRS). Presence and amount of TPs were examined by a standardized procedure. The Symptom Checklist (SCL-90-R) was used to screen for psychopathology.

Results: 40 patients were included into the study (26 females, mean age 38.0±11.7 years, mean time since injury 108±11.6 days). Passive coping was negatively ($r = -.34, p < 0.05$) and coping with distraction was positively associated ($r = -.35, p < 0.05$) with improvement of the ability to work. Active coping ($r = .42, p < 0.01$) and coping with distraction ($r = .34, p < 0.05$) were associated with an improvement of pain. Patients with a higher number of TPs indicated higher pain intensity, fear, and depression levels (all $p < 0.01$). These patients also claimed for more therapies at FU ($r = .38, p < 0.05$).

Conclusions: Passive Coping and coping with distraction might be linked with the ability to work and with subjective experience of pain. Myofascial TPs might be associated with more claiming for therapies and use of medical support, and higher levels of depression and fear. The presence of myofascial TPs seems to be associated with an increased risk for chronification. Treatment should focus on physical and psychological aspects, in particular on coping mechanisms to help preventing chronification processes after a WAD.

Keywords: Chronification, coping, trigger points, whiplash associated disorder, pain.

INTRODUCTION

Whiplash injury is caused by a violent extension of the neck. This condition is the most common injury following a motor vehicle accident. The annual incidence of whiplash-associated disorders (WAD) ranges between 70 per 100,000 persons in Canada [1] and 328 per 100,000 persons in the United States. [2] The incidence of hospital visits for traffic-related WAD has increased over the past 20 years in most industrialized countries, accompanied by increasing socio-economical costs including direct medical costs (paid by health insurances) and indirect costs (productivity and earning loss). [3,4]

Patients with WAD present a number of physical and cognitive problems, such as pain in the neck and upper limbs, headache, dizziness and tinnitus, and moreover, they complain about problems with concentration and memory function. [5] Furthermore, WAD increases the incidence of future health problems: People who have experienced a WAD following a car accident are more likely to suffer from future sleep disturbances and headache compared to those people without a history of WAD. [6] Additionally, they also show a delayed return to work. [7,8]

Relating to recovery there are different time frames being discussed in literature. The majority of patients recover within a few days or weeks, while for example in Switzerland about 10% of them still suffer months or even years after a WAD. [9] A recent study examining 470 patients with acute WAD found a chronification rate of 3.1%. [10]

Risk factors for chronification

Patients with a WAD are at risk of perceiving health related symptoms over a prolonged time. An in depth knowledge of chronification mechanisms might provide a chance to reduce or even avoid this risk. The available literature suggests an association

of different factors with the chronification process: 1) Psychosocial factors, such as a lack of higher education [11] and gender: women seem to be more often affected by pain syndromes than men. [12,13] Additionally, recovery expectations, depressed mood, and fear of movement seem to be associated with slower or less complete recovery. The role of (higher) age as a risk factor for chronification is not perfectly clear. [13] 2) Medical factors affecting chronification are higher initial pain, a higher number of comorbidities and reported symptoms (e. g. neck pain or dizziness). [14] 3) Only a few factors related to the mechanism of the WAD itself might be a prognostic factor for chronification, for example the direction of the collision or the headrest type. [15]

Coping strategies and chronification

Coping strategies seem to be important for the patients recovery. [14] Coping as conceptualized by Lazarus et al. evaluates a person's cognitive and behavioural efforts to manage internal or external challenges, called stressors. [16] It is assumed that a particular stressor influences the individual's appraisal of the situation, and as a consequence, the strategy of coping that will be used. Physical factors like pain or dizziness, which experienced by WAD patients, might be powerful stressors that can activate a wide spectrum of cognitive and behavioural efforts to cope with. Coping styles may be interpreted as an element of a maladaptive schema. [17,18] Some patients may react with increased emotional symptoms of depression and anxiety, while others might be more optimistic and trust their own strengths. Some might even withdraw themselves from their daily life activities [19] whereas others do not. Withdrawing may lead to physical deconditioning, a lack of positive reinforcement, and could increase depression or anxiety (kinesiophobia). [20] It

was supposed that different coping strategies might play a positive or negative role in chronification processes and could be predictors of disability and pain outcomes. [21] But there remains still some uncertainty about which coping strategies. For example, coping with avoidance might result in an increase of pain, but also with an improvement in physical and psychological functioning. [22]

Passive coping style seems to be a risk factor for chronification. A recent study with 2986 patients found that a passive coping style predicted neck pain and self-assessed disability recovery. [23] In patients suffering from low back pain, a passive coping style was associated with a threefold increased risk for developing a persistent disabling pain condition. The authors concluded, that “it may be beneficial to assess and improve coping style early in WAD”.

Low back pain patients, who used a more avoidance coping style showed a higher functional disability. [24] Similar results were found for coping with distraction and for coping with distraction and praying (with irrational beliefs). [25] All these coping styles predicted poorer outcomes. Furthermore, Walton et al. have identified a catastrophizing coping style as not very helpful. Catastrophizing was associated with worse outcome. [13] However, some other coping strategies can be helpful: an active coping style is supposed to be associated with more physical activity and less anxiety in daily life and therefore, with a better outcome of the patients. [26]

In this study, patients’ coping styles were assessed and evaluated for their influence on pain and functional outcome after one year.

Myofascial trigger points and chronification

Another important factor for chronification could be the presence of

myofascial trigger points (TP). TPs are defined as hyperirritable areas of tissue that are tender when compressed and can cause referred pain. [27] In most cases TPs are associated with myofascial pain syndromes. TP can be found in all muscles that have been exposed to severe mechanical stress, as for example by a WAD. [28] TP examination has been used as a more or less objective method to detect a cervical syndrome after a WAD. Fernández et al. found four times more TPs in the trapezius muscle in patients with WAD in comparison to healthy controls. [29]

MATERIALS AND METHODS

A prospective longitudinal study with two measurement points was conducted in a rehabilitation center in North-western part of Switzerland. Patients were recruited from the inpatient and outpatient department and were assessed twice: once within six months (T0) after their WAD and once 12 months (T1) after their WAD. At T0 patients were assessed regarding their coping style and their TP status. At T0 and T1 patients were asked for their actual ability to work and their use of the health care system (medication, therapies, consultations etc.). Furthermore, all patients also were asked if they were involved in lawsuits concerning their WAD. The study was approved by the regional ethics committee (Ethikkommission Aarau, registration number 2007 / 023) and conducted based on established national and international research guidelines (Good Clinical Practice, Declaration of Helsinki).

Study population

Patients were included if they had experienced a WAD (mostly car accidents with rear end crashes), and were classified to the Quebec Task Force (QTF) classification grade I or II. Those patients suffered from pain, stiffness or tenderness, and may show additional musculoskeletal signs, such as decreased range of motion and point

tenderness,^[30] but had no further problems or injuries.

Patients were excluded if they had a chronic health problem with an impact on social functioning and life quality: additional causes of neck complaints, clinically relevant psychological complaints, depression or anxiety, pre-existing psychiatric diagnoses or neuropsychological complaints, suffered from dementia or were not able to communicate in German language.

Patient recruitment and inclusion procedure

Patients were recruited as soon as possible after they suffered their injuries. Some patients were seen quite soon after their accident, while many others were examined with a remarkable delay. This delay had to do with legal decisions that took place in jurisdiction. In our clinic, the number of patients with the diagnosis WAD decreased from 90 patients in 2007 (43 of them with duration of disease less than one year) to 27 in 2011 (17 of them with duration of disease less than one year).

After receiving oral and written study information, interested patients were invited to a consultation to provide written informed consent. After obtaining personal data, patients were handed out all questionnaires to fill in. Personal data included potential confounders identified from the literature: gender, education and age, marital status, pre-collision health status, quality of life, and prior injury or hospitalization periods. Additionally, they received an appointment for the TP examination.

Patients were transferred from different therapists (psychologists, medical doctors, physiotherapists). We only saw those patients who agreed to participate in the study.

At T0 patients were assessed in two different categories: 1) predicting variables including current coping strategies and

trigger point status and 2) outcome variables including the usage of medical support, the ability to work (%), and pain intensity. To identify possible confounders demographical data, such as age and gender were evaluated. All patients were also screened for pre-existing psychiatric problems.

At T1 follow-up data regarding information on current coping strategies (predicting variable), usage of medical support, ability to work in %, pain intensity (outcome variables), and involvement in lawsuits (confounder) were evaluated.

Questionnaires

Predicting variables

Coping strategies were assessed with the short form of the Freiburg Questionnaire of Coping with Illness (FQCI) including 35 items loading on five subscales (passive coping, active problem-oriented coping, coping with distraction and self-enforcement, coping with religiosity and searching for sense, and minimizing and wishful thinking).^[31] The FQCI is a self-administered questionnaire in German language and is widely used in adults with chronic bodily complaints or individuals with complaints following acute medical conditions.^[32] The FQCI was assessed at both measurement events (T0, T1).

The Trigger point status was examined at T0 on both sides of the body (left and right) and included m. semispinalis capitis, m. trapezius pars descendens, m. levator scapulae, m. scalenus medius, m. sternocleidomastoideus and m. masseter. The selection of muscles was based on previous experience and recommendations from the literature.^[28,33] The TP examination was performed by an experienced physiotherapist with a special qualification in this field. Patients were in a sitting position, arms laying relaxed on the upper legs and with both feet on the floor.

Each muscle was tested in a stretched and a rested position for the following criteria:

- a) Palpable hardening in the muscle belly,
- b) Pressure pain in the trigger point or taut band,
- c) Referred pain while manipulating the trigger point in the taut band, and
- d) Recognition of the elicited pain as the patient's known and familiar pain.

A positive TP was diagnosed if three out the four criteria were fulfilled. Additionally, the passive lengthening of each muscle, the intensity of the pain during palpation of the trigger point or taut band, and the existence of oedema in the taut band were examined. [28]

Outcome Variables

Usage of medical support was assessed with the Freiburg Complaint List (FCL) at T0 and T1. [34] The FCL evaluates the current health care utilization (patients' use of physician and therapist consultations, medication intake for pain and sleeping disturbances). The FCL consists of 80 items loading on 10 subscales.

Patients' ability to work (%) was assessed by two items. -First, patients gave information, if they were at work at all or unemployed. _Second, they informed about their present ability to work, as actually assessed by their treating doctors, varying between 0 and 100%. This measure was used as an additional objective measure for recovery after a WAD. [35] Patients' ability to work was calculated using the difference between the results at T0 and T1.

Global pain intensity was assessed on a Numerical Rating Scale (NRS) reaching from zero to ten. [36]

Confounders

Demographical and medical data such as age, gender, marital status, and involvement in lawsuits that might provide external rewards (for example. financial support) were evaluated by direct questions. Education was assessed by using the

International Standard Classification of Education. [37]

As described in the study exclusion criteria patients were screened for psychiatric complaints with the Symptom Checklist (SCL-90-R) at T0. The SCL-90-R uses 90 items on nine subscales, including somatization, depression, anxiety, and psychoticism. [38]

To assess the subjectively perceived general health status patients had to fill in the Health Survey Questionnaire (SF-12). [39] It takes approximately two minutes to fill in the questionnaire including 12 items with two subscales: physical health (Physical Component Summary, PCS) or mental health (Mental Component Summary, MCS).

Statistical analysis

Statistical analyses were guided by the main study hypothesis that a passive coping style might lead to poorer recovery. Therefore, a bivariate correlation model was used to identify predictors of the outcome variables. The number of trigger points, and passive and active coping style scores from T0 were calculated as predictors for the outcome variables "(change in) ability to work / use of the health system" and "(change in) pain intensity" at T1. Data on descriptive variables are presented as mean, standard deviation, or percentages depending on the data level. For all statistical analyses SPSS (statistical package for social science, SPSS Inc. Chicago, version 20.0) was used with $p \leq 0.05$.

The optimal way to interpret our data would be to calculate multiple regression analyses on our main variables "pain intensity", "passive coping style" and "number of trigger points". But due to our small sample size (between $n = 40$ and $n = 28$) and the high number of predictors this procedure could not be expected to bring reliable and valid results. To increase the number of participants in a reasonable

period of time unfortunately seemed to be unattainable. Missing values were few, due to the small sample size. They were handled as usual by ... markus wie sagt man das am besten?

RESULTS

The patients' recruitment lasted from June 2007 to February 2011. The last one-year follow-up measurement was finished in February 2012. In total, 40 patients could be included into the study. Table 1 provides an overview on the patient characterisation. The higher rate of female patients in our study corresponds to the available literature. [40] All patients had suffered from different kinds of injuries causes, mostly car accidents (85%) and were classified as QTF 2. Subjective quality of life (SF-12) was reduced with a mean of 33.4 ± 7.5 for physical health status and 40.7 ± 12.7 for mental health status. Both values are distinct below the estimation of healthy people, which would have a mean of 39.3 and 50.8. [41] The reduced subjective quality of life status is comparable to other patient groups, such as patients suffering from hypertonia or angina pectoris. [39]

Table 1: Characterization of participants.

Age (years)	38.0 (11.7)
Gender (% female)	60
Time since injury (days)	108 (11.6)
SF-12 (m/sd)	33.4 (7.5) (physical health) 40.7 (12.7) (mental health)
Recruitment	
Outpatients (n)	23 (57.5%)
Inpatients (n)	17 (42.5%)
Cause of injury	
Car accident (n)	34
Bike / motor bike accident (n)	3
Sports, others (n)	3

Legend: m= mean, sd= standard deviation, n= number, SF-12: Health Survey Questionnaire (Subjectively perceived general health status)

Only 26 out of the 40 included study patients could participate in the TP examination. Three patients could not be contacted for the follow-up assessment (T1). They had moved or did not respond to postal

mailing or telephone calls. In most cases the reason was long travel distances between their homes and the clinic.

Coping strategies and outcome variables

Data analyses showed that all patients used all possible coping strategies that were assessed (Table 2). The amount of coping efforts corresponds to the coping efforts of other patient groups. [32] Active coping style (m=3.4, sd=0.8) was more common than passive coping style (m=2.4, sd=0.9). The least common coping strategy was "wishful thinking" (m=2.1, sd=0.9). From T0 to T1, FQCI scores (coping activities) decreased from 13.6 to 12.0 points, mostly due to a reduction of passive coping and wishful thinking. Changes in the use of coping styles were assessed by calculating multiple correlations between the assessments baseline and follow up.

Table 2: Coping styles assessed.

Coping style FQCI-LIS	Baseline (T0) mean (sd)	Follow-up (T1) mean (sd)
Passive coping	2.4 (0.9)	1.9 (0.8)
Active problem-oriented coping	3.4 (0.8)	3.1 (1.1)
Coping with distraction and self-enforcement	3.1 (0.7)	3.1 (1.0)
Coping with religiosity and searching for sense	2.6 (0.8)	2.3 (0.8)
Minimizing and wishful thinking	2.1 (0.9)	1.6 (1.0)
Sum of coping efforts	13.6	12.0

Legend: sd = standard deviation, n = number, FQCI-LIS = Freiburg Questionnaire of Coping with Illness.

Patients, who showed more passive coping tended to be less successful in reintegrating into the working process: Passive coping style was negatively associated with improvement of the ability to work (at T0 and T1), ($r=-0.34$, $p<0.05$). Furthermore, passive coping was associated with an increased pain level at T0 ($r=0.33$, $p<0.05$), but not at T1. Passive coping was not associated with increased use of medication and medical treatments. A strong relationship was also found between passive coping style and the SCL-90-R items

depression, anxiety and somatisation with r ranging between 0.54 to 0.73 ($p < 0.001$).

Contrary to our hypothesis, an active coping style did not show any correlations with the outcome variable ability to work and use of medical support. However, an effect on pain intensity was found. Patients, who showed more active coping style experienced an improvement of pain at T1 ($r = 0.42$, $p < 0.01$). Coping with distraction was positively associated with an improvement of the ability to work. Patients who showed more coping with distraction tended to reintegrate more successfully into the working process ($r = -0.35$, $p < 0.05$).

Psychopathology

Our patient's SCL-90-R scales showed almost normal levels. Patients

somatization levels measured with the SCL-90-R scales were slightly increased, as it may be expected in patients suffering from pain syndromes. [42,43]

Table 3: Number of trigger points at T0 (sum of left and right side).

Muscle	Average of Trigger points (m, sd)
M. semispinalis capitis	1.5 (0.65)
M. trapezius descendens	1.7 (0.62)
M. levator scapulae	1.5 (0.71)
M. scalenus medius	0.9 (0.80)
M. sternocleidomastoideus	1.3 (0.80)
M. masseter	0.3 (0.55)
M. splenius capitis	1.1 (0.91)
Total sum	8.3 (3.3)

$n = 26$ patients with trigger points. Each patient could find zero to two TPs per muscle pair (right, left). In total, on patient could have zero to 14 TPs including all seven muscles on both sides of the body.

Legend: m = mean of all patients' trigger points, sd = standard deviation.

Table 4: Correlations of predictors at T0 and outcome variables at T1.

	Pearson Correlations (2-tailed)	Treatments (n)	Treatments (n) (Improvement)	Ability to work (%)	Ability to work (%) (Improvement)	Pain (NRS)	Pain (NRS) (Improvement)
Main Hypotheses	Passive coping (FQCI)	0.10	0.04	-0.19	-0.34*	0.15	-0.09
	Active coping (FQCI)	0.17	0.1	-0.06	0.17	0.29	0.42**
	Coping with distraction (FQCI)	0.22	0.15	0.08	0.35*	0.30	0.34*
	Trigger-points (n)	0.38°	-0.04	-0.13	0.18	0.54**	0.13
Other Correlations	Coping with religiosity (FQCI)	-0.01	-0.11	-0.03	0.04	0.08	-0.09
	Coping with minimizing (FQCI)	-0.18	-0.32	0.0	-0.05	0.01	-0.12
	Pain at baseline (NRSI)	0.30	-0.19	-0.18	.12	0.57**	-0.17

Legend: n = number, NRS = Numerical rating scale for pain intensity, FQCI-LIS = Freiburg questionnaire of coping with illness, ** = Correlation is significant at the 0.01 level (2-tailed), * = Correlation is significant at the 0.05 level (2-tailed), ° = Correlation is significant at the 0.05 level (1-tailed).

Improvement = (T1-T0)

Trigger points and outcome variables

Patients presented TPs mostly in the trapezius descendens muscle, but also in the semispinalis capitis muscle and the levator scapulae muscle (Table 3). The pain intensity and the number of TPs showed a moderate correlation both at T0 ($r = 0.57$, $p < 0.01$) and at T1 ($r = 0.54$, $p < 0.01$) (Table 4). Patients with a higher number of TPs had an increased use of medical support (treatments and therapies) at T1 ($r = 0.38$,

$p < 0.05$). But there were no significant correlations between the number of TP and the ability to work. Middle and strong correlations were found between the number of TPs and the SCL-90-R subscales somatization ($r = 0.61$, $p < 0.01$), depression ($r = 0.40$, $p < 0.05$) and anxiety ($r = 0.50$, $p < 0.05$).

Pain intensity

At T0 the average pain intensity was moderate with 5.1 NRS (± 1.7). At T1 pain

levels decreased significantly to 3.8 NRS (± 2.7 , $r=0.71$, $p<0.01$). Patients, who experienced a higher pain level at baseline were more likely to seek medical treatment at T1 ($r=0.30$, $p<0.05$, using one-tailed statistical testing).

Confounders:

No significant correlations could be found between the predictors (coping style, number of TP) and psychosocial data such as age, gender, or education. Overall, 26 patients reported upper secondary education and nine patients (23%) had an even higher qualification.

Table 5: Correlation of coping styles (FQCI-LIS) and SCL-90-R scales at T0.

Pearson Correlations (2-tailed)	Passive coping	Active problem-oriented coping	Coping with distraction and self-inforcement	Coping with religiosity and searching for sense	Minimizing and wishful thinking
Somatization	0.57**	-0.08	0.02	0.27	0.41*
Obsessive-compulsive	0.62**	-0.01	0.16	0.25	0.52**
Interpersonal sensitivity	0.73**	-0.25	-0.05	0.09	0.43**
Depression	0.68**	-0.07	0.05	0.26	0.52**
Anxiety	0.69**	0.08	0.13	0.35*	0.51**
Hostility	0.71**	-0.10	0.04	0.02	0.39*
Phobic anxiety	0.68**	-0.03	0.12	0.19	0.45**
Paranoid ideation	0.67**	-0.21	0.00	0.04	0.40*
Psychoticism	0.54**	-0.04	0.01	0.15	0.37*
GSI	0.54**	-0.26	-0.09	0.14	0.43**

Legend: SCL-90-R = Symptom Check List, FQCI-LIS = Freiburg Questionnaire of Coping with Illness, GSI = mean of all 90 Items of SCL-90-R;

** = correlation is significant at the 0.01 level (2-tailed), * = correlation is significant at the 0.05 level (2-tailed).

DISCUSSION

Our results contribute to the present knowledge about chronification, emphasizing the negative effect of passive coping style on chronification processes. [14] The impact of our findings is that coping with WAD is correlated not only with subjective well-being, but with hard facts, in this case with the ability to work and with possibly huge indirect costs (see Carroll et al 2008, Petersen USW.). In this study, both, coping with distraction and passive coping were associated with the development of the ability to work between baseline and follow up.

Active coping style may be associated with a reduction in pain intensity. Therefore, it seems reasonable to continue daily activities, (“act as usual”), and to accept the WAD – associated symptoms as a physiological element in the recovery process. [10] In addition, also medical training therapy has been shown to be effective in reducing pain intensity. [44]

The mechanisms between coping style and chronification are not perfectly

understood. However, evidence from the literature demonstrates a reasonable way in which a patient’s coping style might influence chronification processes. Coping might work as a mediating factor between pain experience in the early stages and chronification in the longer term. [45]

Trigger Points might become important in predicting chronification processes. Patients with WAD show an increased number of TPs in the semispinals, the trapezius descendens, and the levator muscle. [28] But there are still methodical problems left: A TP is diagnosed not only by objective measures, such as hardening in the tissue, but also by the patients subjective estimation of experienced pain during palpation of the examiner. It is well known that people, who fear pain are often sensitized and tend to rate higher pain levels. [46] Therefore the number of trigger points was associated with increased anxiety, somatization and depression (SCL-90-R). Future research might find valid and reliable methods for diagnosing TPs, independent from the patient’s subjective judgement for

example by using ultrasonic devices to assess TPs. [47]

Patients who were involved in lawsuits at T1, presented higher pain level ($r=0.59$, $p<0.001$) and a higher number of TPs ($r=0.43$, $p<0.005$) at T0 (Table 5). It could be concluded that patients with more severe health problems chose the legal route. This finding supports the “reverse causality” hypothesis. [48]

CONCLUSION

WAD might be interpreted as a result of maladaptive coping strategies rather than being associated with psychopathology. In this study, there was no evidence for other psychological variables, such as depression to be important for the prognosis, confirming previous results. [49] Therefore, treatment efforts should focus on the improvement of coping mechanisms in order to prevent chronification processes. It has been shown that Myofascial TPs were associated with more claiming for therapies and an enhanced use of medical support. Myofascial TPs might therefore indicate an increased risk for chronification.

Both coping strategies as well as trigger points are relatively easy to assess and should be implemented into future recommendations, such as the guidelines of the South Australian Centre for Trauma and Injury Recovery (TRACsa) [50] or the risk assessment tool for WAD. [51]

List of Abbreviations

FCL	Freiburg Complaints List
FQCI	Freiburg Questionnaire of Coping with Illness
FU	Follow- up
QTF	Quebec Task Force
SF-12	Short form of SF-36 (subjective quality of life)
SCL-90-R	Symptom checklist
SPSS	Statistical Package for Social Sciences
TP	Trigger point
WAD	Whiplash Associated Disorder

Competing Interests

The authors declare that they have no competing interests.

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