SYMPTOMS AND SIGNS INDICATING TEMPOROMANDIBULAR DISORDERS AFTER CERVICAL ACCELERATION-DECELERATION TRAUMA IN CAR IMPACTS

Olle Bunketorp, The Traffic Injury Register, Department of Orthopaedics, Institute of Surgical Sciences
Yvonne Gustafsson, Bengt Wenneberg, Department of Stomatognathic Physiology
Sahlgrenska Academy, Göteborg University
Lotta Jakobsson, Hans Norin, Volvo Car Corporation
Göteborg, Sweden

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ABSTRACT

A prospective in-depth follow-up study was made on 146 subjects with whiplash-associated disorders after car impacts. Symptoms indicating temporomandibular disorders (TMD) of minor to moderate grade were noted in three men and three women the first month after the accident, and developed in eight women during the following year. Signs indicating TMD, often asymptomatic, were noted initially in one third of the subjects, more often after rear-end impacts, and associated with increased tension in the masticatory muscles before the accident. TMD were also associated with rostral neck symptoms, headache, and post-traumatic stress, but not with the crash severity, expressed as Δv, below 30 km/h.

TEMPOROMANDIBULAR DISORDERS (TMD) is a collective term embracing several clinical problems involving the masticatory muscles, the temporomandibular joint (TMJ) and associated structures. TMD may result from whiplash trauma, and some authors have suggested that injuries of the TMJ are caused by the inertia forces acting on the mandible during the acceleration of the head in rear-end impacts (Weinberg & Lapointe 1987). However, there are no conclusive studies indicating a substantial risk of acute injuries in the masticatory system caused by the physical whiplash trauma itself. For a review, see McKay & Christensen 1998. Severe TMD have been reported in 89% of patients with chronic whiplash associated disorders (WAD) by Klobas et al. 2004. TMD during the first six months after whiplash trauma have been investigated prospectively by Kasch et al. 2002. They reported quite a low risk of TMD, but the study was small, and they recommended further studies to identify factors that could contribute to the disorder. Headache is a common complaint in WAD patients during the acute phase as well as later (Packard 2002). Headache is also a common complaint in patients with TMD who have not been exposed to whiplash trauma (Schokker et al. 1990). For a review, see Okeson 1996.

The overall purpose of this study was to describe the prevalence of initial symptoms, including psychological reactions, and clinical findings indicating TMD, and the relation between TMD and headache during the first year after a cervical acceleration-deceleration trauma. A specific purpose was to investigate relationships between crash characteristics in frontal and rear-end impacts, on one hand, and the occurrence of TMD and headache on the other.

METHODS

A total of 80 women and 66 men with neck problems of WAD grade I-III after car collisions were recruited, prospectively, from two emergency departments in Gothenburg during 1997-2001. Of these, 108 were injured in rear-end and 23 in frontal impacts. A specialised physiotherapist examined all the subjects within 35 days after the crash and also after one year. Car crash analysts, neurosurgical, orthopaedic and radiological experts, and biomechanical specialists analyzed all the cases together. The methods, including psychometric protocols for muscular tension, depression, and post-traumatic stress, are described in detail in Bunketorp et al 2004. Symptoms and signs related to TMD and the occurrence of headache were analysed with respect to the type of impact (frontal or rear-end), Δv, and engagement of the longitudinal side members of the car. The character of the impact pulse is called "stiff" if the longitudinal side members were engaged during impact and "soft" in other cases. In this study, subjective symptoms (pain from the TMJ/ear regions, difficulties in mouth opening and/or chewing) and clinical signs (pain, reduction and/or deviation during mouth opening/closing

movements) of TMD were recorded. The Regional Ethical Review Board approved the study, and all participants joined the study by informed consent.

RESULTS

Of all 146 subjects, 14% reported previous neck problems of more than a minor degree; women more than three times as often as men. Three men and three women reported having weekly or more frequent headache during three months before the accident. Three other men reported coincident headache and neck pain before the accident. Eight men and eleven women had suffered from TMD symptoms related to increased tension in the masticatory muscles, but no one reported having TMD symptoms during three months before the accident. Earlier TMD were not associated with earlier neck problems or headache. Thirteen subjects reported an impact against the head or face in the accident, one of them against the mandible.

TMD, HEADACHE, AND PSYCHOMETRIC VARIABLES: No one reported symptoms after the accident, indicating injury to the TMJ. Three men and three women reported TMD symptoms at the primary examination. Clinical signs of TMD were noted in 53 of 145 cases (37%) at the first examination, equal for men and women, and the occurrence of TMD-signs was significantly related to increased tension in the masticatory muscles before the accident (odds ratio = 8.7; P<0.001). No relation was found between TMD symptoms or signs at the primary examination and a head or face impact in the accident. The occurrence of each of the three TMD signs varied between 12% and 19%. There was a very weak relation (P=0.2) between TMD symptoms and signs at the first examination and also quite a low sensitivity (67%) and specificity (64%) for symptoms versus signs.

In total, 116 (80%) reported headache at the first examination; men and women almost equally frequent. Post-traumatic headache was not associated with previous headache or previous neck problems. There was a weak relation between TMD signs and headache at the first examination, indicating an odds ratio of 2.1 (P=0.1). Fifty-eight (35%) of the subjects reported coincident headache and neck pain increase, more often after rear-end (45%) than frontal (20%) impacts (P=0.04).

One year after the accident, no one reported severe TMD symptoms; nine subjects reported minor to moderate TMD symptoms, all of them women, and eight of these had developed the symptoms after the primary examination. TMD signs were found in 28 (24%) of 117 examined subjects after one year; equal for men and women. There was a strong relation between each of the three TMD signs at the primary examination and after one year. There was also a strong relation between the TMD symptoms and signs after one year. One year after the accident, 54% of the subjects reported headache; women more often then men. Initial TMD signs were significantly related to headache after one year, giving an odds ratio of 2.7 for headache, having at least one of the three TMD signs at the primary examination (P=0.01). Reduced mouth opening capacity and pain during mouth opening were both significantly related to residual headache after one year (table I).

A significant relationship was found between TMD signs at the primary examination and post-traumatic stress according to the Impact of Event Scale (IES, logistic regression, P=0.007). High initial IES-scores were also related to residual TMD signs one year later, but not significantly (P=0.07). Similar relationships, however not significant, were found between high scores of muscular tension and depression on one hand and TMD on the other.

Table I. TMD signs at the primary examination and headache after one year (m.o. = mouth opening).

TMD sign	TMD signs at prim exam		Headache after one year		P	Odds ratio
	n	%	n	%		
Deviation on m.o.	20	16	13	19	0.28	1.7
Reduced m.o.	15	12	12	18	0.03	3.9
Pain on m.o.	19	15	15	22	0.02	3.8

LOCATION OF PRIMARY NECK SYMPTOMS, TMD SIGNS AND HEADACHE: The axial location of the dominant neck symptoms was related to the occurrence of TMD signs and headache at the first examination and after one year (table II). Seven of 20 subjects (35%) with isolated rostral neck symptoms had TMD signs at the primary examination but not one of the 15 subjects with isolated caudal neck symptoms [P(Fisher) = 0.01]. The TMD signs persisted after one year in two of these subjects but not one of the other 15 developed TMD signs during the first year. Six of 18 subjects with isolated rostral neck symptoms had TMD signs after one year but not one of the five subjects with isolated caudal symptoms [P(Fisher)=0.27]. A rostral symptom dominance was noted in 43% after frontal impacts and 58% after rear-end impacts, but the difference was not statistically significant

(P=0.7). Ninety percent of those with rostral cervical symptoms and 67% of those with caudal symptoms reported headache at the first examination. Almost half of the subjects with rostral symptoms at the primary examination reported headache after one year related to the accident, but no one with caudal symptoms did so (P=0.003).

Table II. Dominant primary neck symptom level, TMD signs, and headache.

Dominant primary neck symptom level	TMD signs				Headache			
	At prim. exam.		At one year		At prim. exam.		At one year	
	n	% yes	n	% yes	n	% yes	n	% yes
Rostral	20	35	17	12	20	90	17	47
Central	11	18	9	22	11	82	10	40
Caudal	15	0	14	0	15	67	14	0
Both	92	48	72	32	92	82	77	69
Total	138	38	112	24	138	81	118	55

TMD, CHARACTER OF IMPACT, AND ΔV: Five of the six occupants who reported TMD symptoms at the primary examination were injured in rear-end collisions and one in a frontal crash with a head impact. TMD signs were noted at the primary examination in 41 subjects (38%) after rear-end impacts (some with unknown Δv) and in five subjects (22%) after frontal impacts, indicating an odds ratio for TMD after rear-end vs frontal impacts equal to 2.2 (P=0.13). This difference was less obvious after one year. The character of the impact pulse, as defined in this study, had an insignificant influence on the occurrence of TMD signs at the primary examination after rear-end impacts, but not after frontal impacts. TMD signs were noted in 45% after "soft" rear-end impacts and in 28% after "stiff" rear-end impacts (P=0.15).

Δv could be estimated in all the frontal impacts and in 76 of the rear-end impacts. Maximum Δv was 30 km/h. As is shown in table III, the occurrence of TMD signs was greater for greater Δv after frontal impacts, but not significantly, however [P(Fisher)=0.3]. A reversed relationship was noted for rear-end impacts. Almost half of the subjects had TMD-signs after impacts with Δv less or equal to 15 km/h, and no one after impacts with greater Δv (P=0.01). The relationship was also reversed for the Δv-limit = 10 km/h. At or below this limit, 24 of 54 (44%) subjects had TMD signs at the primary examination. Above this limit, 6 of 22 (27%) had TMD signs. However, the difference was not statistically significant (P=0.16).

Table III. Delta v and TMD signs at the primary examination in frontal and rear-end impacts

Δv (km/h)	Frontal impacts				Rear-end impacts			
	TMD signs		Total	%	TMD signs		Total	%
	No	Yes			No	Yes		
≤ 15	12	2	14	14	37	30	67	45
16-30	6	3	9	33	9	0	9	0
Total	18	5	23	22	46	30	76	39

DISCUSSION

In this study, the symptoms and signs and the diagnostic methods used, were defined to investigate WAD in general aspects and not TMD specifically. Nevertheless, the study confirms that TMD are not usually caused by injuries to the temporomandibular joint in whiplash trauma. TMD-symptoms were reported almost equally by men (5%) and women (4%) during the first month after the accident. TMD-symptoms developed only in women (10%) during the following eleven months, indicating a gender-specific long-term risk. Severe TMD were not noted and seem to be very uncommon after whiplash trauma, which is in good agreement with Kasch et al. 2002. The greater prevalence of TMD after whiplash trauma in other studies may be due to different diagnostic selection criteria for TMD and study designs.

TMD seem to be more common after rear-end than frontal impacts. This could indicate different mechanisms of injury with a greater risk of neck symptoms in rear-end impacts, triggering the development of TMD, but the number of frontal impact cases was too small to make more specific conclusions in this respect. The occurrence of TMD was not related to the severity of the impact, expressed as Δv, below 30 km/h. However, Δv and general structure engagement are very approximate descriptors of the crash severity and poor determinants of the kinematics of the occupant during the

crash. Factors such as occupant sitting posture (e.g. head to head restraint distance and rotated head) probably have greater influence on the injury risk in a short-term perspective.

Individual pre- and post-traumatic factors may have a greater influence in a long-term perspective. The emotional response to whiplash trauma is an important prognostic factor, according to Drottning et al. (1995). Clinical signs, which could indicate minor disturbances of the masticatory system, were noted in about one third of the subjects during the first month after the accident and significantly related to previous tension in the masticatory muscles, but only about ten per cent of them reported TMD-symptoms. TMD were related to rostral neck symptoms and so was headache. Low sensitivity and specificity for TMD-symptoms versus signs, slow development of TMD-symptoms, and dominant symptoms from adjacent regions after the accident might explain why disturbances of the masticatory system seldom are noted by the injured or health professionals. The neuro-physiological mechanisms involved in the regulation of the muscles in the cranio-cervical region, including the jaw-neck system, are quite complex, as described by Eriksson et al. 2004, and the mechanisms probably also involve stress-related factors and sensitization of the neuromuscular system. Even if TMD are less obvious during the acute phase, attention and early diagnosis is recommended in patients at risk, as TMD may lead to problems if not treated. The diagnosis and treatment of TMD in whiplash patients should not only consider factors related to specific injuries and biomechanical characteristics, but also individual factors associated with muscular tension tendency, depression, and post-traumatic stress.

CONCLUSIONS

Whiplash trauma does not cause injuries to the temporomandibular joint and the crash severity, expressed as Δv, does not influence the risk of TMD below Δv=30 km/h. TMD of minor or moderate grade seem to affect about five percent of WAD-patients within the first month after the accident in both genders and develop in a further ten percent, predominantly in women, during the following year. However, severe TMD seem to be very uncommon. Patients and health professionals may neglect TMD after whiplash trauma because of a low risk, but TMD should be considered in subjects with previous increased tension in the masticatory muscles and post-traumatic headache, especially in women injured in rear-end impacts with rostral neck symptoms and post-traumatic stress.

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