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MULTIMODAL TREATMENT TO PREVENT THE LATE WHIPLASH SYNDROME

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ABSTRACT. In order to assess the long-term efficacy of a multi-modal rehabilitation approach on whiplash injury, 60 patients were recruited within two months after neck injury. They were randomly allocated either to an experimental multimodal treatment (A) consisting of postural training, manual technique and psychological support or to a control treatment (B), using physical agents only, such as electrical and sonic modalities. Pain level, range of movement, self-rating scale of treatment efficacy and return-to-work delay were evaluated before and at the end of treatment, and later, 30 and 180 days after randomisation. The benefit obtained with treatment "A" was greater and longer lasting than that experienced using "B", despite the fact that the same benefit was obtained in joint mobility in the two groups. Patients undergoing the experimental treatment returned to their usual occupations sooner than the controls. The results seem to confirm the hypothesis of a multifactorial involvement as a possible mechanism for the late whiplash syndrome.

Key words: whiplash injury, physical therapy, rehabilitation, neck sprain.

INTRODUCTION

For many years now there has been a lively debate about the symptoms following whiplash injury. Even the terms regarding causal mechanisms and clinical pattern are not widely accepted (7, 8, 10, 17, 21, 28, 32, 38). Whiplash may be defined, according to the original description of Crowe in 1928 (8), as the effects of sudden acceleration-deceleration forces on the neck and upper trunk due to external forces exerting a "lashlike effect". The acute consequences of dynamic injury on the cervical spine are often called "neck sprain" pointing to a collection of painful symptoms following injury to the neck, usually of a hyperextension-flexion type, without symptoms or signs of traumatic nerve root or cord dysfunction (33). The occurrence of long-lasting extra-articular symptoms focused attention on the so-called "late whiplash syndrome" whose nature and pathogenesis is still far from being defined (5, 7, 12, 15, 16, 30), owing to its peculiar epidemiological and clinical features, i.e. an unexplained higher incidence in women (2, 19), the frequent involvement of patients in compensation claims (30), the occurrence of "neurotic" symptoms such as anxiety, fatigue, insomnia (25) and the poor efficacy of analgesic drugs.

The clinical picture was justified on the basis of spine, neuromuscular and neurological involvement. An antecedent cervical spondylosis highlighted by radiological investigation and including disk space narrowing and posterior osteophyte formation was stressed by some authors while others emphasised the role of cervical zygapophyseal joint or disk lesions (10, 18, 29). The role of root, cervical cord and myofascial lesions is widely discussed, but the occurrence of persistent neurological signs excludes a real neck sprain (32), whereas an injury to the neck muscles (from minor tears to partial avulsion of sternocleido mastoid or longissimus colli), followed by vertebral artery spasm, might explain both the physical and behavioural symptoms (23).

Recent data provide evidence of the involvement of the central nervous system (CNS) after a whiplash injury (11). While Ettlin et al (12) try to correlate the abnormal behavioural response to pain with subtle structural damage of the basal frontal and upper brainstem structures, Pearce (31) rejects the hypothesis of any anatomical disruptive lesion on the basis of the normal BAEP and MRI results described by

different authors in patients having suffered neck injury (9, 12, 24, 38).

Radanov et al. (35) have advanced the theory of functional brainstem damage producing both cervical and encephalic symptoms (the so-called "cervico-encephalic syndrome"), and discussed psychosocial, financial, demographic and clinical factors influencing the persistence of the syndrome (34).

Unfortunately, most of the works quoted address prognosis through a retrospective evaluation of patients, without considering an adequate control group obtained through randomised treatment protocols (28).

The usefulness of any treatment for the late whiplash syndrome is still subject to discussion (20). Since Mealy et al. (26), who obtained a greater benefit using early mobilisation than that produced by the standard treatment based upon rest and immobilisation with a soft cervical collar, there have been very few reports on this issue. Recent approaches include different techniques, ranging from the application of physical agents (13, 14) to subcutaneous sterile water injections (6), to intraarticular steroid or anaesthetic administration (3, 4). No report seems to be conclusive and the chronic whiplash syndrome continues to be a frequent cause of absence from work.

The present study aims to evaluate the efficacy of a multimodal treatment in reducing symptoms during the acute phase and preventing their continuation in the form of a delayed syndrome.

MATERIAL AND METHODS

Patients

A randomized controlled single-blind prospective study was carried out on 60 consecutive patients suffering from a cervical acceleration-deceleration injury following a car accident. The dynamics of the cervical involvement were always represented by primary rear impact with the struck car either in motion or stationary.

Inclusion criteria were: *i*) time interval between injury and randomisation of less than 60 days; *ii*) regular performance of job or profession before the car accident; *iii*) no infective, neoplastic, metabolic or inflammatory bone disease; *iv*) no X-ray evidence of traumatic or severe degenerative lesions of the cervical spine; *v*) no symptom exaggeration with the intention of enhancing financial rewards; and *vi*) informed consent to the investigation.

Patients included were 25 men and 35 women, suffering from "neck sprain" and showing both joint problems (range of neck movement decrease) and myofascial symptoms (muscle spasm, painful contractures). Furthermore, they complained of extracervical symptoms, such as headache, fatigue, dizziness, poor concentration, disturbed accommodation and impaired adaptation to light intensity, thus meeting the criteria described by Radanov et al. (35) for the "cervico-encephalic syndrome".

Patients were enrolled within an average of 30 days from whiplash (SD: 17.4 days; range 16–60 days) and showed satisfactory compliance with the treatment.

They all received muscle relaxants and/or analgesic drugs and wore a soft cervical collar during the first two weeks following injury.

Procedure

Cervical and extracervical symptoms were recorded using a check-list. The clinical examination assessed the occurrence of orthopaedic or myofascial disorders such as mobility restriction and pain. A cervical X-ray, using routine A-P, side and foramen projections was employed to rule out spine diseases; magnetic resonance imaging was performed in a few cases, when a spinal cord injury was suspected.

After the basal examination, patients were randomly assigned to two groups of 30 subjects each.

Group A underwent an experimental multimodal treatment, providing:
- relaxation training based on diaphragmatic breathing in supine position (36);
- active reduction of cervical and lumbar lordosis, based on the suggestions provided by the Neck School (37);
- psychological support to reduce anxiety and limit emotional influence, according to Radanov's suggestions (34);
- eye fixation exercises in order to prevent dizziness, according to the technique described by Shutty et al. (36); and
- manual treatment (massage, mobilization) of the cervical spine (26).

Group B received a treatment based on the application of physical agents (i.e. electrical and sonic modalities), including:
- transcutaneous electrical nerve stimulation (TENS) (especially applied to the Arnold nerve) and pulsed electromagnetic therapy, as suggested by Foley-Nolan (14), and
- ultrasound (1.5 Watt/cm^2) and calcic iontophoresis with calcium chloride, as frequently applied after neck injury (15).

Each patient underwent 10 therapeutic one-hour sessions over a two week period. One physician, blind to patient allocation, performed the clinical assessment four times: before treatment (T0), on completion of rehabilitation intervention , i.e. 15 days later (T1), and one and six months (T2 and T3 respectively) after T0.

The outcome was judged by considering the following measures: *a*) range of neck movement (ROM), *b*) pain level, *c*) self-rating scores of treatment efficacy, and *d*) return-to-work delay.

a) Cervical ROM was quantified by measuring maximal flexion, declination and rotation, i.e., respectively: *i*) the distance from the chin to the breast-bone after maximal flexion and neck extension, *ii*) the distance between the tragus and the acromion after right and left declination, and *iii*) the distance between the chin and the acromion after left and right rotation. According to the procedure adopted by Foley-Nolan et al. (14), the values obtained for each parameter were transformed into ordinal scores, after the comparison with normative data, as follows: 2 = value equal to normal; 1 = value ranging from 2/3 to 1/3 of normal values , 0 = value lower than 1/3 of normal values. Such a method led to a maximum score of 6 (i.e. 2 points x 3 measures) and a minimum score of 0.

b) Pain was evaluated on a visual analogue scale (VAS), where intensity levels ranged from 0 to 10.

c) The self-rating scale of outcome consisted of a list of 7 precoded opinions describing the subjective judgement of changes, with respect to the baseline (T0), as follows: +3: total recovery, +2: marked improvement; +1: slight improvement; 0: no change; −1: slight impairment; −2: marked impairment; −3: complete disability.

d) The time interval between injury and return to work was calculated taking into consideration the real number of working days and excluding the occurrence of holidays in that period.

Data analysis

One-way analysis of variance (ANOVA) was applied to test differences between groups with respect to age, post-traumatic interval and return-to-work delay.

Inter-group differences in trends of VAS and ROM scores were statistically analysed by means of the two-way Friedman test.

The analysis of contingency tables was utilised to compare the distribution of symptoms and prognostic factors in the two groups and the subjective evaluation of outcome.

RESULTS

No differences were found between the two groups with respect to personal data (age, sex, injury-randomisation interval, early treatment) (Table I), basal clinical features (Table II) or negative prognostic factor distribution (Table III).

The treatment evaluation indicated greater improvement in Group A, when compared with Group B, for all outcome measures except for neck mobility.

Median ROM values recorded at T0 were 3.8 for Group A and 3.9 for Group B. At T3, they increased respectively to 5.5 and 4.6 (two-way Friedman test: intra-group comparison: $p < 0.0001$). Although patients from Group A showed a progressively increasing benefit, even after the interruption of treatment, in contrast to Group B subjects, whose recovery reached a plateau, the data analysis failed to demonstrate any significant difference in ROM trend between the two groups (Fig. 1).

Pain occurrence decreased in both groups at a similar rate. At the six-month check-up, 21 patients from group A and 20 from group B did not complain of pain. Pain intensity decreased from median VAS scores of 6.8 and 7.4 (respectively in Groups A and B) at T0, to 1.9 and 4.8 at T3, the advantage for Group A becoming much more evident in the longer period (two-way Friedman test: time x treatment interaction: $p < 0.001$) (Fig. 2).

Self-assessment of outcome showed a greater satisfaction for the recovery in patients undergoing the experimental treatment, than in controls. At the end of therapy sessions (T1), median outcome scores were 1 and 0, respectively for Group A and B. At T3, these scores had increased to 2, in Group A, but decreased to -1 in Group B (Fig. 3). The analysis of contingency tables confirmed the statistical significance of the different distribution of judgement, both at T1 ($p < 0.01$) and at T3 ($p < 0.001$).

Table II. *Occurrence of symptoms at randomisation, in the two groups of patients*

Symptom	Group A *n* (%)	Group B *n* (%)
Neck pain	27 (90)	28 (93)
Headache	19 (63)	23 (76)
Shoulder pain	17 (56)	15 (50)
Back pain	8 (27)	10 (33)
Blurred vision	6 (20)	5 (17)
Dizziness	24 (80)	20 (67)
Transient finger paraesthesia	9 (30)	7 (23)
Fatigue	18 (60)	18 (60)
Anxiety	14 (47)	15 (50)
Sleep disturbances	16 (53)	17 (57)
Irritability	7 (23)	5 (17)
Poor concentration	19 (63)	21 (70)
Forgetfulness	11 (37)	13 (43)

Table I. *Personal data of randomised subjects*

	Group A	Group B
No of subjects	30	30
Age (years): mean (SD)	40.3 (15.1)	40.9 (23.1)
range	18–76	23–70
Male : female ratio	13 : 17	12 : 18
Post-trauma interval (days) (mean; SD)	31.1 (18.8)	28.9 (16.7)
Acute phase treatment		
Application of a soft collar (days) (mean; SD)	15.5 (7.3)	13.2 (6.9)
Analgesic drug assumption (days) (mean; SD)	10.5 (5.4)	11.4 (7.1)

Table III. *Occurrence of risk factors influencing the outcome, in the two groups*

Parameter	Group A *n* (%)	Group B *n* (%)
Early onset of pain (within 12 hours of injury)	12 (40)	14 (47)
Past history of neck pain	5 (17)	4 (13)
Degenerative (not severe) changes on Rx	11 (37)	9 (30)
Loss of consciousness (less than 5')	1 (3)	2 (7)
Past history of neurosis	3 (10)	3 (10)

Finally, a difference between the two groups was observed by comparing the delay in returning to work; at the 6-month follow-up stage all patients but one from Group A were engaged in their usual occupation, as compared to 24 subjects out of 30 from Group B. The mean values of the delay in Groups A and B were 38.4 ± 10.5 days and 54.3 ± 18.4 days, respectively (ANOVA: $p < 0.001$).

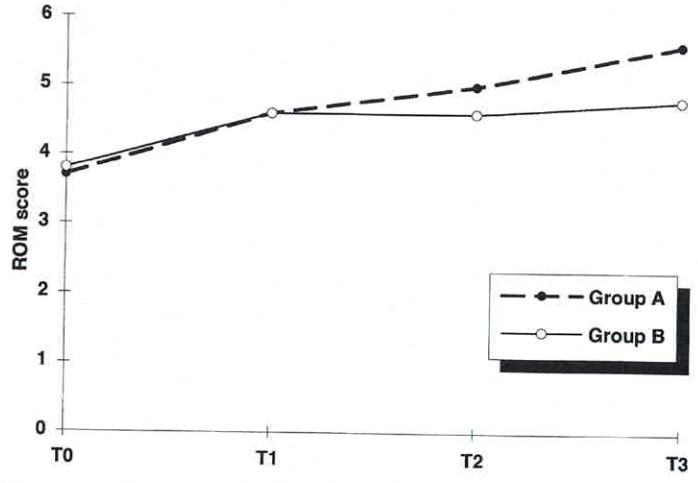

Fig. 1. Trend in ROM scores (median values) evaluated in the two groups, in different phases after randomisation. No significant inter- group differences were found. Intra-group changes were highest immediately after treatment ($p < 0.0001$).

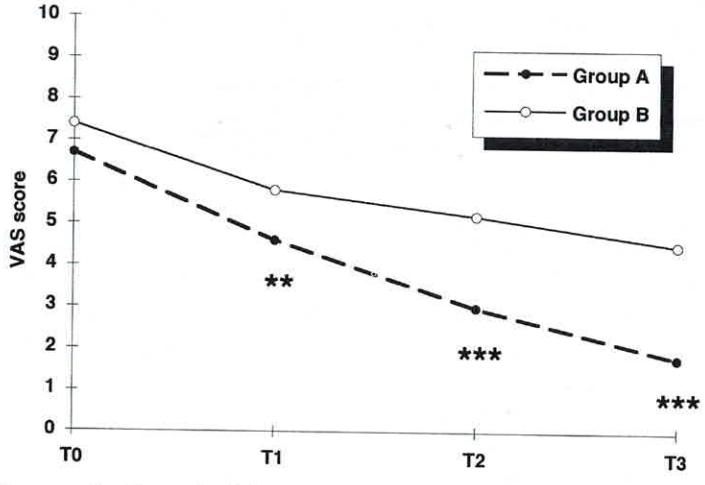

Fig. 2. Trend in VAS scores (median values) in the two groups. Inter-group differences are marked (**: $p < 0.05$; ***: $p < 0.001$). Intra-group changes were found to be significant at the 0.0001 level for both groups.

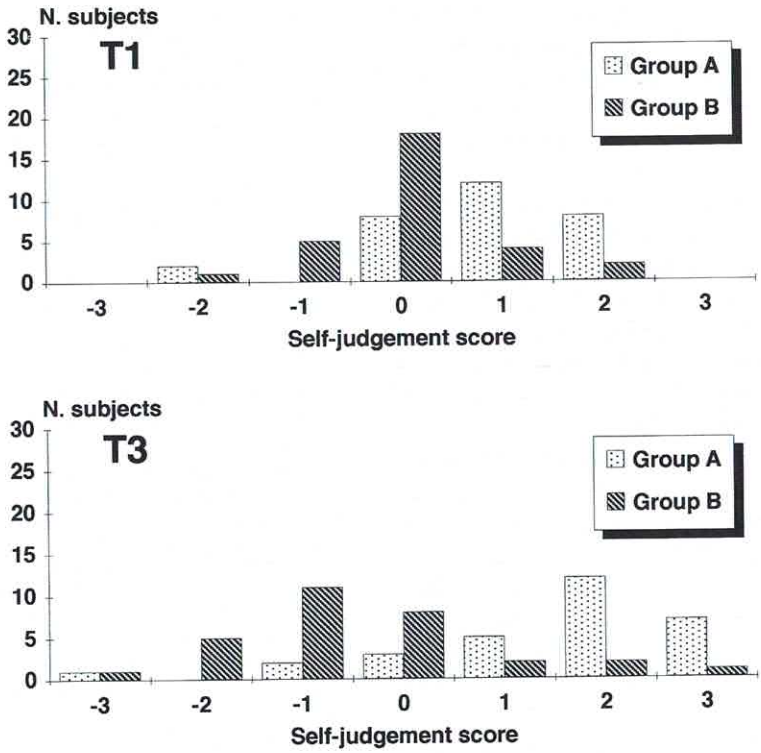

Fig. 3. Self-assessment of outcome on completion of treatment (T1) and six months later (T3). Both times, the distribution of judgements in the two groups was significantly different (T1: $p < 0.01$ level; T3: $p < 0.001$). Score scale reads as follows: 3: total recovery; 2: marked improvement; 1: slight improvement; 0: no change; −1: slight impairment; −2: marked impairment; −3: complete disability.

DISCUSSION

The purpose of this study was to assess whether whiplash injured patients could benefit from a treatment aimed not only at reducing local pain and stiffness, but also at controlling all symptoms causing disability and delay in returning to work.

In this study, subjects were chosen who had homogeneous clinical features, all satisfying the criteria of cervico-encephalic syndrome. The population studied did not differ from other series with respect to age distribution (30) and male-female ratio (2, 34); symptom occurrence was similar to that described by others (2, 30, 34), with the exception of arm pain, ruled out by the inclusion criteria for the cervico-encephalic syndrome. The predictive factors of whiplash outcome were similarly distributed in the two groups of patients.

Outcome measures were chosen by considering both parameters directly influenced by the treatment, such as pain and ROM, and independent measures of handicap, such as return to work delay. The use of an ordinal scale for the measurement of neck flexibility has been recommended by Foley-Nolan et al. (14). This approach may be considered less sensitive than that based on goniometric values whose intraobserver reproducibility is not high (1).

The application of a multimodal treatment aimed to reduce chronic pain has been discussed in a recent analysis by Linssen & Spinhoven (22). A few studies have been carried out on the efficacy of this approach to low back pain (27). To our knowledge, no reports describe the benefits related to a multimodal approach, including a cognitive/behavioural treatment, in patients with cervical pain.

When analysing the results, we found that neck movements improved both in patients given a multimodal treatment, including active mobilization (Group A), and in those treated with physical agents (Group B). However, a difference between the two groups was observed when considering the outcome expressed by subjective symptoms such as pain, emotional changes

and postural disturbances. The number of people free from pain was similar in the two groups, whereas pain intensity was greater in Group B than A. The overall percentage of people complaining of cervical symptoms falls within the range of other investigations (2, 10, 30).

All these features proved to be better controlled by the multimodal treatment both in the acute phase and in the long term. The duration of benefit for a long period after treatment interruption allows the ruling out of a placebo effect on the experimental treatment. On the other hand, the psychological support may reduce the emotional influence on muscle tone and increase tolerance to pain (13, 15).

Subjects undergoing the experimental treatment complained of persistent discomfort or pain at a rate similar to that described in other prospective studies (10, 19, 30), but they reported both a lower intensity of symptoms and a reduction in their disabling effect. Furthermore, almost all patients in Group A were able to carry on their usual occupations after six months, compared with other series which report return-to-work values of 74% to 89% (2, 30).

Of course, the comparison of a passive treatment with a multimodal approach may lead to the conclusion that many different interventions are better than one single type lasting the same time. However, an interesting point to note is that the persistence of disability is related to the rehabilitation approach independent of the amelioration of pain and neck mobility. This fact may support the hypothesis that many factors, other than pain and neck flexibility, are involved in the late whiplash syndrome. In line with Radanov's opinion (35), postural and cognitive symptoms may be considered components of post-traumatic disability and secondary to functional CNS involvement.

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ANNOUNCEMENTS

The Volvo Award for CNS Injury Research 1997, by the Neurotraumatology Committee of the WFNS

In order to encourage research aimed at injury prevention analysis and mitigation of central nervous system injuries, the Volvo Company of Göteborg, Sweden, is sponsoring an award for 1997 of US$5,000.

Paper entering the contest must contain *original* materials, not previously submitted for publication. Papers by multiple authors are acceptable. The English-language manuscripts should be full-length, include original illustrations, and in a form suitable for submission as an original paper (not a postgraduate thesis) to a scientific journal. One original and 5 copies of each paper must reach the address below *not later than December 15, 1996.*

One of the authors should be prepared to come to Amsterdam, the Netherlands, at his own expense, for the 11th International Congress on Neurological Surgery, July 6–11, 1997, to present the paper and to receive the award.

The board of referees will be chaired by the undersigned and will contain members chosen by the Neurotraumatology Committee of the World Federation of Neurosurgical Societies.

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