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EYE MOTILITY DYSFUNCTION IN CHRONIC PRIMARY FIBROMYALGIA WITH DYSESTHESIA

Ulf Rosenhall,[1] Göran Johansson[2] and Gustav Örndahl[3]

From the [1]Department of Audiology and Otolaryngology, the [2]Department of Rehabilitation Medicine, Sahlgren's Hospital and the [3]Department of Medicine, Östra Hospital, Göteborg, Sweden

ABSTRACT. Thirty-six patients with "chronic primary fibromyalgia" combined with dysesthesia were studied using oculomotor tests. The test results were compared with those of a control group consisting of 71 healthy persons. The saccades were found to be abnormal in 42 % of the patients studied. The maximum velocity of the saccades was often reduced, while the accuracy was normal. The smooth pursuit eye movements were deranged in 89 % of the patients. The velocity gain was reduced and the number of corrective saccades was increased. The results indicate that brain dysfunction, often at the brainstem level, is commonly seen in patients with chronic primary fibromyalgia syndrome combined with dysesthesia.

Key words: chronic pain, chronic primary fibromyalgia (CPF), dysesthesia, oculomotor tests, saccades, smooth pursuit eye movements.

Patients with pain in muscles and muscle-insertions that cannot be properly explained, seem currently to constitute an increasing group in clinical practice. In addition to the pain these patients also complain of stiffness in musculature and joints, tender areas in the musculature and limitation of movement. They also often have manifestations of autonomic dysfunction (18). The etiology is unknown and only symptomatic treatment can be given (12). The course of the disease is often chronic and disabling (4). The syndrome is often referred to as chronic primary fibromyalgia (22).

In earlier studies the main symptoms of patients with chronic primary fibromyalgia (CPF) were pain, muscular weakness and mental asthenia (Johansson & Nyström, to be published). The pain was located in the cervical and lumbar regions, in most cases also involving the extremities. It was usually described as more severe on one side of the body. The muscular weakness was also most pronounced on the same side where in many cases there were also varying degrees of dysesthesia. All patients complained of headache and in most cases also of dizziness and vertigo. Mental asthenia in combination with memory disturbances, lack of concentration and sensitivity to noise was observed in all cases. Symptoms of autonomic dysfunction usually described in terms of psychosomatic symptoms were reported by most patients. Hallucinosis of different types was reported by 55% of the patients and an exaggerated startle reaction by 30% (Johansson & Nyström, to be published).

The mental symptoms and the neurological signs indicate the presence of a psychoorganic syndrome in certain patients with CPF. Therefore we studied a series of consecutive patients with CPF by oculomotor test techniques.

Lesions at different locations in the brain might disturb eye motility. Lesions in various parts of the central nervous system have been studied by oculomotor test techniques. Supratentorial lesions in the frontoparietal region have been reported to cause dysfunction of the smooth pursuit eye movements (2, 15, 19) as well as of the saccadic system (5, 10, 15). Normal saccadic velocity has, however, also been reported in such lesions (2). Lesions in the occipital lobe can also affect the smooth pursuit system (9).

Infratentorial lesions very often cause disturbance of the oculomotor system. Lesions affecting structures in the brainstem, e.g. the eye motor nuclei, the medial longitudinal fasciculus, the paramedian pontine reticular formation, the inferior olive, the vestibular nuclei and the nucleus prepositus hypoglossi might cause eye motor dysfunction. The maximum saccadic velocity is reduced, the saccadic accuracy might be disturbed and the smooth pursuit velocity and velocity gain decreased in such disorders (2, 6, 10, 17, 20). Cerebellar disorders might cause saccadic dysmetria (the saccadic velocity is normal) and reduced smooth pursuit velocity gain (6, 8, 17, 21). There is often a combination of brainstem and cerebellar symptoms in posterior fossa lesions causing complex eye motility dysfunction (2, 21).

MATERIAL

Thirty-six subjects, 31 females and five males (mean age: 46 years, range: 29–58 years) were studied. They were chosen from a consecutive series of patients sent to a rehabilitation clinic for pain treatment and vocational guidance. The patients were referred mainly from orthopedic surgeons but also from rheumatologists and internists. The main symptoms were chronic pain of the muscles specially the muscle insertions of the neck–shoulder girdle and the lumbar–hip region with radiation to the extremities. The patients fulfilled the criteria for CPF suggested by Yunus (22). They were included in the present study because they complained, apart from the pain, also of mental symptoms and dysesthesia of the face and upper and lower extremities on the same side where the pain was described as most severe. The dysesthesia was never restricted to one nerve segment or only to the innervation area of a peripheral nerve. Sensibility was examined clinically using a needle and cotton wool. The examination was performed in all subjects on at least three different occasions with an interval of at least one month. The examiner was a skilled senior internist with special interest in neurology (G. Ö.). Specific neurological disease was excluded prior to the oculomotor test procedure. All patients were thoroughly examined clinically, and electro- and echoencephalograms were performed. In three patients where there were minor changes of the echoencephalograms, CT-scan was performed with normal test results. Lumbar puncture was performed in 23 patients; two had a slight increase in cerebrospinal fluid protein and one of them also a slight pleocytosis (3–5 cells/ml). In the third patient only a slight pleocytosis was observed.

The dysesthesia comprised half the face and the ipsilateral extremities in 33 patients while in 3 patients only the extremities were affected. In all 36 patients the sensation of pain was different in the two halves of the body when tested by pinprick. An abnormality of the sensation of pain was observed in the same half of the body where the musculoskeletal symptoms were reported to be most severe. In eight of these cases there was also a difference of the sensibility to touch when tested by cotton wool. Thirty-three patients reported a decreased sensitivity to pain while in three cases this sensation was increased. Seven patients reported a reduction of sensitivity to touch while in one case this sensation was reported as increased. Sensitivity to vibration was normal in all subjects.

All patients had been examined by an otrhopedic surgeon, who had excluded orthopedic disease as a cause of the pain. Inflammatory rheumatic disease had been excluded by laboratory test procedures. The patients had further been examined by EMG which, in all cases, showed signs of myopathy, i.e. a greater number of polyphasic potentials than normal, and potential complexes of short duration (1–2 ms) were observed. The physical performance was evaluated by bicycle ergometer test and most patients showed a pronounced reduction of physical performance (mean: 60 W).

Spirometry was performed in every patient and was normal in all cases, whereas maximum respiratory pressures as a measure of respiratory muscle function were significantly reduced in all cases, mean inspiratory pressure: 3.72 kPa (expected value: 8.62); mean expiratory pressure: 3.11 kPa (expected value: 10.1).

In one case there was a history of meningitis but all other patients denied infections of the CNS, and none had had head injury with unconsciousness. All patients denied abuse of alcohol and drugs and, according to the extensive files available in this group, no patient could be judged to suffer from any kind of toxicomania.

All patients had had an early pension or had been on sick leave for at least 12 months. They were manual workers in unqualified professions. The pain and the dysesthesia were of long duration, ranging from three years to, in one case, 20 years.

Our control group consisted of 71 healthy individuals, 38 females and 33 males with an age range of 20–60 years. The measurements from each patient were compared with those of the control group. The control group mean ± 2 SD was considered to be the normal value. The female patient group (31 subjects, mean age 45 years, range 29–58 years) was compared with a matching control group selected from the total control group. This selected control group consisted of 24 healthy females of 30 to 60 years of age, with a mean age of 40 years.

METHODS

Horizontal eye movements were studied by a curve-shaped ramp equipped with 240 light-emitting diodes, which was placed 120 cm in front of the test subject. The diodes were selectively activated by an encoder which was controlled by a pre-programmed microprocessor. The corneo-retinal potentials were picked up binocularly by surface electrodes. The signal was amplified and filtered using a 15 Hz lowpass filter and registered with an AC-coupled Siemens-Elema Mingograph 34 ink-jet recorder with a time constant of 5 s.

The patients were instructed to stay off all medication for 48 hours prior to the testing procedures. In spite of this instruction three patients admitted having used analgetics when asked immediately before the testing procedure. In these cases the tests were repeated within a couple of days after further instructions to stay off medication.

For the saccade test the gaze angles 20°, 40° and 60° were used. The saccades were non-predictable. The time that elapsed between two consecutive saccades varied randomly from 0.8 s to 2 s. Fifteen saccades of both directions for each gaze angle were recorded.

Only events which occurred in direct connection with the saccade were measured, to avoid problems with drift of the baseline. The peak saccadic velocity, i.e. the speed of the gaze during the fastest phase of the saccade, was measured directly from the recorded curve and given in degrees per second. Moreover, the accuracy of the saccades in percent of the total amplitude and the latency of the saccades (i.e. the reaction time in milliseconds elapsing from the change of the light spot to the start of the eye movement) were measured.

For the linear smooth pursuit eye movements test a light spot was moved over the ramp with the velocities 10°/s, 20°/s, 30°/s and 40°/s. The mean velocity gain, i.e. the ratio between the velocity of the eyes and the target

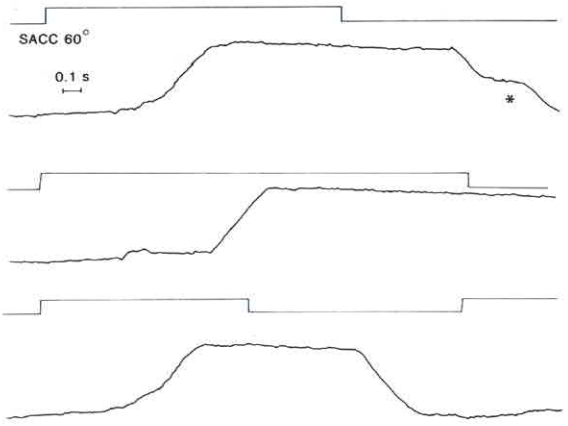

Fig. 1. Registration of voluntary, horizontal 60°-saccades from a patient with chronic pain of the so-called chronic fibromyalgia syndrome. The saccadic velocity is reduced, the curve slopes gradually when a saccade is performed. The asterisk (*) shows a hypometric saccade with a corrective saccade. The upper curve shows the target.

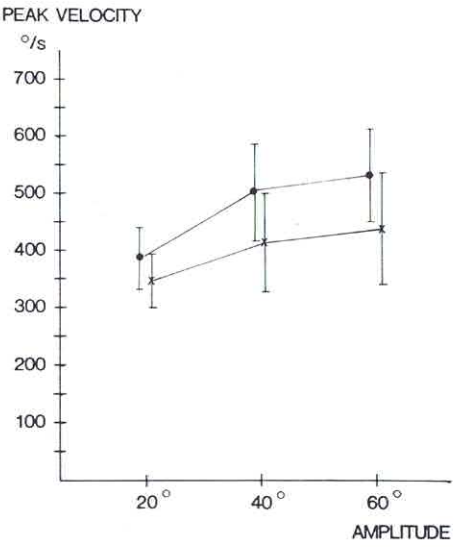

Fig. 2. Peak velocity in degrees per second of the voluntary saccades. Group means and standard deviations are given for the gaze angle amplitudes 20°, 40° and 60°. The patient group (×) has significantly reduced velocities for all three gaze angles compared with the control group (·).

velocity, was estimated. The mean speed of the smooth pursuit eye movements, measured in degrees per second, when the corrective saccades had been excluded, was used for the calculation of the gain. The gain was averaged from at least 12 tracking eye movements of both directions for each target velocity. The number of the corrective saccades per second and the mean amplitude of the corrective saccades were also calculated.

For each parameter measured a one-sided Mann-Whitney U test was used for comparisons between the female patient group and the matching control group.

RESULTS

Saccades

A total of 15 of the 36 patients studied (42%) were found to have abnormal saccades either with reduced saccadic velocity or reduced saccadic accuracy or both.

The peak velocity of the saccades was reduced in subjects with the chronic primary fibromyalgia syndrome group compared with the controls for all three gaze angles (Figs. 1 and 2). The statistical analysis of the peak velocity in the female patient group and the control group showed significant differences between the groups ($p < 0.01$ for all three gaze angles). In 14 of the patients the saccadic velocity was below normal mean −2 SD for one or more of the gaze angles studied. The 60° saccades were abnormally slow in 13 of these 14 subjects, the 40° saccades in 8 instances and the 20° saccades in 3 instances. The saccadic velocity was reduced in both directions in 9 cases and in one direction only in 4 cases.

The accuracy of the saccades was found to be similar in the patient group and in the control group (Fig. 3). The saccades were normometric, i.e. they

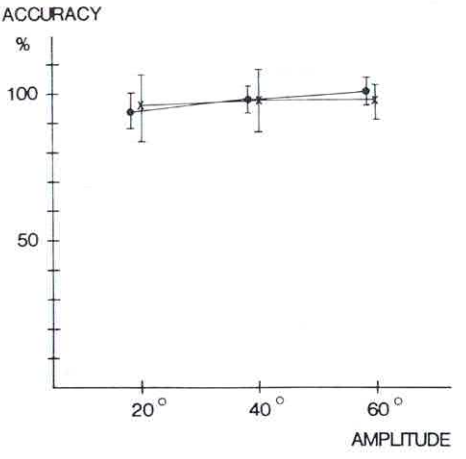

Fig. 3. Group means and standard deviations of the accuracy of the saccades in percent for the patients (×) and the controls (·). There is no difference between the two groups concerning this parameter.

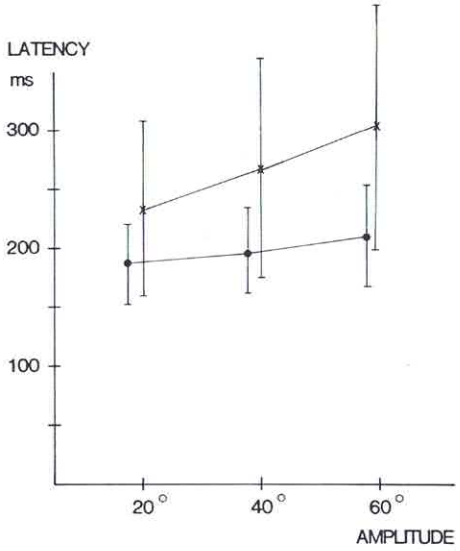

Fig. 4. Latencies in milliseconds for the patient group (×) and for the control group (·). The patients have generally longer reaction times than the normals, but the variability is very pronounced. Group means and standard deviations are given.

had normal amplitudes, in a majority of the patients. However, five patients, four with reduced saccadic velocity, had hypometric saccades (Fig. 1) with reduced accuracy (normal mean −2 SD). There was no significant difference of the accuracy between the female patient group and the control group for any of the gaze angles studied.

The latency of the saccades were longer for all

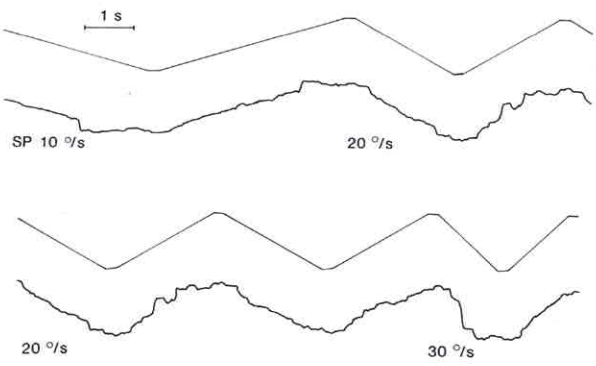

Fig. 5. Smooth pursuit eye movements from a patient with chronic fibromyalgia. The target speed varies from 10% to 30%. The eye movements (lower recordings) are moderately abnormal. There is an increasing number of corrective saccades when the target speed is increased. The upper recordings show the target movements.

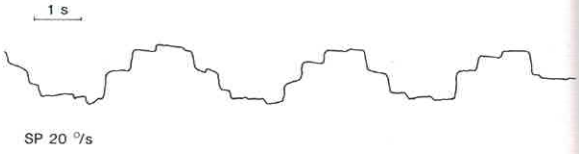

Fig. 6. Severely altered smooth pursuit eye movements (target speed: 20°/s). The eye movement consists almost entirely of corrective saccades which gives the curve a step-like appearance. The velocity gain is close to zero in this case.

three gaze angles studied than for the controls (Fig. 4). The inter- and intraindividual variability of this parameter was, however, very pronounced and the latency measurements were therefore discarded when estimating the frequency of saccadic abnormality.

Smooth pursuit eye movement

The smooth pursuit eye movements were abnormal with reduced velocity gain in 32 patients, or 89% of the total material. The velocity gain was reduced for all target velocities studied in 19 of these patients. Twelve of them had profoundly altered smooth pursuits (velocity gain 0.5 or less for the target speed 20°/s).

The velocity of the smooth pursuits was generally reduced, and to make it possible for the gaze to follow the moving target corrective saccades were added to the eye movement (Figs. 5 and 6).

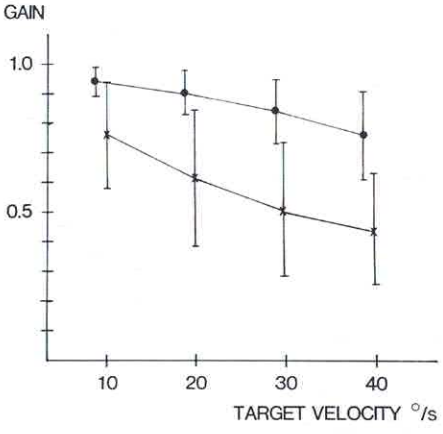

Fig. 7. The mean velocity gain, i.e. the ratio between the velocity of the eyes and the velocity of the moving light spot, for the smooth pursuit eye movements. The velocity gain is considerably lower in the patient group (×) compared with the normals (·). The decreased gain is apparent for all four target velocities used in the study.

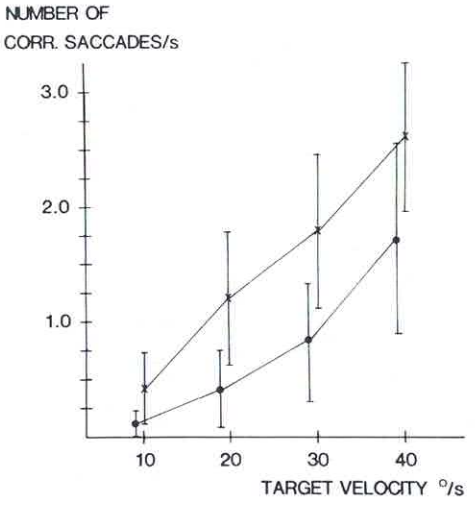

Fig. 8. Smooth pursuit eye movement test. The velocity of the light spot is depicted on the *x*-axis (target velocity). The number of the corrective saccades per second in tracking eye movements is shown on the *y*-axis. There is a considerable increase of the number of corrective saccades in the patient group (×) compared with the control group (·).

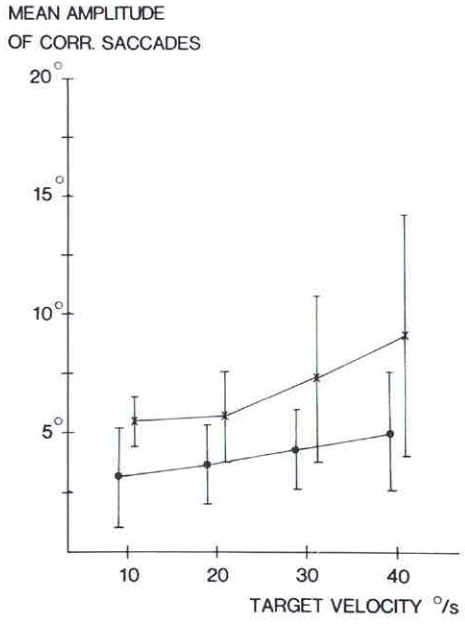

Fig. 9. The amplitudes in degrees of the corrective saccades in the tracking eye movements. The mean amplitude of the corrective saccades is increased in the patient group compared with the control group.

A comparison of the velocity gain between the patient group and the entire control group is shown in Fig. 7. There are marked differences for all target velocities between the two groups. A comparison between the female patient group and the matching control group showed that these differences were significant ($p < 0.001$). The variability of this parameter in the patient group was, however, very pronounced. The velocity gain was abnormal in both directions in 28 instances and in one direction only in 4 instances. All the patients (except two) who had abnormal saccadic velocity had also pathological smooth pursuits.

There was a significant increase of the number of corrective saccades in the patient group compared with the control group ($p < 0.001$) (Fig. 8), and the amplitude of these corrective saccades was also increased ($p < 0.001$) (Fig. 9).

A total of 34 patients (95%) had dysfunction of either one or both of the eye motor tests used, and only two patients had totally normal oculomotor function. All but two of the patients with abnormal saccadic velocity also had pathological smooth pursuits. Both these patients had reduced saccadic velocity and one had hypometria as well.

Retest results

Nine of the patients were retested from 7 months to 2 years 10 months after the initial testing. All patients had abnormal test results at the initial testing (all nine had abnormal smooth pursuits and five of them pathological saccades). At the retest session all nine patients still had pathological oculomotor test results. One patient showed improvement of the smooth pursuits. Another patient showed deterioration of the smooth pursuits. This patient, who had completely normal saccades at the initial testing, had slightly reduced saccadic velocity in one direction at the retest session.

DISCUSSION

Population of study

The pain and other symptoms reported and the signs observed here are in agreement with those of CPF according to the criteria suggested by Yunus (22). However, as the patients in this study were selected because of their dysesthesia and as this type of dysesthesia is not seen in all cases, they cannot be looked upon as representative of all pa-

tients with this disease. As a group, however, the patients in this study can be considered homogeneous. The EMG findings showed signs of myopathy in all cases and the results of the physical performance tests and the maximum respiratory pressures for both inspiration and expiration were invariably reduced. Moreover, the patients showed conformity concerning anamnestic data and clinical examination. The possibility of other neurological, orthopedic or rheumatological disease had been excluded as far as possible using routine clinical procedures.

The dysesthesia, which has been described earlier (11), was looked upon as a minor neurological sign and was therefore only tested for using simple clinical methods. It was, however, constant on the three different occasions both concerning extent on the body surface and perception, and may therefore be looked upon as a neurological sign. Conversive mechanisms cannot be ruled out completely although in such cases anesthesia is common. This study was, however, based more on the overall clinical picture which indicated that part of the CPF syndrome might, in some cases, be the result of a psychoorganic syndrome.

Oculomotor tests

Varying degrees of dysfunction of the oculomotor system were frequently observed in subjects suffering from the CPF. In some instances highly abnormal saccades and extremely deranged smooth pursuits were found while in others only slightly abnormal smooth pursuits with normal saccades were observed.

There are some obvious pitfalls when evaluating the oculomotor function. All patients were suffering from pain and they had earlier used various analgetics regularly. The most common drugs used were salicylates and compounds paracetamol containing. Some patients also used hypnotics and sedatives. Prior to the testing the patients were instructed to refrain from all kinds of drugs (7). Some patients, however, admitted having taken drugs before the test session. These patients were retested after being free of drugs for at least 48 hours.

One of the policies of the clinic is to make the patients free from all medication, and this instruction was obeyed by 11 patients of the study, as far as could be controlled. Of these patients 10 had abnormal test results. The influence of drugs cannot, however, be ruled out completely since the blood and tissue concentrations of the different substances were not measured.

All the patients suffered from consistent and sometimes very severe fatigue, a factor which could be of importance in cases with marginally abnormal findings (16). We tried, however, to minimize the influence of fatigue by keeping the patients alert during the testing procedure, which only took a few minutes for each patient.

Moreover, the concordance between the results of the initial tests and the retests indicates that the oculomotor abnormalities observed are genuine.

The abnormal test results might be explained by defective function of the eye muscles as part of a generalized muscle disorder. However, the patients did not show any other clinical signs of such disorders. Another possible explanation of the smooth pursuit abnormalities could be disturbances of the proprioceptive system in the cervicocranial area. A defective proprioception in the neck can probably explain some of the findings in patients with mild to moderate eye motor dysfunction. Many patients, however, had pronounced abnormalities of the smooth pursuits, often in combination with saccadic dysfunction, findings which probably indicate a CNS-dysfunction.

Brainstem lesions cause a reduction of the saccadic peak velocity (13). Fourteen of the 15 patients who had abnormal saccades had significantly reduced saccadic velocity consistent with brainstem dysfunction. Moreover, 13 of these patients (1/3 of all patients studied) had abnormal smooth pursuit eye movements as well, a finding which supports the concept that brainstem dysfunction might be present in many patients with CPF combined with dysesthesia.

Five of the patients studied had hypometric saccades, findings which can be explained by either supratentorial or pontocerebellar dysfunction (13).

Two of the patients had abnormal saccades, one with hypometria, but normal smooth pursuit eye movements, findings which may be consistent with a frontal lobe lesion (14).

Since many of the patients had severely altered eye movements the results of the present study indicate that CNS-dysfunction, often at the brainstem level, occurs in patients with CPF. This observation is supported by the finding of pathological auditory brainstem responses in many patients (Rosenhall et al., to be published).

The etiology of the CNS-affection is obscure and

only speculations can be made. Subclinical aseptic meningoencephalitis is one possible explanation since many patients report that the symptoms have started in connection with respiratory tract infections, probably of viral origin (3). Other mechanisms, e.g. toxic encephalitis must also be considered.

We hope that the findings of the present study will hopefully contribute to an elucidation of the mechanisms involved in the enigmatic and highly disabling chronic primary fibromyalgia syndrome.

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Address for offprints:
Dr Ulf Rosenhall
Department of Audiology
Sahlgren's Hospital
S-413 45 Göteborg
Sweden