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Međunarodni simpozijum o eksperimentalnom tremoru: 1-3. april 1971. godine

Stern, Pavao

1972

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Preuzeto s Baštine Akademije nauka i umjetnosti Bosne i Hercegovine

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AKADEMIJA NAUKA I UMJETNOSTI BOSNE I HERCEGOVINE

POSEBNA IZDANJA

KNJIGA XVII

ODJELJENJE MEDICINSKIH NAUKA

KNJIGA 4.

MEĐUNARODNI SIMPOZIJUM

O EKSPERIMENTALNOM TREMORU

1 — 3. APRIL 1971. GODINE

Urednik
PAVEL STERN,
redovni član Akademije nauka i umjetnosti
Bosne i Hercegovine



SARAJEVO
1972

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A STUDY OF THE EFFECTS OF CONTROLLED AFFERENT INFLOW ON TREMOR IN PARKINSONIAN PATIENTS

Several studies on Parkinsonism, to mention only a recent one by Hoehn and Yahr (2), have shown that tremor is the most frequent initial symptom. There is no wonder, therefore, that so many both clinical and research workers interested in Parkinsonism focused their attention on tremor.

In our study we were concerned with so-called static tremor appearing in the relaxed patient as the well-known pill-rolling forearm and finger movements.

EXTENSORS OF THE WRIST

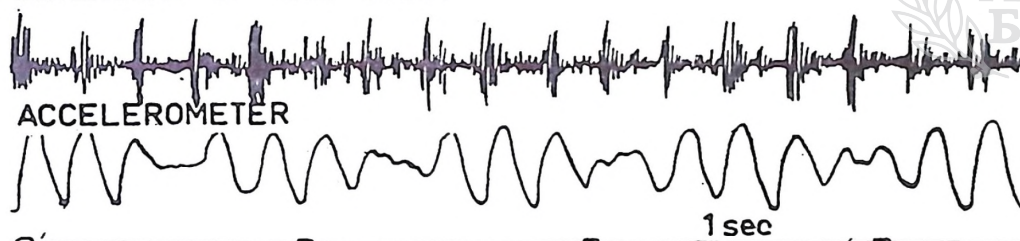


Fig. 1

Electromyographic and accelerometric recording of tremor.

Figure 1 is an EMG recording of the tremor, showing its rather regular rhythmicity.

Our study had two goals: The first one was modest as regards scientific achievements and was just to develop a method of recording and computation of EMG and accelerometric parameters of the tremor, accurate enough to achieve the next goal; and this was to see whether this parameter can be influenced by adding some sensory information incorporated into a feedback loop.

MATERIAL AND METHOD

The study included 5 patients aged 50 to 60, suffering from uncomplicated Parkinsonism for 4 years or longer. We have satisfactory recordings from three of these.

The EMG was detected by surface electrodes over the flexors and extensors of the wrist and fingers. Two accelerometers were placed in perpendicular directions on the back of the hand.

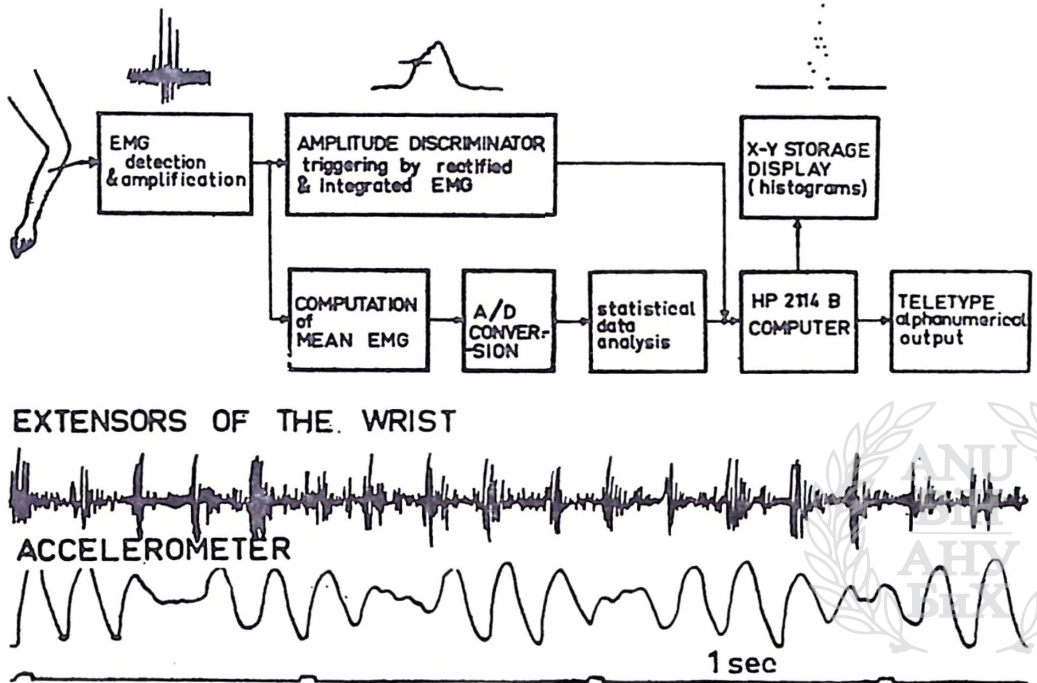


Fig. 2

Block diagram of the experiment.

The EMG and the accelerometers were automatically and on-line processed in the way symbolically shown in figure 2. Several of the methodological and technical solutions used here are original innovations by our engineer, Mr. Janez Trontelj.

RESULTS

Table 1 shows the results of such an analysis. From mean EMG you can see that relaxation combined with mental effort gave the strongest tremor, while voluntary movement depressed it. In fact, nothing very new is in this table; it is shown just as an example of how our analysis works.

Table 1.

MEAN FREQUENCY OF TREMOR AND MEAN EMG OF BURSTS
IN TWO PARKINSONIAN PATIENTS

PATIENT	EXPERIMENTAL SITUATION	NUMBER OF BURST	MEAN FREQUENCY OF TREMOR	MEAN EMG OF BURSTS	STANDARD DEVIATION	COEFFICIENT OF VARIABILITY
TRP 2	RELAXATION HAND PRONATED	250	4.6	336	99	0.29
	RELAXATION HAND SUPINATED	250	5.1	141	59	0.4
	ANTE-FLEXION HAND PRONATED	250	4.3	229	24	0.1
	CALCULATION HAND PRONATED	250	4.9	434	113	0.26
	RELAXATION HAND PRONATED	250	4.9	297	76	0.25
	CALCULATION HAND PRONATED	250	4.7	426	90	0.2

Now we wanted to see whether or not it is possible to change the parameters of the tremor by introducing a purely afferent inflow.

We chose a 20 ms lasting train of high frequency electrical pulses applied to the median or radial nerve. Such a stimulus gave a kind of a paraesthetic sensation, but was in all cases too weak to give any direct or indirect motor effect.

The stimulus was triggered by the tremor itself, the triggering signal being generated when the acceleration or the rectified and integrated EMG burst reached certain level.

The actual stimulus was delayed after the triggering signal by 35, 70 or 105 miliseconds. In this way our artificial sensory inflow was in a feedback loop with the oscillating activity of motoneurons (fig. 3).

What happened to tremor as a result of such feedback stimulation was a change in tremor frequency and mean tremor EMG (figs. 4 and 5): the frequency of the tremor was significantly increased, while mean EMG of its bursts diminished. The important fact here is that only one of the three delays was really effective: 35 milliseconds after the triggering point on the rising slope of the acceleration signal. The effect was very constant and was proportional to the strenght of the stimulus. With the other two delays, even 50% increased stimulus showed little effect.

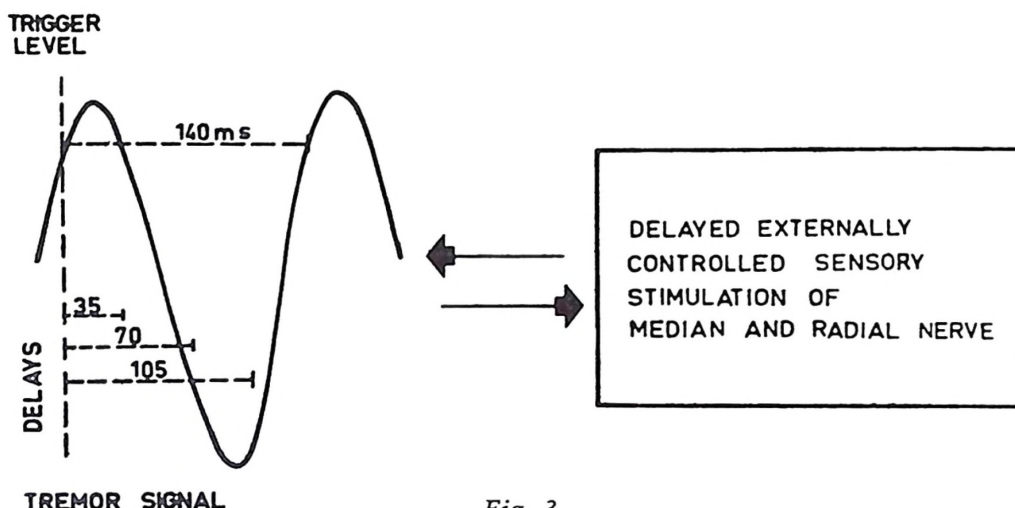


Fig. 3

Generation of trigger signal by tremor acceleration.

RELAXATION

MEAN = 4.7 ± 0.2 Hz

30 40 50 60 Hz

SENSORY STIMULATION

MEAN = 6.5 ± 0.2 Hz

50 60 70 80 Hz

INSTANT RATE OF TREMOR

Fig. 4

Change in frequency of the tremor due to sensory stimulation of the median nerve (train: 1000 Hz, 20 ms, 75 Volts; delay after trigger signal 35 ms).

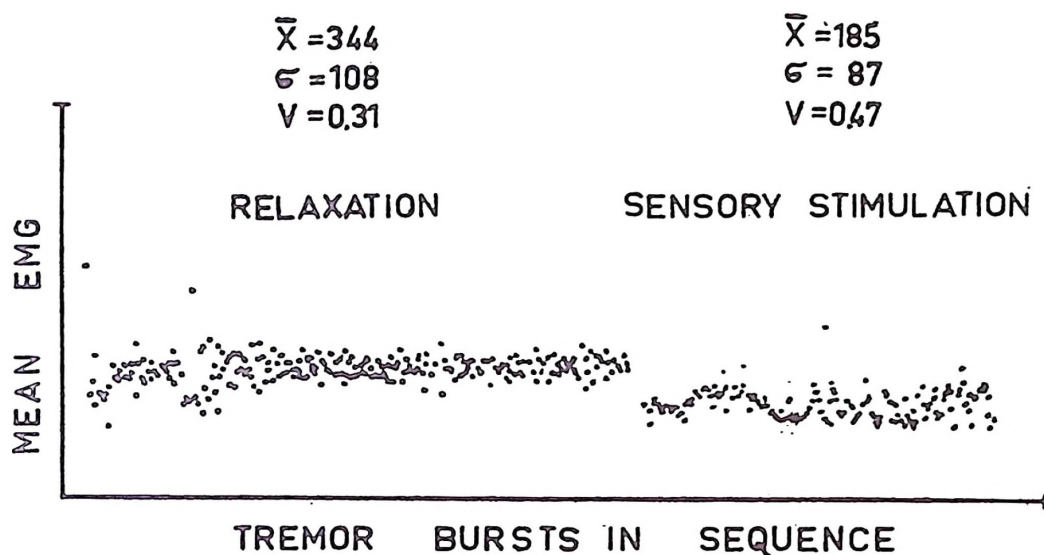


Fig. 5

Change in mean EMG of tremor bursts during sensory stimulation of the median nerve (train: 1000 Hz, 20 ms, 75 Volts; delay after trigger signal 35 ms).

DISCUSSION

If any preliminary conclusion can be drawn from this very preliminary work, then this is the suggestion that the Parkinsonian tremor can be modified by certain sensory inflow, appropriately phase-locked to the tremor. The emphasis is on appropriately, and it does seem that the interval during which the system is sensitive is rather rigidly determined.

Discussing this phenomenon I have to mention another observation made by our group a few years ago: we found that sensory stimulation can suppress ankle clonus in hemiplegic patients (1). Here again, the effective parameters of stimulation were highly specific. This interesting analogy, of course, can not be taken to point to a common pacemaker for both tremor and clonus, but it does prove some degree of dependence of either phenomenon on the afferent inflow.

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PROUČAVANJE UČINKA KONTROLISANOG AFERENTNOG UTICAJA NA TREMOR PACIJENATA OBOLJELIH OD PARKINSONOVE BOLESTI

KRATAK SADRŽAJ

U ovoj studiji pokušalo se ustanoviti, dali je moguće promjeniti parametre parkinsonskog tremora sa uvođenjem senzorne informacije uklopljene u povratnu vezu.

Elektromiografski i akcelerometrički parametri tremora bili su automatsko analizirani sa kompjuterom; u različitim fazama akcelerometričkog signala odnosno perioda elektromiografske aktivnosti na nervus medianus ili radialis apliciran je električki nadražaj ispod praga za direktni ili indirektni motorni odgovor. Pokazalo se, da je na ovaj način moguće značajno uvećati frekvenciju i smanjiti veličinu periodičke EMG aktivnosti, ali samo kad je nadražaj apliciran u tačno određenoj fazi tremora. Ukazano je na analogiju sa klonusom kod paraplegičara, na koji se slično može utjecati samo sa senzornim stimulusom specifičnih vremenskih parametara.

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2. Hoehn, M. M., M. D. Yahr: Parkinsonism: onset, progression and mortality. Neurology, 17: 427, 1967.

