

## ELECTRIC MYOGRAPHIC CONTROL OF ELECTRIC THERAPEUTIC APPARATUS -CERAGEM MASTER CGM 3500 INFLUENCE ON BACKBONE OF PATIENTS WITH SCOLIOSIS

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**Abstract.** *Purpose:* determination of effectiveness of electric therapeutic apparatus Ceragem master CGM 3500 in its influence on backbone of patients with scoliosis. *Material:* in examination 11 female patients with scoliosis of age from 21 to 35 years and 12 practically healthy persons participated. The research of para-vertebral muscles of back was fulfilled with method of electric myography. *Results:* we determined positive effect in nervous-muscular functioning of back. The proof was increase of integrated amplitude of back muscles' electric activity on convex and concave sides of scolytinae arc; increase of maximal amplitude of H-reflex and M-response. *Conclusions:* standard electric myography permits to receive objective information about functional state of muscles of patients with scoliosis and assess effectiveness of rehabilitation process with application of electric therapeutic apparatus -- Ceragem Master CGM 3500.

**Key words:** scoliosis, muscles of back, physical rehabilitation, electric myographic control.

### Introduction

Adult people with scoliosis (in contrast to children and adolescents with such pathology) have quite different problems that is connected with specificity of etiology and pathogenesis of scoliosis progressing and peculiarities of approaches to treatment. It is considered that by the end of growing process (for women – by 18-20 years and for men – by 22 – 24 years) progressing of scoliosis stops. Surely, after such terms stoppage of progressing scoliosis with therapeutic methods is practically impossible [7]. As usual, increase of scoliosis deformation stops after finishing of bone growth [4, 5, 14, 17]. However, in patients with weak muscular corset and articular ligaments deformation can slowly progress [18, 20]. Sometimes, increase of deformation cannot be stopped even with perfectly developed muscles and everyday therapeutic exercises. In spite of favorable prognosis, prospects for future with scoliosis threaten with progressing of abnormalities in different structures of backbone and some functional system of the whole organism [5]. That is why programs of physical rehabilitation for adult persons shall be oriented on stoppage of backbone deformation and pain killing. It is connected with improvement of backbone's flexibility and mobility, normalization of muscles' functioning, complete or partial elimination of body asymmetry, prophylaxis of possible complications. The subject of discussions is still a problem about working out and implementation of innovative technologies in rehabilitation process of persons with scoliosis. Its purpose is excluding of unfavorable static-dynamic loads on affected sections of backbone, stimulation of backbone muscles' own functioning; influence on not vertebral organs. Origin of nervous-muscular asymmetry with scoliosis is also unknown. Some authors regard it as result of backbone deformation [3, 4, 6]. Other researchers connect nervous-muscular abnormalities with changes in central nervous system and relate them to reasons of scoliosis [5, 9, 11, 13, 15, 21]. That is why electric myographic researches are of theoretical importance when speaking about etiology and pathogenesis of scoliosis and of practical importance for improvement already known and working out of new physical rehabilitation methods. As on to day scientific substantiation of application of effective correction- recreational programs on the base of innovative rehabilitation technologies is rather urgent; in particular with the help of non traditional equipment – electric therapeutic apparatus Ceragem master CGM 3500 [8, 10].

### Purpose, tasks of the work, material and methods

*The purpose of the works* is determination of effectiveness of electric therapeutic apparatus Ceragem master CGM 3500 in its influence on backbone of patients with scoliosis.

*The methods and organization of the research:* the research was conducted on the base of medical center Valeo Melitopol, Zaporizska region. In conditions of rehabilitation department we examined 11 female patients of age from 21 to 35 years with backbone scoliosis. Control group consisted of 12 practically healthy persons. We carried out electric myographic (EMG) testing of para-vertebral muscles of back with surface myography (SEMG). EMG testing was conducted during fulfillment of motor tests:

- Static load of back muscles – keeping of torso in initial position (I.P.) – lying on abdomen during 3 minutes;
- Dynamic load – bending and unbending of torso in I.P. – lying on abdomen.

Registration of skeletal muscles' bio-potentials was conducted as per standard methodic [6]. Testing of shin muscle was conducted in order to receive M-response and H-reflex.

### Results of the researches

Members of experimental group (patients with scoliosis) were examined before their complex rehabilitation. We measured static forces of SEMG on convex side of scolytinae arc. We detected expressed asymmetry of bio-electric activity at first and at the last minutes of the test. At the beginning of static test integrated amplitude of muscles' electric activity on convex side of scolytinae arc was  $313.4 \pm 57.5$  mV $\times$ sec. It is lower ( $p > 0.05$ ) than on concave side –  $376.9 \pm 63.3$  mV $\times$ sec. At the last minute of the test amplitude of EMG curve at convex side decreased significantly. Comparing with initial data ( $p > 0.05$ ) it was  $278.6 \pm 54.8$  mV $\times$ sec. Amplitude of EMG curve at concave side increased and became

415.2±62.3. It witnesses about switching on of compensatory mechanism ( $p>0.05$ ). In three tests total electric activity of back muscles reduced by the end of test on convex and concave sides of scolytinae arc. In control group (practically healthy persons) we did not observe any asymmetry (see fig.1.).

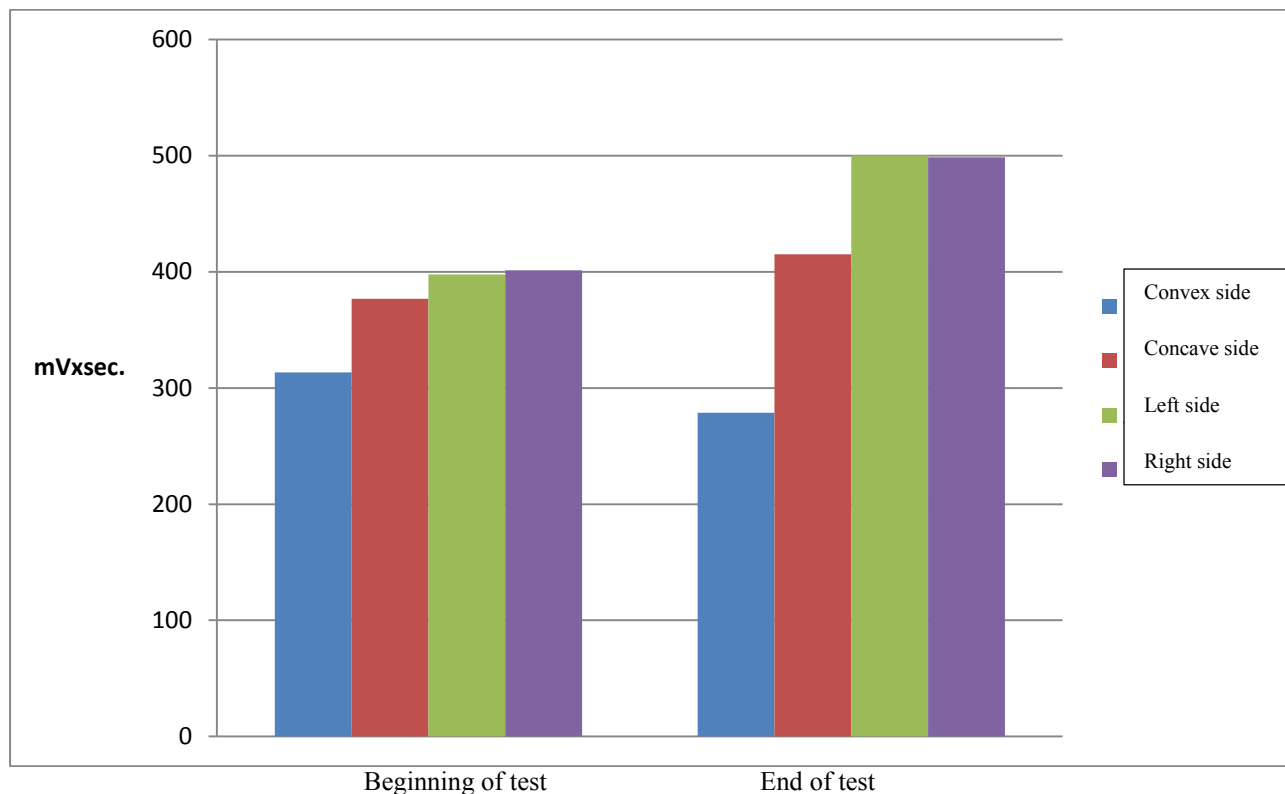


Fig.1. Indicators of back muscles' electric activity in experimental and control groups during static test

In control group there was a tendency to increasing of total electric activity of back muscles: from  $397.6\pm 36.7$  mV×sec. (beginning of static loads) to  $500.1\pm 56.4$  mV×sec. (at the end,  $p>0.05$ ). It is connected with tiredness and switching on of additional motor units.

During dynamic test we observed similar dynamic of changes of back muscles' electric activity in both groups (see fig.2).

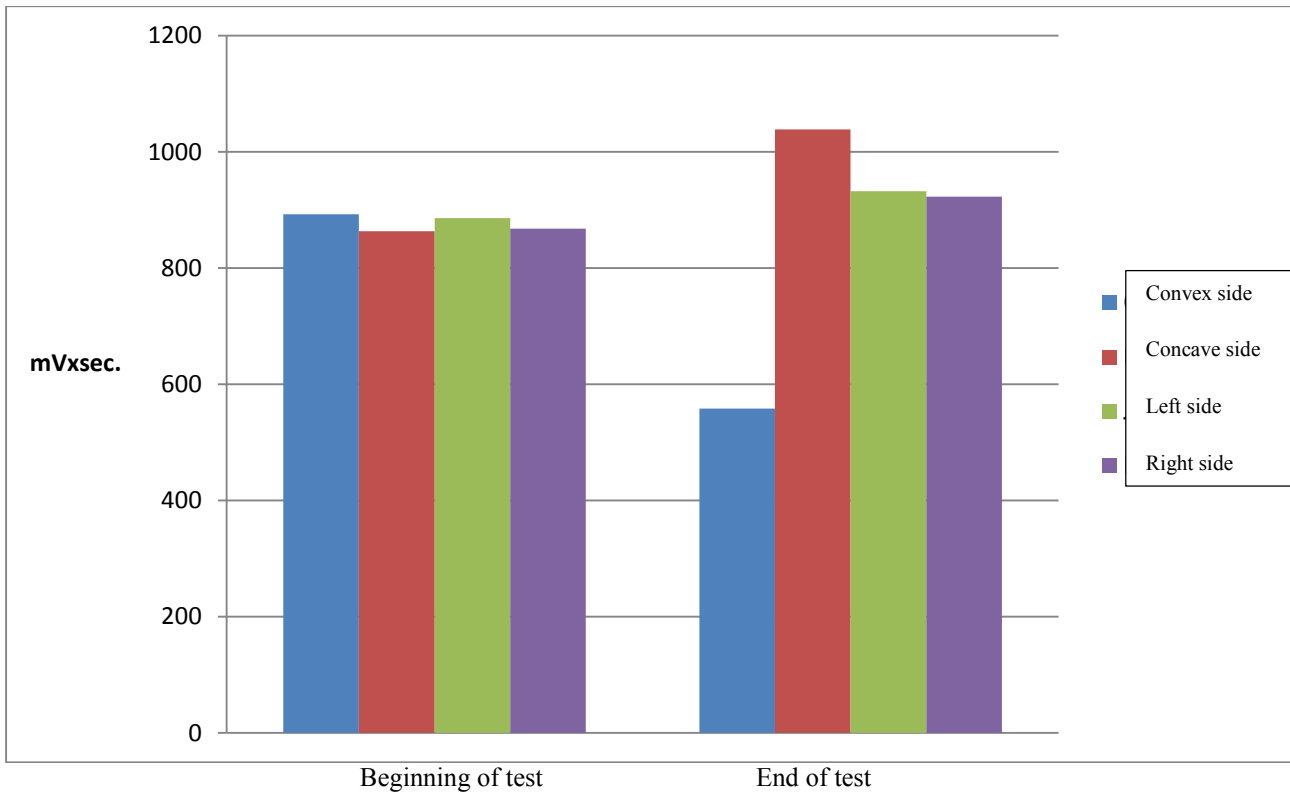


Fig.2. Indicators of back muscles' electric activity in experimental and control groups during dynamic test

We determined that in control group, in average there was confident ( $p < 0.05$ ) increment of total electric activity from  $867.7 \pm 29.6 \text{ mV} \times \text{sec.}$  to  $930.0 \pm 49.2 \text{ mV} \times \text{sec.}$

In experimental group mean group value of integrated muscles' activity on convex side of scolytinae arc was  $892.6 \pm 58.3 \text{ mV} \times \text{sec.}$  at the beginning of test. By the end of keeping of body position this indicator confidently ( $p < 0.001$ ) reduced to  $558.4 \pm 84.4 \text{ mV} \times \text{sec.}$  (see fig. 2).

Back muscles on concave side fulfilled compensatory function. Their integral amplitude confidently ( $p < 0.005$ ) increased from  $863.6 \pm 72.2 \text{ mV} \times \text{sec.}$  (at the beginning of the test) to  $1038.6 \pm 65.5 \text{ mV} \times \text{sec.}$  (at the end of the test). In both tests total activity of back muscles on both sides reduces. It permits to speak about possible two sided trauma of spinal roots of this backbone segment, which is characteristic for clinical symptoms of osteochondrosis.

After rehabilitation in complex with apparatuses Ceragem Master CGM 3500 in experimental group we observed the following:

- In four persons there were no improvement; two of them had reduced integral amplitude ( $p < 0.05$ ) on both sides at the beginning and at the end of the test;
- Concerning ten persons, total electric activity of back muscles was  $497.6 \pm 67.1 \text{ mV} \times \text{sec.}$  (on convex side of scolytinae arc) at the beginning of static test and  $510.2 \pm 64.4 \text{ mV} \times \text{sec.}$  (on concave side). It was confidently ( $p > 0.05$ ) higher than before the procedures ( $313.4 \pm 57.5 \text{ mV} \times \text{sec.}$ ,  $376.9 \pm 63.3 \text{ mV} \times \text{sec.}$ , accordingly) (see fig. 3).

By the end of test total electric activity of back muscles on convex side of scolytinae arc also increased ( $p > 0.05$ ). It was, in average,  $340.4 \pm 57.3 \text{ mV} \times \text{sec.}$  Before complex rehabilitation integral amplitude was  $278.6 \pm 54.8 \text{ mV} \times \text{sec.}$

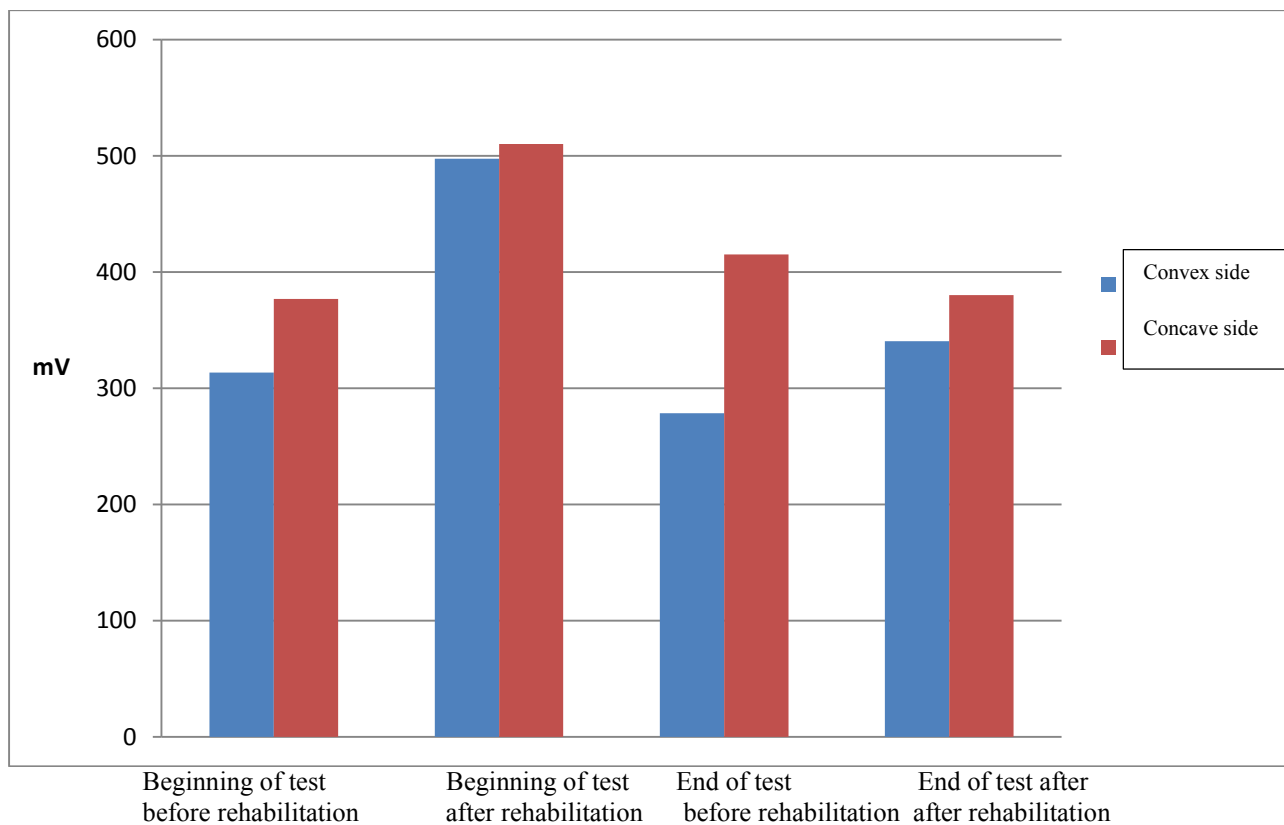


Fig.3 Mean group values of total electric activity of back muscles in experimental group with keeping of static force before and after rehabilitation

Electric activity of muscles on concave side before the end of the test reduced ( $p > 0.05$ ) in six persons from  $415.2 \pm 63.3$  mV $\times$ sec. (before complex rehabilitation) to  $380.2 \pm 32.5$  mV $\times$ sec. (after rehabilitation). In two tested it remained unchanged. The same picture was observed during dynamic load. Increment of total muscles' activity ( $p > 0.05$ ) was registered on convex side of scolytinae arc:  $892.6 \pm 58.3$  mV $\times$ sec. (at the beginning of test, before complex rehabilitation) to  $922.6 \pm 52.3$  mV $\times$ sec. (after rehabilitation); from  $558.4 \pm 84.4$  mV $\times$ sec. (at the end of the test) to  $878.4 \pm 81.3$  mV $\times$ sec. (after test) ( $p < 0.05$ ).

During examination female patients complained on pain in lumbar sacral sector. Most of them had pain expanded to lower limb with root syndrome. This syndrome is characteristic for lumbar osteochondrosis of backbone at level of L5 and S1. It is known that sacral plexus together with coccygeal plexus innerves buttocks, hips, shin and feet. That is why we conducted EMG – testing of shin muscle.

Comparative analysis of EMG parameters showed that in relative rest in experimental group there happened confidently significant ( $p < 0.05$ ) reduction of amplitude of maximal reflective spinal response of shin muscle (see table 1).

Table 1.

*Electric miogram parameters of shin muscle in rest state*

Indicators	Control group n=12	Experimental group n=11	
		Before rehabilitation	After rehabilitation complex
Maximal amplitude of H-response, mV	$5.6 \pm 0.8$	$3.9 \pm 1.2$	$4.3 \pm 0.9$
Current of maximal H-response, mA	$6.4 \pm 1.6$	$10.8 \pm 2.0$	$8.9 \pm 1.9$
Threshold current of H-response, mA	$7.9 \pm 1.6$	$9.0 \pm 2.1$	$8.6 \pm 1.2$
Maximal amplitude of M-response, mV	$7.4 \pm 1.3$	$5.2 \pm 0.6$	$6.4 \pm 0.9$
Current of maximal M-response, mA	$6.0 \pm 0.8$	$6.9 \pm 1.6$	$6.6 \pm 1.8$
Threshold current of M-response, mA	$7.1 \pm 1.4$	$12.3 \pm 2.4$	$7.8 \pm 2.9$

H-response to affected limb of two tested persons was absent. After rehabilitation procedures mean group maximal amplitude of H-response increased from  $3.9 \pm 1.2$  mV to  $4.3 \pm 0.9$  mV (see table 1). In two patients its value was near maximal amplitude of healthy persons. Threshold of nerve fibers' irritation in patients with scoliosis is higher than in healthy persons ( $p < 0.05$ ). Threshold current for receiving of M-response in experimental group was higher than in

control one. Threshold current does not differ confidently ( $p > 0.05$ ). Some patients ( $n=3$ ) have it even lower than in control group. It can point at insignificant reduction of quantity of sensitive fibers Ia or at their thinning [1, 16]. For obtaining of maximal by amplitude H-response in experimental group it is necessary to apply higher current ( $p < 0.05$ ), than in control group.

M-response is a total electric potential of muscles in response to single electric irritation of motor fibers of mixed periphery nerve. Maximal amplitude of motor response in control group is confidently lower than in patients with scoliosis. In some tested persons ( $n=2$ ) we observed crest-like form of indicator. In some cases ( $n=3$ ) in experimental group M-response appeared the first. In the process of current increasing H-response also appeared. In other cases ( $n=2$ ) with increasing of stimulation and simultaneous increasing of M-response there was no reduction of H-response amplitude. Output M-response shows that for irritation of low threshold afferent fibers Ia (which are responsible for H-response) less current is required than for activation of efferent motor fibers (which are responsible for M-response) [6, 15]. The found peculiarity can point at the fact that in condition of damaged spinal nerve sensitive afferents Ia suffer to larger extent than efferent fibers [1, 17]. After complex rehabilitation with electric therapeutic apparatus Ceragem Master CGM 3500 many patients ( $n=10$ ) had increased maximal amplitude of M-response ( $p > 0.05$ ). Its mean group value was  $6.4 \pm 0.9$  mV, comparing with initial level of  $5.2 \pm 0.6$  mV. Also threshold current confidently reduced ( $p < 0.05$ ) in ( $n=8$ ). Two patients did not demonstrate obvious changes of EMG parameters.

### Discussion

The results of our researches are confirmed by data of other scientists. A.M. Ziedman et al. [5], Berven S. and Bradford D.S. [13] showed that innervations of para vertebral muscles on convex and concave sides of scolytinae arc confidently differs from biological activity of the same muscles of healthy peers. With it, EMG amplitude and total value of biological activity on convex side of arc is higher. EMG frequency is lower than on concave side. At the beginning of our research we received the same results. T.A. Korshunova [11] and S.L. Shcherbinin [9] connect increasing of muscles' biological activity on convex side of deformation with increasing of motor neurons' irritation under influence of increased impulses from over stretched muscles. Significant distinctions in biological activity of para vertebral muscles on convex side of scolytinae arc are connected with progressing of deformation. The authors use these data as diagnostic criteria for prognosis of disease.

Similar EMG researches were conducted by A.L. Boyko [2] and Yu.A. Maximova [10] on sportsmen, suffering from lumbar-sacral osteochondrosis. That is why we can note that changes in nervous-muscular apparatus of persons with scoliosis and osteochondrosis of backbone are of the same type.

In our EMG researches of shin muscle we confirmed the data about reduction and asymmetry of quickness of irritating impulses' conduct by motor fibers of shin nerves [3, 11].

The results, received by us are of certain novelty. We received the data about positive influence of electric therapeutic apparatus– Ceragem Master CGM 3500 on nervous-muscular system of female patients with scoliosis.

### Conclusions

Application of apparatus Ceragem Master (CGM) renders tonic effect on healthy persons. It increases total electric activity of back muscles. Among female patients of experimental group most of them felt positive effect in work of nervous-muscular functioning of back muscles.

After complex rehabilitation we observed:

- Increase of integrated amplitude of back muscles' electric activity on convex and concave sides of scolytinae arc;
- Increase of maximal amplitude of H-reflex and M-response of shin muscle;
- Reduction of threshold current for receiving of H-reflex and M-response;

Thus, standard EMG (except differentiated diagnostics of deformation's etiology and character of its progressing) permits: to receive information about functional state of muscles and central nervous system's structures of patients with scoliosis; to assess effectiveness of rehabilitation process. The conducted researches showed purposefulness of application of electric therapeutic apparatus– Ceragem Master CGM 3500 in general program of health related-correction measures in rehabilitation of persons with scoliosis.

*The future researches* shall be oriented on determination or purposefulness of application of electric therapeutic apparatus– Ceragem Master CGM 3500 in system of correction measures for patients with osteochondrosis of backbone.

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### Conflict of interests

The author declares that there is no conflict of interests.

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