Myofascial Manual Release In Cardiac Rehabilitation: Therapeutic Effects Post Sternotomy Surgery

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Abstract

Cardiovascular diseases represent actually the major cause of premature death in Europe even if there has been a drop in the death rate caused by those pathologies in developed countries, while they still preserve their main role as death cause in developing countries. Therefore, considering also the spread of surgical intervention aimed at the care of these pathologies, it is important to assesses the relevance of a structured physiotherapeutic approach in the improvement of these kind of diseases.

In this experimental study, we would like to evaluate the effectiveness of a rehabilitation treatment based on the use of Neuromuscular Manual Therapy Techniques on the functional recovery of patients undergoing cardiac surgery via sternotomy. A total of 16 patients undergoing hearth sternotomy surgery were selected and treated with Neuromuscular Manual Techniques on the typically most dysfunctional muscles for this kind of conditions, for a total of 6 weekly sessions in 24,9 days of hospitalization, carried out before and after the hearth surgery.

Results obtained showed as the Neuromuscular Manual Therapy affect in a positive way the state of health and quality of life of patients submitted to cardiac surgery in the recovery period, improving vital parameters and motor abilities of patients. We can conclude that Neuromuscular Manual Therapy could be considered a useful tool in the management of this disease.

Key words: Cardiological Rehabilitation, Manual Therapy, Surgery, cardiovascular pathologies

Introduction

Cardiovascular diseases still represent the leading cause of premature death in Europe, although in recent decades there has been a substantial decrease in cardiovascular mortality in many European countries. It is estimated that over 80% of the total CVD mortality is currently occurring in developing countries: coronary artery disease accounts for the majority of the morbidity and mortality associated with such pathological conditions[1].

However, with the fall of Coronary heart disease mortality rates, an increasing number of people live with Coronary heart disease and may need support to manage their symptoms and prognosis. Cardiac rehabilitation after myocardial surgery improves exercise tolerance, coronary risk factors, psychological well-being, and health-related quality of life.

A multidisciplinary Cardiovascular Rehabilitation (CR) Program typically includes aerobic training, health education, counseling for the patient and his family about the risk factors and lifestyle changes (weight loss, discontinuance of cigarette smoking, stress management).

The World Health Organization has defined the Cardiac Rehabilitation as a multifactorial process, active and dynamic, that has as its main goals to establish the clinical stability, to reduce the disability resulting from the illness and to support the maintenance and recovery of a role active in society [2,3].

In randomized, controlled trials, Meta-analyses suggest that CR also reduces long-term mortality [4,5], but none of the 4300-plus patients in the 2 earlier meta-analyses and none of the 7600-plus patients in the recent meta-analysis were older

than 75 years. Furthermore, in the most recent trial of CR in the elderly, the average age was only 71 years [6]. Exercise-based cardiac rehabilitation (CR) aims to improve the health and outcomes of people with CHD.

Such a limited generalizability of results of CR trials to the older population identifies an important research gap.

Currently cardiovascular disease is a public health problem. According to the World Health Organization (WHO), about 17 million people every year die from cardiovascular diseases [7].

Cardiac surgery is a complex procedure that carries significant implications, both organic, and changes the patient's physiological mechanism, resulting in a higher incidence of complications that tend to significantly decrease the potential for recover [8].

Moreover, physiotherapy participates in the process of cardiac rehabilitation, before and after operative cardiac surgery, to contribute significantly to better prognosis, acting in the preoperative period with techniques aimed at the prevention and minimization of pulmonary complications, and in the postoperative period, with hygiene maneuvers and pulmonary expansion, to contribute on reducing the effects of time spent in the bed and decrease the length of the hospitalization period [9,10].

Thus, cardiac surgery requires the work of a multidisciplinary team, and the physiotherapist is one of the professionals, of great importance, involved in the rehabilitation process. According to the Guidelines for Cardiopulmonary and Metabolic Rehabilitation and the scientific Literature it becomes clear protocols for cardiac rehabilitation during hospitalization deficit. There are protocols that demonstrate a progression in which individuals go through stages (steps) that evolve according to their recover [11].

Others as a daily rehabilitation, adopting different therapeutic strategies in PO, both in cardiac rehabilitation after acute myocardial infarction as in the postoperative period of cardiac surgery [12,13,14].

However, in recent years, new therapeutic-rehabilitative proposals have been tried in the cardiac patient and in that underwent cardiac surgery, it was found that in these patients the responses of the cardiovascular, and respiratory systems get better after neuromuscular manual therapy [15, 16].

Manual therapy produces an analgesic and balancing effect of the sympathetic to starting receptor specific device system. The strong correlation between manual therapy and its effects, suggests that a central control mechanism could be activated by manual therapy [17].

It has been observed that somatic afferent discharges have a dual action on the sympathetic nervous system: a more generalized action on supraspinal reflexes via the sympathetic centers and a more limited action on the preganglionic neurons in segmental [18, 19]level.

The activity of skin patterns of the sympathetic nervous system in the clinical abnormalities of the musculoskeletal system are suspects are long, and the literature suggests that the patterns altered sympathetic activity (Sweat and vasomotor activities) changes or events seem to be reflected in sensory input derived from nerve endings and receptors in skeletal muscle tissue or the effects of direct insults to the nerve fibers, or a combination of both [20,21].

In this experimental study, we want to evaluate the effectiveness of a rehabilitation treatment based on the use of neuromuscular manual therapy techniques in terms of functional recovery in patients undergoing cardiac surgery via sternotomy.

Materials and methods

This experimental study and the research protocol is compatible with the Declaration of Helsinki. and all subjects involved in the study have been informed about the procedure and the aim of the research and signed the informed consent.

This study was conducted at the University Centre of Physical and Rehabilitation Medicine, „Gabriele D'Annunzio" University in Chieti in collaboration with the Department of Cardiovascular Diseases Institute of Research and Treatment John Paul II in Campobasso.

A sample of 16 patients undergoing heart sternotomy surgery was randomly selected. The sample consisted of 7 males (mean age 65.3) and 9 females (mean age 66.8 years); the intervention type of heart surgery were: coronary artery bypass, valve surgery.

The average distance from the execution of the first test (T0) and the surgery was of 7.7 days and the second test (pre-discharge: T2) 24.9 days.

The length of stay was 24.9375 (± 1.691892) days in the entire sample (25.28571 ± 1.4
days for the males; 24.6 ± 1.8 days for females)

Inclusion criteria

- Adherence to informed consent
- Cardiac intervention for sternotomy
- Aged between 50 and 80 years.

• No severe disabling diseases

Exclusion criteria

• Serious mental deficits
• Non-adherence to the informed consent
• Neurological result of cerebrovascular accident
• Neurological diseases

Each patient was subjected to a clinical and functional assessment in 2 phases of inpatient period:

• PRE-OPERATIVE PHASE T0 (at admission);
• POST REHABILITATION PHASE T2 (discharge from the Cardiac Rehabilitation Department).

Functional Evaluation

• Vittorio Test21

(Euroqol-5D, Test of Strength and upper and lower limbs flexibility, Foot Up and Go Test, 6 min walking test)

• ADL Scale
• Tinetti Scale

Fig. 1 Evaluation Method: Techniques

Clinical Evaluation

- Blood pressure
- Heart rate
- Peripheral oxygen saturation

Rehabilitation Program

Throughout the period of hospitalization, patients were subjected to 6 weekly sessions of neuromuscular manual therapy (MNT) lasting 40 minutes. The treatment in the hospital setting was carried out in three phases:

– pre-operative treatment;
– post-operative treatment in the ICU;
– treatment of Cardiac Surgery Department;
– treatment of Cardiac Rehabilitation Department.

The neuromuscular manual techniques have been used bilaterally for the treatment of the following muscles, expression of the most important somatic dysfunction clinically and functionally assessed, in the hospitalization period:

1. *Muscles of the foot's sole area* (in particular, abductor hallucis, abductor of the fifth finger, short flexor of the fingers, the quadratus plantae).
2. *Muscles of the pelvic floor (pubococcygeal)*.
3. *Diaphragm Muscle.*
4. *Muscle pectoralis minor.*
5. *Muscle elevator scapula.*

Data analysis

Wilcoxon Signed-Rank Test realized with the NCSS statistical analysis software was used for statistical analysis. Although often called Mann-Whitney test, the nonparametric equivalent of Student's t test for paired data is due also to Wilcoxon.

From the data analysis performed, we can conclude the following considerations and conclusions observing the Vittorio test parameters:

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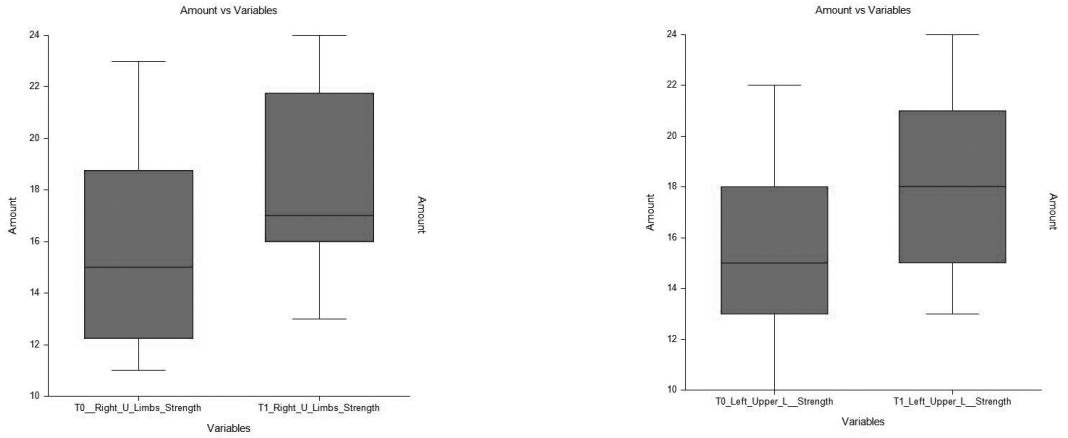
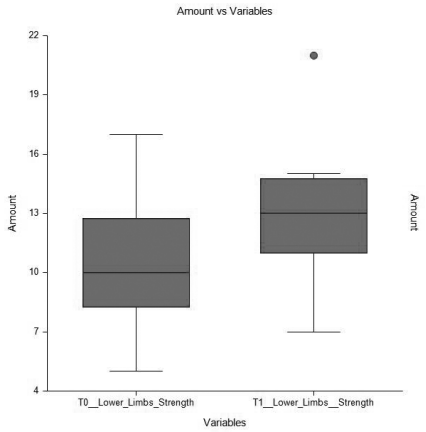
			Standard	Standard	95,0% LCL	95,0% UCL
Variable	Count	Mean	Deviation	Error	of Mean	of Mean
T0_Right_Upper_L__Strength	16	15,8125	3,986958	0,9967394	13,688	17,937
T1_Right_Upper_L__Strength	16	18,25	3,172801	0,7932003	16,55933	19,94067
Exact Probability*			Approx. Without Correction		Approx. With Correction	
Alternative	Prob	Reject H0	Prob	Reject H0	Prob	Reject H0
Hypothesis	Level	(α = 0,050)	Z-Value	Level	(α = 0,050)	Z-Value Level. (α = 0,050)
Diff ≠ 0		-2,0266	0,042704	Yes	-2,0077	0,044680 Yes
Standard	Left Upper Limbs Strenght					
Alternative	Mean	Error of			Prob	Reject H0
Hypothesis	Difference	Difference	T-Statistic	d.f.	Level at α = 0,050	
μ1 - μ2 ≠ 0	-2,5625	1,222936	-2,0954	29,96	0,04469	Yes



Graph 1 And 2 The strength of the upper limbs has increased significantly from a statistical point of view, with absolute best value for the upper limb right

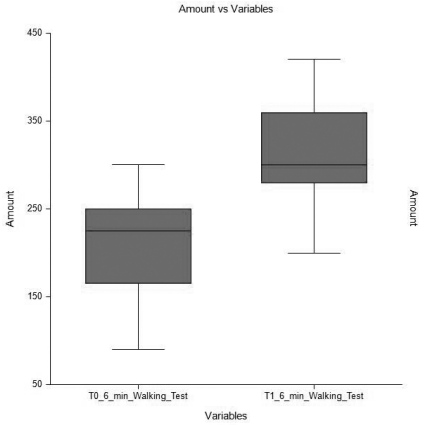
			Standard	Standard	95,0% LCL	95,0% UCL
Variable	Count	Mean	Deviation	Error	of Mean	of Mean
T0__Lower_Limbs_Strength	16	10,3125	3,198307	0,7995767	8,608243	12,01676
T1__Lower_Limbs__Strength	16	12,8125	3,187868	0,7995767	8,608243	14,5112
Alternative	Prob	Reject H0	Prob	Reject H0	Prob	Reject H0
Hypothesis	Level	(α = 0,050)	Z-Value	Level	(α = 0,050)	Z-Value Level. (α = 0,050)
Diff ≠ 0		-2,1602	0,030759	Yes	-2,1412	0,032255 Yes



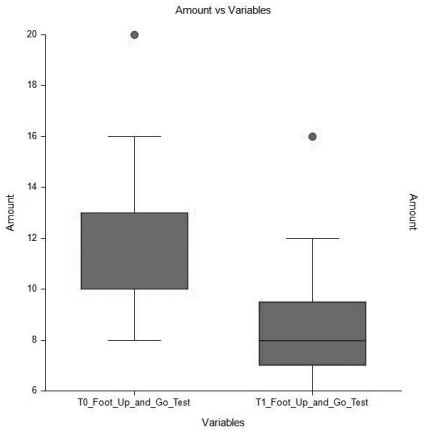
Graph 3 The strength of the lower limbs has increased significantly from a statistical point of view

As regards flexibility, it is not revealed a statistically significant increase in the load of the upper limbs, nor there has been a significant change in the lower limbs.

			Standard	Standard	95,0% LCL	95,0% UCL
Variable	Count	Mean	Deviation	Error	of Mean	of Mean
T0_6_min_Walking_Test	16	210	61,64414	15,41103	177,1522	242,8478
T1_6_min_Walking_Test	16	318,125	56,59432	14,14858	287,968	348,282
Alternative	Mean	Error of			Prob	Reject H0
Hypothesis	Difference	Difference	T-Statistic	d.f.	Level at α = 0,050	
μ1 - μ2 ≠ 0	-108,125	20,92086	-5,1683	29,78	0,00002	Yes

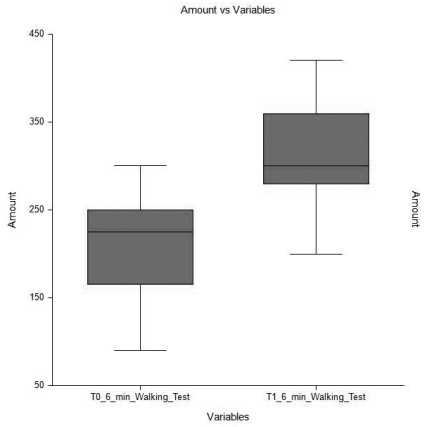


			Standard	Standard	95,0% LCL	95,0% UCL
Variable	Count	Mean	Deviation	Error	of Mean	of Mean
T0_Foot_Up_and_Go_Test	16	11,6875	3,048907	0,7622267	10,06285	13,31215
T1_Foot_Up_and_Go_Test	16	8,5625	2,475715	0,6189288	7,243284	9,881716
Standard						
Alternative	Mean	Error of			Prob	Reject H0
Hypothesis	Difference	Difference	T-Statistic	d.f.	Level at α = 0,050	
μ1 - μ2 ≠ 0	3,125	0,9818668	3,1827	28,79	0,00349	Yes

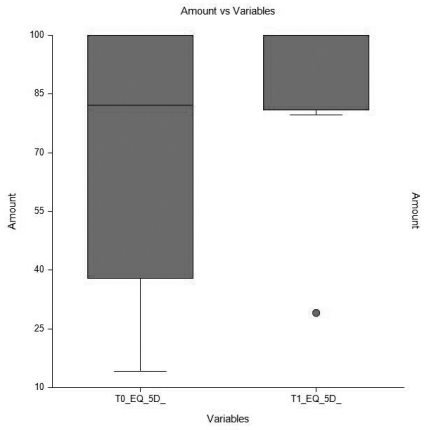


Graph 4 and 5 The skill and speed in walking (6 minute walking test and Foot up and go test) improved statistically significantly

			Standard	Standard	95,0% LCL	95,0% UCL
Variable	Count	Mean	Deviation	Error	of Mean	of Mean
T0_ADL_Scale	16	7,6875	0,8732125	0,2183031	7,222198	8,152802
T1_ADL_Scale	16	8,4375	0,7274384	0,1818596	8,049875	8,825125
Alternative	Mean	Reject H0	Prob	Reject H0	Prob	Reject H0
Hypothesis	Level	(α = 0,050)	Z-Value	Level	α = 0,050	Z-Value Level(α = 0,050)
Diff ≠ 0	-2,3646	0,018050	Yes	-2,3445	0,019050	Yes



Graph 6 The test that evaluates the quality of life (ADL Scale) shows statistically significant increases

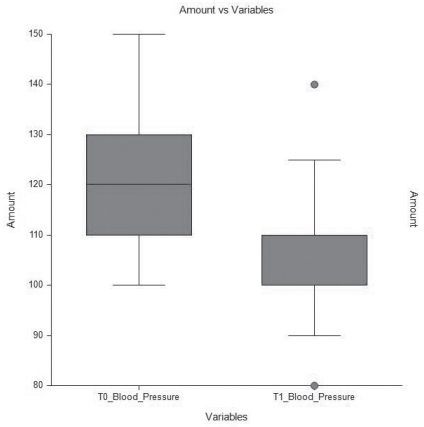


Alternative	Prob	Reject H0	Prob	Reject H0	Prob	Reject H0
Hypothesis	Level	(α = 0,050)	Z-Value	Level	α = 0,050	Z-Value Level(α = 0,050)
Diff ≠ 0	-1,5776	0,114647	No	-1,5574	0,119371	No

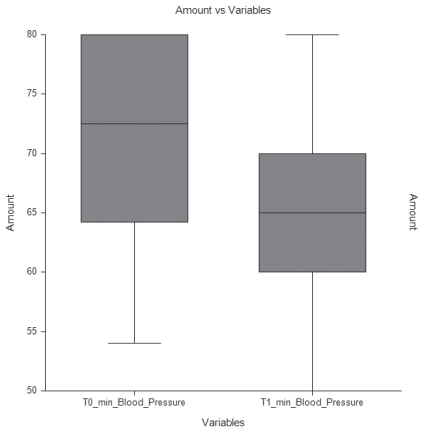
Graph 7 The test instead also includes the psychological component (EQ-5D), to visible improvements numerically, there were no statistically significant ones.

It did not observe a significant increase in the score at the Tinetti test for the walking and the balance.

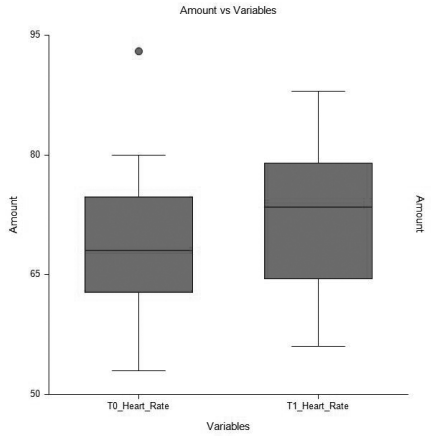
T0_Blood_Pressure	16	120,8125	13,05996	3,264989	113,8533	127,7717
T1_Blood_Pressure	16	105,3125	14,54519	3,636297	97,56191	113,0631
Note:	T*(T0_Blood_Pressure) = 2,1314;		T* (T1_Blood_Pressure) = 2,1314			
Alternative	Prob	Reject H0	Prob	Reject H0	Prob	Reject H0
Hypothesis	Level	(α = 0,050)	Z-Value	Level	α = 0,050	Z-Value Level(α = 0,050)
Diff ≠ 0	2,9607	0,003069	Yes	2,9415	0,003267	Yes



			Standard	Standard	95,0% LCL	95,0% UCL
Variable	Count	Mean	Deviation	Error	of Mean	of Mean
T0_min_Blood_Pressure	16	71,4375	9,430226	2,357557	66,41249	76,46251
T1_min_Blood_Pressure	16	65	7,302968	1,825742	61,10852	68,89148
Alternative	Mean	Reject H0	Prob	Reject H0	Prob	Reject H0
Hypothesis	Level	(α = 0,050)	Z-Value	Level	α = 0,050	Z-Value Level(α = 0,050)
Diff ≠ 0	2,0420	0,041155	Yes	2,0225	0,043123	Yes



			Standard	Standard	95,0% LCL	95,0% UCL
Variable	Count	Mean	Deviation	Error	of Mean	of Mean
T0_Heart_Rate	16	69,125	10,03909	2,509773	63,77555	74,47446
T1_Heart_Rate	16	72	9,612492	2,403123	66,87786	77,12214
Alternative	Mean	Reject H0	Prob	Reject H0	Prob	Reject H0
Hypothesis	Level	(α = 0,050)	Z-Value	Level	α = 0,050	Z-Value Level(α = 0,050)
Diff ≠ 0	-0,7559	0,449692	No	-0,7370	0,461104	No



			Standard	Standard	95,0% LCL	95,0% UCL
Variable	Count	Mean	Deviation	Error	of Mean	of Mean
T0_Heart_Rate	16	96,375	1,5	95,57571	97,17429	
T1_Heart_Rate	16	96,875	1,087811	0,2719528	96,29535	97,45465
Standard						
Alternative	Mean	Error of			Prob	Reject H0
Hypothesis	Difference	Difference	T-Statistic	d.f.	Level at α = 0,050	
μ1 - μ2 ≠ 0	-0,5	0,4632314	-1,0794	27,36	0,28985	No

Graph 8 and 9 The values of vital signs have improved in a statistically significant way, except for the values the values of peripheral oxygen saturation (SpO2). The significant finding of statistical evidence used was $p < 0.05$.

Discussion and conclusion

In this study, the aim was to experience the effectiveness of neuromuscular manual therapy before and after surgery in patients undergoing cardiac surgery via sternotomy, the motor and overall functional abilities, and the patient's level of autonomy during the period of hospitalization.

Neuromuscular manual techniques applied on certain muscle and fascial districts, that at the clinical and functional evaluation were significantly more dysfunctional from a somatic point of view before and in the period following surgery, allowed a statistically significant improvement in particu-

lar as regards abilities and the speed of gait, and as regards the strength of the upper and lower limbs bilaterally.

However it was not found no statistically significant improvement of joint flexibility generated by the upper and lower limbs. As regards the vital parameters taken into account, there was a statistically significant reduction of blood pressure values.

The results obtained finally showed as the neuromuscular manual therapy affect in a positive way the state of health and quality of life of patients submitted to cardiac surgery in the recovery period.

The study showed the real potential and safety of use of the neuromuscular manual therapy, confirming the hypothesis already demonstrated in literature about the relationship existing between somatic and autonomic stimulation implications, without risk to the patient.

Myofascial continuity ensures that the correct somatic stimulation can achieve positive structural effects and autonomic effects (local and general).

Researches have clarified and described the neural pathways by which the stimulation of the sensory-somatic receptors (ending nerves of the musculoskeletal system) produces visceral reflexes [22,23].

The primary afferent nociceptors hyperfunctioning lead to an increase of functions of the anterior roots of the spinal cord, with a consequential increase in the tonic state of the associated muscles on the correlated spinal segment [24,25].

The centers of the somatosensory spinal reflexes may show a very strong segmental organization and effects on the innervated organs may be quite specific [26,27,28].

When the central nervous system is intact, responses are sometimes general, as seen in cerebral cortical blood flow, heart rate, adrenal medullary hormonal secretion and splenic immune function, whereas sometimes they have a strong segmental organization. The analysis of neural mechanisms of these reflex responses seems to be very important for clinical application to regulate visceral functions by somatic stimulation [29].

Previous evidence indicate that inhibitory cardiac sympathetic reflexes originating from arterial baroreceptors and excitatory ones originating from somatic afferents interact, probably, at the brainstem [30].

Considering the lack of scientific evidence in the literature regarding this specific subject, our experience could be a good beginning for future studies program.

However, benefits of such a rehabilitative approach, presented in this pilot study, could justify the need for a study involving a larger number of subjects.

According to these experiences neuromuscular manual therapy, such as proper stimulation of the somatic system, could be considered a formula of integrated intervention in the cardiac rehabilitation already used and accepted in the scientific literature in the patient's cardiac rehabilitation treatment, thereby further improving the physiological and psycho-social status subject, and leading to a reduction in length of stay and thus to a reduction of costs and commitment of health care facilities.

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