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ORIGINAL ARTICLE

Influence of osteopathic manipulation on blood flow velocity of the cerebral circulation in chronic mechanical neck pain*

Influência da manipulação osteopática na velocidade de fluxo sanguíneo da circulação cerebral em indivíduos com cervicalgia mecânica crônica

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ABSTRACT

BACKGROUND AND OBJECTIVES: Osteopathic manipulation is indicated for pain, myofascial tensions and/or decreased movement amplitude. This study aimed at checking whether osteopathic manipulation with cervical rhythmic articulatory technique generates abnormal blood flow velocity oscillations or risks to internal carotid, vertebral and basilar arteries circulation.
METHODS: The sample was made up of 58 individuals with chronic mechanical cervical pain (40 females and 18 males), with mean age of 36 years, submitted to internal carotid, vertebral and basilar arteries ultrasound before and after a single osteopathic manipulation with cervical rhythmic articulatory technique. Individuals were evaluated by ultrasound in three moments: control evaluation, rest control evaluation and study evaluation. Separation was sequential and methods were randomly and blindly applied.
RESULTS: Ultrasound has shown no significant differences in the comparison of flow velocity variables means among evaluations. However, a slight increase in vertebral, intracranial and basilar arteries blood flow was observed after osteopathic manipulation with cervical rhythmic articulatory technique in the study evaluation, without statistical significance.
CONCLUSION: In this studied population, osteopathic manipulation with cervical rhythmic articulatory technique has not generated significant blood flow velocity oscillation of internal carotid, vertebral and basilar arteries and has not posed risk to brain circulation.
Keywords: Carotid arteries, Cervical pain, Doppler Ultrasound, Spine manipulation, Vertebral artery.

RESUMO

JUSTIFICATIVA E OBJETIVOS: Na presença de dor, tensões miofasciais e/ou redução da amplitude de movimento, é indicada a manipulação osteopática. O objetivo deste estudo foi verificar se a manipulação osteopática com técnica articulatória rítmica cervical gera oscilações anormais de velocidade de fluxo sanguíneo ou riscos à circulação das artérias carótidas internas, vertebrais e basilar.
MÉTODOS: A casuística foi constituída por 58 indivíduos com cervicalgia mecânica crônica (40 mulheres, 18 homens) com idade média de 36 anos, submetidos a ultrassonografia das artérias carótidas internas, vertebrais e basilar antes e após única manipulação osteopática com técnica articulatória rítmica cervical. Os indivíduos foram analisados pela ultrassonografia em três momentos: exame controle, exame controle de repouso e exame estudo. A separação se deu de forma sequencial e os métodos de forma randomizada e encoberta.
RESULTADOS: A ultrassonografia demonstrou que não existe diferença significativa em nenhum dos casos analisados, no comparativo das médias das variáveis de velocidade de fluxo entre os exames. Porém, foi observado um discreto aumento na velocidade de fluxo sanguíneo das artérias vertebral, intracraniana e basilar, após a manipulação osteopática com técnica articulatória rítmica cervical no exame estudo sem significância estatística.
CONCLUSÃO: Nessa população estudada, a manipulação osteopática com técnica articulatória rítmica cervical não gerou significativa oscilação da velocidade de fluxo sanguíneo das artérias carótidas internas, vertebrais e basilar e não ofereceu risco à circulação cerebral.
Descritores: Artérias carótidas, Artéria vertebral, Cervicalgia, Manipulação da coluna, Ultrassonografia Doppler.

INTRODUCTION

Vertebral somatic dysfunctions and spinal injuries are in general caused by sudden and unexpected movement. These dysfunctions generate medullary, peripheral and autonomic neural circuit sensitization, called sensitization phenomenon or medullary facilitation, where there is sympathetic hyperactivity with increased vascular tone, venous and lymphatic congestion, change in visceral-somatic reflexes and myofascial tensions. This may bring some signs and symptoms such as cervical pain, postural change and decreased amplitude of some movements[1-8].

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In normal individuals, in spite of the complex pathway, vertebral arteries (VA) blood flow should not be impaired by normal spinal movements, because there is immediate and enough compensation of arterial irrigation to the brain through arterial branches and ccommunications. In case of vertebrobasilar insufficiency (VBI), clinical tests envolve cervical extension associated to rotation above 45 or 50º, which compress vertebral artery. During these tests, there may be typical symptoms such as dizziness or vertigo, visual disorders, nystagmus or even fainting, but seldom they cause stroke or death[9-13]. However, such signs and symptoms may also suggest benign paroxysmal positional vertigo and not VBI[14].

Osteopathic Manipulation (OM) aims at treating somatic dysfunctions or vertebral hypomobility correlated to pain, myofascial tensions, loss of movement amplitude, postural change, dizziness of cervical origin, some headaches, etc.[7,8,11,12,15,16]. After cervical manipulation or mobilization, it is considered that there is a normalizing effect on the nervous system, allowing normalization of vascular tone (spasm), as well as of vertebral and carotid arteries, with improvement in blood flow velocity by ultrasound analysis[12,13], improvement of muscle strength and resistance[15] and decreased headache[16].

There are different osteopathic techniques, among them the Cervical Rhythmic Articulatory Technique (CRAT)[3,7,8,12]. It is described that VA dissection associated to cervical manipulation is uncommon, but it can be severe or fatal in some cases[17-19]. There are reports that cervical manipulation and mobilization do not pose risk to VA and carotids[13,20-22], and it is considered that vertebral and carotid arteries dissection or injury should be attributed to mechanical impact common during car accidents (whiplash) or to arterial diseases, being uncommon for cervical manipulation to generate such injury[13,19,21,23].

Vascular ultrasound is indicated to evaluate blood flow from internal carotid (ICA), vertebral (VA) and basilar (BA) arteries. This is a non-invasive exam that screens arteries and analyzes the integrity of vertebrobasilar or carotid systems through arterial flow velocity and other data[12,24,25].

This study aimed at checking whether OM-CRAT generates abnormal oscillations or risks to the circulation of internal carotid, vertebral and basilar arteries. The hypothesis is that OM-CRAT may generate blood flow oscillations shown by ultrasound without impairing health. Is OM-CRAT a safe therapeutic technique for the health of such arteries in individuals with mechanical cervical pain?

METHODS

Sample was made up of 58 individuals with chronic mechanical cervical pain, being 18 males and 40 females with mean age of 36.0±6.5 years (males: 36.5±6.1 years / females: 34.8±7.3 years), involving a volunteer group of employees of the Clinicas Hospital, Federal University of Paraná. Study period was from August 2010 to March 2012.

Inclusion criteria were individuals of both genders with chronic common cervical pain of mechanical origin, mild to moderate intensity according the Neck Disability Index, aged between 25 to 45 years. Exclusion criteria were any change preventing the performance of the protocol, severe cervical hypomobility (for ex., unco-arthritis, discopathy, bone malformation), spinal deformity (for ex., Scheuermann disease), individuals in post-surgical state, sequelae by brain or spinal trauma, using clutches, walking aids or wheelchair.

Individuals were evaluated by ultrasound in three moments (ICAs, VAs and BA), including control evaluation (CE), 5-min rest control evaluation (RCE) and study evaluation (SE). Separation was sequential and methods were randomly and blindly applied. Procedures were carried out in a single session of approximately 30 min.

After interview, data collection and signature of the Free and Informed Consent Term (FICT), individuals laid down in supine position on a stretch with small and low pillow (children's style), remaining like this in a silent environment until the end of the following sequence of procedures: (1) Ultrasound (CE); (2) Rest or OM-CRAT; (3) Ultrasound (RCE or SE); 94) OM-CRAT or Rest; (5) Ultrasound (RCE or SE). In a randomized sequence, from 58 individuals, 29 have performed the Rest Method first and then the OM-CRAT method, and the other 29 individuals have performed the OM-CRAT method first and then the Rest Method. This separation was applied in case of possibility of differences in results. Methods were performed always by the same professionals (operator), being operator-1 for ultrasound and operator-2 for rest control and OM-CRAT.

Vascular ultrasound

These exams were performed by the same examiner (operator-1) who was blind to the evaluation moment, with ultrasound device model VIVID E, brand GE, with linear transducer of 7.5 to 10 MHz for extracranial circulation and with transversal transducer of 1.5 to 5 MHz for intracranial circulation.

There were three exam stages (CE, RCE, SE), lasting 3 min each. Soon after each one operator-1 would leave the room for 5 minutes and would return for the next stage. After routine exam to evaluate abnormal findings in carotid and vertebral arteries and lack of pathological changes, arterial Doppler samples were saved for right ICA (RICA), left ICA (LICA), right VA (RVA) and left VA (LVA) (Figure 1), RVA in its intracranial segment (RVAintra), LVA in its intracranial segment (LVAintra) and BA. Second and third stages were started with direct analysis of vessels LICA, LVA, RICA, RVA, LVAintra, RVAintra and BA. From all analyzed vessels, the following variables were collected: peak systolic velocity (PSV); end diastolic velocity (EDV); mean velocity (MV); pulsatility index (PI); resistance index (RI). The three latter were collected by means of a formula.

OM-CRAT

OM-CRAT was performed with the hands of operator-2 involving the neck with second fingers close to each vertebra and its interfacet joint (posterior region of transverse processes). With passive, rhythmic and smooth movements with 3 repetitions for each interfacet joint (zygapophisial), that is, with mobilizations from one side to the other, associating

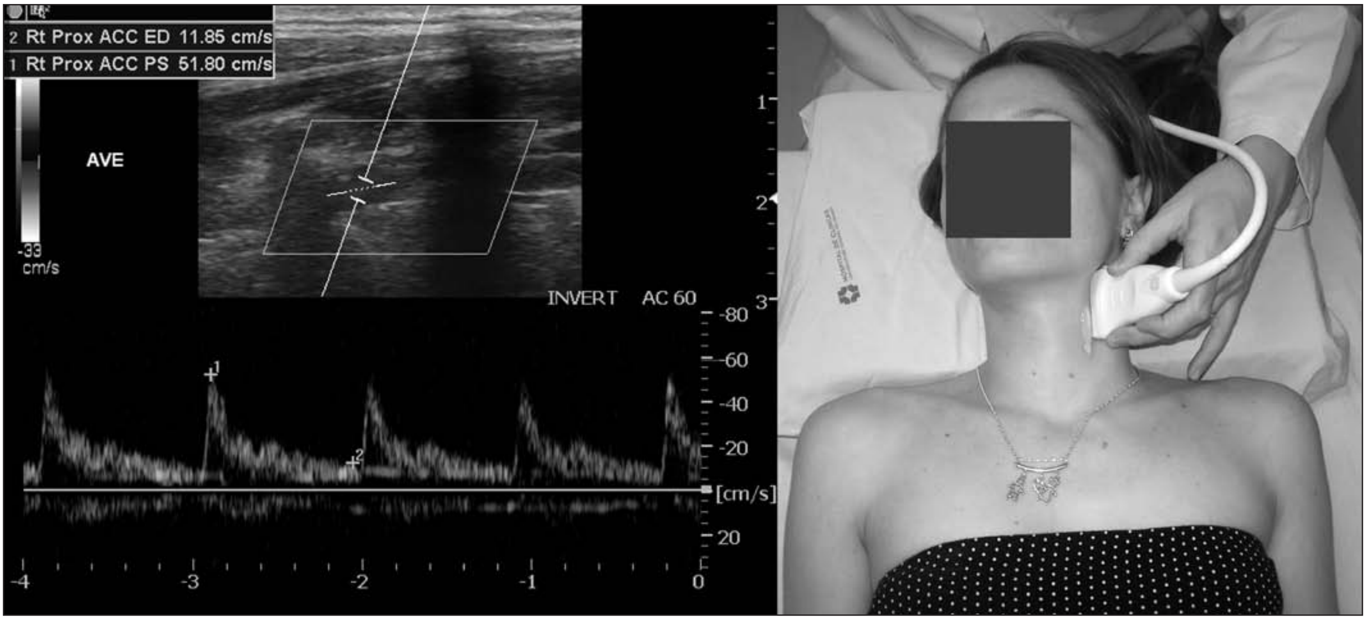

Figure 1. Arterial ultrasound: image of blood vessel and image of blood flow Doppler effect, and application of the method.

lateral sliding with rotation (Figure 2A), with a movement in "∞" at axial view. The process was started in the first thoracic vertebra (T1) ascending by all cervical vertebrae until antlantoccipital joints. In upper cervical, 3 mobilizations in flexion and 3 in bilateral extension of occipital condyles (atlantoccipital) were added (Figure 2B), plus 3 lateral slidings for atlas (Figure 2C) and 3 rotations for C3 and 3 rotations for C2-C1 (Figure 2D). For atlantoccipital vertebrae, one of the hands remained over the head of the subject (frontal or lateral region).

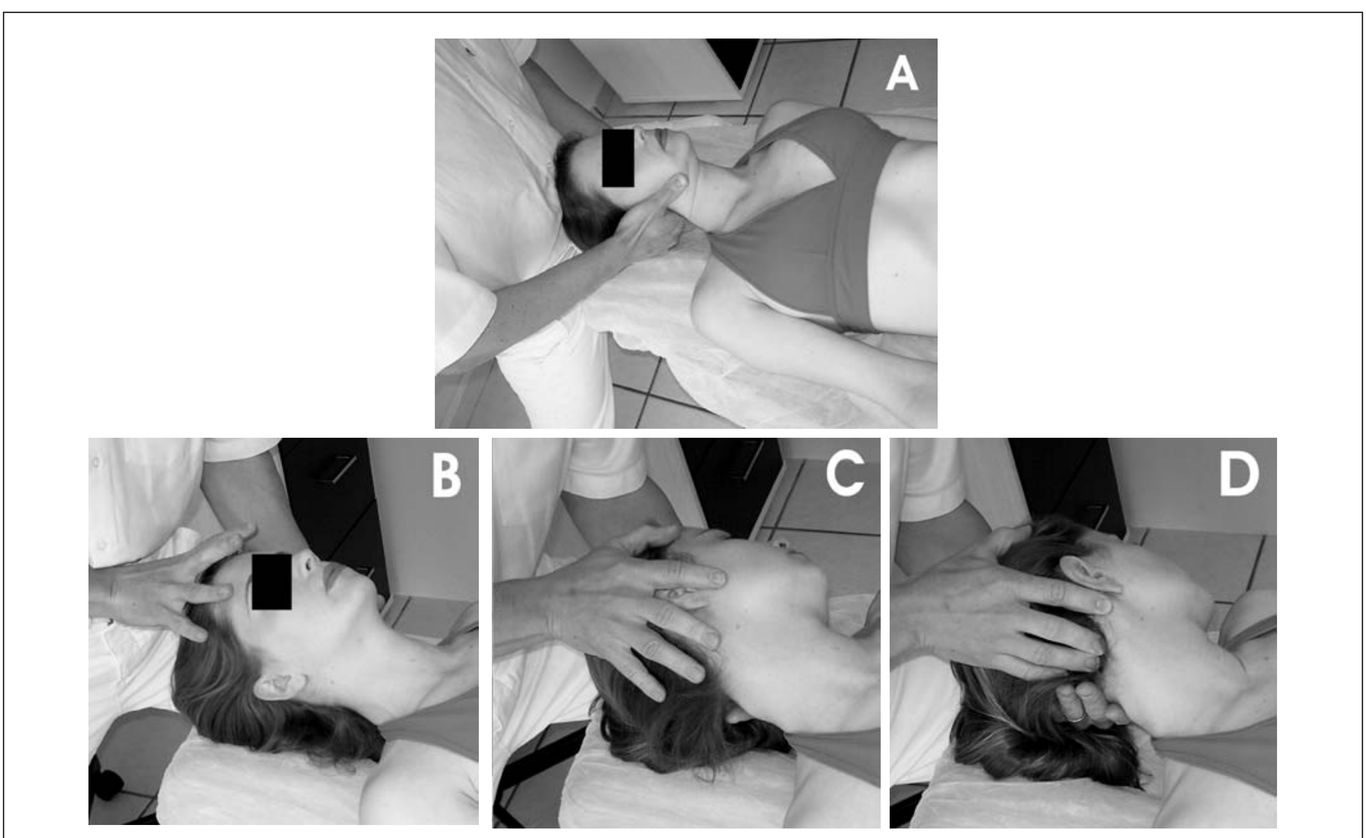

Figure 2. Osteopathic manipulation with cervical rhythmic articulatory technique. (A) Sliding. (B) Atlantoccipital flexion and extension. (C) Atlas sliding. (D) Atlas-axis rotation.

Rest

Controlled by operator-2, subjects were oriented to relax and rest for 5 minutes.

Statistical analysis

Student *t* test was applied with significance level of 0.05 (5%). Soon after the beginning of the study, carotid ultrasound was included in the method, having analyzed 46 individuals for internal carotid artery and 58 individuals for vertebral and basilar arteries. This difference has not interfered with results because the analysis was artery by artery rather than a comparison among different arteries, which differ in size and blood flow. Program used was Excel 2012.

This study was approved by the Research Ethics Committee (Registration CEP-HC-UFPR: 2233.127/2010-06) and complies with the Declaration of Helsinki.

RESULTS

Table 1 shows no significant difference in the comparison of peak systolic velocity (PSV, EDF, MV) between CE and SE with the application of Student *t* test with significance level of 0.05 (5%). Table 1 also shows, however without statistical significance, a slight increase in intracranial arteries flow velocity, more noticeable in right intracranial vertebral artery, with PSV from 48.86 to 50.77 cm/sec; EDV from 23.74 to 25.26 cm/sec; MV from 32.11 to 33.77 cm/sec. To decrease table size, pulsatility and resistance indices were excluded.

Table 2 shows no significant difference in the comparison of flow velocity variables (PSV, EDV, MV) between RCE and SE, with the application of Student *t* test with significance level of 0.05 (5%). Table also shows, however without statistical significance, a slight increase in intracranial arteries flow velocity, more noticeable in right intracranial vertebral, with PSV from 47.56 to 50.77 cm/sec; EDV from 32.21 to 25.26 cm/sec; MV from 31.33 to 33.77 cm/sec.

Table 3 shows significant difference between comparison of flow velocity variables (PSV and MV) between CE and RCE in right carotid artery, by applying Student *t* test with significance level of 0.05 (5%). A slight decrease in flow velocity (PSV, EDV and MV) in other arteries and of PSV of right internal carotid artery was considered without statistical effect.

Table 1. Comparison of mean control and study evaluations

Vessel & side	Variables	Mean CE(cm/sec)	Mean SE(cm/sec)	Student *t* statistics	p value
Vert. extra R	PSV	51.69	46.98	1.540	0.1263
	EDV	15.86	15.05	0.721	0.4722
	MV	28.05	25.65	1.432	0.1550
Vert. extra L	PSV	53.48	50.28	1.318	0.1900
	EDV	17.03	16.47	0.545	0.5870
	MV	29.18	27.74	1.056	0.2934
Vert. intra R	PSV	48.86	50.77	-0.806	0.4219
	EDV	23.74	25.26	-1.331	0.1860
	MV	32.11	33.77	-1.103	0.2722
Vert. intra L	PSV	56.26	54.95	0.516	0.6067
	EDV	26.83	27.02	-0.156	0.8765
	MV	36.64	36.33	0.195	0.8459
Basilar	PSV	64.17	65.31	-0.430	0.6679
	EDV	29.69	31.10	-1.141	0.2564
	MV	39.51	40.47	-0.507	0.6133
Carotid R	PSV	81.22	77.20	0.847	0.3994
	EDV	29.22	27.63	0.858	0.3934
	MV	46.55	44.15	0.987	0.3264
Carotid L	PSV	83.04	80.13	0.658	0.5119
	EDV	31.11	30.43	0.404	0.6870
	MV	48.42	47.00	0.608	0.5445

R: right; L: left; Vert. extra: extracranial vertebral; Vert. intra: intracranial vertebral; CE: control evaluation; SE: study evaluation; PSV: peak systolic velocity; EDV: end diastolic velocity; MV: mean velocity.

Table 2. Comparison of mean rest control and study evaluations

Vessel & side	Variables	Mean RCE(cm/sec)	Mean SE(cm/sec)	Sudent *t* statistics	p value
Vert. extra R	PSV	48.36	46.98	0.448	0.6548
	EDV	15.67	15.05	0.525	0.6005
	MV	26.97	25.65	0.758	0.4497
Vert. extra L	PSV	51.60	50.28	0.463	0.6444
	EDV	16.62	16.47	0.144	0.8860
	MV	28.28	27.74	0.356	0.7223
Vert. intra R	PSV	47.56	50.77	-1.330	0.1863
	EDV	23.21	25.26	-1.768	0.0797
	MV	31.33	33.77	-1.588	0.1151
Vert. intra L	PSV	54.14	54.95	-0.316	0.7528
	EDV	26.41	27.02	-0.429	0.6691
	MV	35.66	36.33	-0.389	0.6978
Basilar	PSV	64.03	65.31	-0.443	0.6588
	EDV	29.91	31.10	-0.893	0.3738
	MV	39.29	40.47	-0.578	0.5645
Carotid R	PSV	71.91	77.20	-1.236	0.2198
	EDV	27.02	27.63	-0.330	0.7424
	MV	41.99	44.15	-0.954	0.3425
Carotid L	PSV	79.54	80.13	-0.142	0.8871
	EDV	29.33	30.43	-0.762	0.4483
	MV	46.07	47.00	-0.447	0.6557

R: right; L: left; Vert. extra: extracranial vertebral; Vert. intra: intracranial vertebral; RCE: rest control evaluations; SE: study evaluation; PSV: peak systolic velocity; EDV: end diastolic velocity; MV: mean velocity.

Table 3. Comparison between means of control and rest control evaluations

Vessel & side	Variables	Mean CE(cm/sec)	Mean RCE(cm/sec)	Student *t* statistics	p value
Vert. extra R	PSV	51.69	48.36	1.038	0.3013
	EDV	15.86	15.67	0.159	0.8743
	MV	28.05	26.97	0.592	0.5549
Vert. extra L	PSV	53.48	51.60	0.693	0.4899
	EDV	17.03	16.62	0.387	0.6995
	MV	29.18	28.28	0.617	0.5382
Vert. intra R	PSV	48.86	47.56	0.562	0.5756
	EDV	23.74	23.21	0.494	0.6220
	MV	32.11	31.33	0.545	0.5869
Vert. intra L	PSV	56.26	54.14	0.827	0.4101
	EDV	26.83	26.41	0.289	0.7734
	MV	36.64	35.66	0.562	0.5750
Basilar	PSV	64.17	64.03	0.051	0.9597
	EDV	29.69	29.91	-0.174	0.8618
	MV	39.51	39.29	0.114	0.9091
Carotid R	PSV	81.22	71.91	2.182	*0.0317
	EDV	29.22	27.02	1.382	0.1703
	MV	46.55	41.99	2.147	*0.0345
Carotid L	PSV	83.04	79.54	0.871	0.3862
	EDV	31.11	29.33	1.057	0.2935
	MV	48.42	46.07	1.062	0.2909

R: right; L: left; Vert. extra: extracranial vertebral; Vert. intra: intracranial vertebral; CE: control evaluation; SE: study evaluation; PSV: peak systolic velocity; EDV: end diastolic velocity; MV: mean velocity.

DISCUSSION

In this study, OM-CRAT was performed in all directions of manipulative movement within spinal physiological limits, including positions similar to classic osteopathic and chiropathic manipulations without using extension with rotation positioning[3,7,8,12].

So, results by immediate ultrasound evaluation have shown (Tables 1 and 2) that there have been no abnormal[24,25] or significant oscillations in blood flow velocity of the studied population. It is possible to state that OM-CRAT in sliding and rotation has not posed risk to the circulation of such arteries and, according to some literature statements, osteopathic manipulative treatment or vertebral manipulation has not caused injury or undue tension on vertebral and carotid arteries[12,13,20-22], providing significantly lower sliding than that of clinical tests for VBI[9,10,13,20]. So, cervical manipulation performed by a professional was not in this study a risk factor for vertebrobasilar and carotid injury[12,13,20-23].

Results of our study confirm that no individual has presented VBI or carotid failure by ultrasound before and after OM-CRAT, because there have been no significant oscillations on the flow of such arteries on CE-SE (Table 1) and on RCE-SE (Table 2), with results within normality indices[24,25]. The study has involved healthy individuals with common cervical pain, and in comparison to mentioned descriptions, in normal individuals vertebral arteries blood flow should not be impaired by common spinal movements or by cervical manipulation[9,21].

As to the hypothesis that OM-CRAT could increase arterial flow velocity this is still not confirmed because, without statistical significance, there has been just a slight increase of intracranial arteries flow velocity after OM-CRAT (SE: Table 1 and 2). However, without rest there has been significant or mild decrease in flow velocity (Table 3), so one may state that there is difference between performing or not OM-CRAT, which suggests further studies with individuals with dizziness of cervical origin or headache.

After OM-CRAT, some individuals have reported muscle relaxation or body comfort sensation. No individual submitted to OM-CRAT or to arterial ultrasound has reported pain or any other complaint.

Due to deadline and inclusion and exclusion criteria, we have closed the study with 58 of the 80 individuals proposed in the project draft.

Notwithstanding slight differences in flow increase, further investigations are suggested in individuals with dizziness or vertigo, where there is the possibility of significant flow oscillation.

CONCLUSION

Our study has shown that there is no significant vertebral (bilateral, intra and extracranial), basilar and internal carotid (bilateral) flow velocity oscillation with OM-CRAT, which brings safety to cervical manipulative treatment without risks of vascular complications as observed in the studied group.

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