

# EFFECT OF ACUPUNCTURE ON THE MOLAR BITE FORCE IN WOMEN WITH CHRONIC NECK PAIN

Efecto de la acupuntura sobre la fuerza de mordida en mujeres con cervicalgia crónico

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## ABSTRACT

**Objective:** To investigate the maximum molar bite force in women with chronic neck pain after treatment with acupuncture.

**Materials and Methods:** Twenty-three women with chronic neck pain participated. Dynamometer was used to measure the right and left maximum molar bite force. Dong Bang acupuncture needles - 0.25 mm x 30 mm was inserted into the integumentary tissue. Treatment was 10 sessions, each 30 minutes long and twice a week.

**Results:** The right ( $p = 0.01$ ) and left ( $p = 0.004$ ) molar bite force was assessed after treatment with acupuncture, and showed increased occlusal strength.

**Conclusions:** This study suggests a functional improvement in the stomatognathic system in women with chronic cervical pain after treatment with acupuncture. However, it is important to note that further research is needed to fully elucidate the long-term effects and potential clinical implications of these findings in the field of pain management and rehabilitation.

**Keywords:** *Acupuncture; Bite force; Neck pain; Women; Neck; Chronic pain*

## RESUMEN

**Objetivo:** Investigar la fuerza masticatoria máxima en mujeres con dolor crónico de cuello después del tratamiento con acupuntura.

**Materiales y Métodos:** Participaron veintitrés mujeres con dolor crónico de cuello. Se utilizó un dinamómetro para medir la fuerza máxima de mordida del molar derecho e izquierdo. Aguja de acupuntura Dong Bang se insertaron 0,25 mm x 30 mm en el tejido tegumentario. El tratamiento fue de 10 sesiones, cada una de 30 minutos de duración, dos veces por semana.

**Resultados:** Se observó la fuerza de mordida del molar derecho ( $p=0.01$ ) e izquierdo ( $p=0.004$ ) después del tratamiento con acupuntura, que mostró un aumento de la fuerza oclusal.

**Conclusión:** Este estudio sugiere una mejora funcional en el sistema estomatognático en mujeres con dolor cervical crónico después del tratamiento con acupuntura. Sin embargo, es importante señalar que se necesita más investigación para dilucidar por completo los efectos a largo plazo y las posibles implicaciones clínicas de estos hallazgos en el campo del tratamiento y la rehabilitación del dolor.

**Palabras Clave:** *Acupuntura; Fuerza de la mordida; Dolor de cuello; Mujeres; Cuello; Dolor crónico*

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**CITE AS:** Rêgo Bechara O, Palinkas M, Siéssere S, Regalo S & Bataglion C. Effect of acupuncture on the molar bite force in women with chronic neck pain. *J Oral Res.* 2023;12(1):108-118. doi:10.17126/joralres.2023.010

**Received:** January 20, 2022  
**Accepted:** August 1, 2022  
**Published online:** August 21, 2023

ISSN Print 0719-2460  
ISSN Online 0719-2479.

## INTRODUCTION

Pain is characterized as an unpleasant experience represented by sensory stimuli with emotional processing related to tissue damage.<sup>1</sup> When considered chronic, it can degrade the quality of life. It is also a worldwide public health problem, with socioeconomic impact.<sup>2</sup>

In dental clinical practice, dental surgeons see several patients with chronic pain in the muscles of the head and neck region and the temporomandibular joint which interferes with mandibular stability and occlusal strength.<sup>3</sup> It is estimated that the global prevalence of chronic cervical pain is 4.9%,<sup>4</sup> affecting musculoskeletal structures.

Occlusal strength is considered to be the dynamic action of the masticatory muscles. When analyzed, it becomes an important clinical parameter that provides references for masticatory performance mainly for dysfunction with painful symptoms in the craniocervical system.<sup>5,6</sup> According to a study by Goiato *et al.*,<sup>7</sup> a reduction in the level of pain can promote an increase in occlusal strength, showing a pattern of functional improvement of the craniocervical system.

In turn, a craniocervical system compromised by dysfunctions can be treated to restore function and reduce or eliminate the pain that promotes deleterious effects on the human body.<sup>8</sup> Among the methods that treat pain, acupuncture stands out; it is a traditional Chinese medicine technique that treats numerous diseases by inserting needles at anatomical points, aiming to promote therapeutic or analgesic effects, relieving chronic pain, with the purpose of improving

the physical and mental health of the human being.<sup>9,10</sup>

The stomatognathic system, composed of the temporomandibular joint, masticatory muscles, and teeth, plays a pivotal role in chewing, speech, and facial expression. Its significance becomes evident in understanding chronic pain, where dysfunctions within this system can contribute to conditions such as temporomandibular disorder. Moreover, bite force, influenced by the stomatognathic system's function, stands as a crucial oral health indicator.<sup>11</sup>

Acupuncture has been widely employed for chronic pain management, including temporomandibular disorder-related pain, though its effectiveness varies. The comprehensive approach of acupuncture, by targeting specific points, aims to modulate pain perception and, by extension, could impact masticatory function, thus contributing to a more thorough management of these conditions.<sup>12</sup>

Therefore, the purpose of this study was to assess the maximum molar bite force in women with chronic cervical pain after treatment with acupuncture. The hypothesis of this study was that treatment with acupuncture would influence the pattern of maximum molar bite force.

## MATERIALS AND METHODS

### Sample

The procedures and methods used in this study were in accordance with the ethical standards determined and the free and informed consent form was signed by all

participants. The sample calculation was performed using a 95% confidence level, reaching a test power of 86%, with an effect size of 1.25. These data were determined by the study of Salles-Netol *et al.*,<sup>10</sup> using G \* Power 3.1.9.2 software (Franz Faul, Kiel University, Kiel, Germany). The women who participated in the study were selected from the Ribeirão Preto School of Dentistry, University of São Paulo, Brazil.

Twenty-three women aged between 18 and 50 years, with all teeth except the third molars, without temporomandibular dysfunction, with chronic pain in the sternocleidomastoid muscles and the descending portion of the trapezius muscles participated in this study. The diagnosis of absence of temporomandibular disorders was determined using the RDC/TMD questionnaire.<sup>13</sup>

The exclusion criteria were as follows: use of muscle relaxants, without previous experience with acupuncture treatment, history of head and neck tumors, sleep bruxism, trauma, or surgery to the skull, chronic degenerative disease, and presence of neurological and psychiatric disorders.

The control group, consisting of 20 individuals, aged between 20 and 50 years, was composed with the exclusive purpose of obtaining reference normality values to verify the progress of the patients submitted to acupuncture therapy. The control group was purposefully included to establish reference normality values. It ensures accurate assessment of progress in the acupuncture therapy group by eliminating confounding variables and validating treatment effects.

The control group underwent no treatment or intervention.

### Acupuncture therapy

Across a series of ten sessions, each lasting<sup>30</sup> minutes and held biweekly, the acupuncture methodology was supervised by a proficient and dedicated practitioner. Throughout this duration, we consistently tracked the participants' responses and symptoms.

The participants verbally conveyed their experience on a scale, reporting improvement from 0 to 10, with 0 denoting no pain and 10 intense pain. Employing a proactive approach to follow-ups, we tracked any shifts in pain perception between sessions. The individual responsible for administering the acupuncture technique is a seasoned specialist in systemic acupuncture, boasting advanced training from Xiamen University (China).

The chosen points for needle insertion were thoughtfully selected to establish a direct connection with the intricacies of the stomatognathic system. These specific acupuncture points were strategically located in the facial region, as well as the upper and lower limbs, enhancing the potential to impact the functional aspects of the stomatognathic system. The selection process for these acupuncture points was driven by a profound understanding of the physiological and anatomical interplay to the stomatognathic system.

Points such as Jiache (ST 6), Xiaguan (ST 7), Quan liao (SI 18), Tinggong (SI 19), Yifeng (TE-17), Fengchi (GB 20), Renzhong (GV

26), Yangbai (GB 14), and points of the lower and upper limbs: Tai chong ( LV 3), Zusanli (ST 36), Sanyinjiao (SP 6), Kunlun (BL 60), He Gu (LI 4) and Yanglingquan (GB 34) were intentionally chosen due to their anatomical proximity to key structures and pathways involved in the stomatognathic system's function.

The rationale behind each chosen point considers its potential to modulate neural pathways, improve circulation, and impact muscular tone, ultimately contributing to the overall function and harmony of the stomatognathic system. Furthermore, the use of Dong Bang Acupuncture needles specifically calibrated at 0.25 mm x 30 mm further attests to the precision of the approach, ensuring accurate targeting of these specific points.

Before needle insertion, meticulous aseptic measures were followed, involving the application of 70% alcohol, to maintain a clean environment and minimize the risk of infection. Through this methodical approach, we aimed to not only address chronic pain but also to optimize the functioning of the stomatognathic system by leveraging the intricate network of acupuncture points that intimately correspond to its structure and dynamics.<sup>14</sup>

To ensure participant safety, we closely monitored and recorded any adverse events or side effects related to acupuncture treatment. If any symptoms or adverse reactions occurred during or after the sessions, we documented these events and assessed their intensity and nature. This

approach allowed us to evaluate treatment safety, complementing the study results.

### Maximum molar bite force analysis

A digital dynamometer (IDDK, Kratos, Cotia, São Paulo, Brazil) with a force of up to 980.66 N which was considered as the maximum molar bite force. The device scale is in Newtons, with control of the values by the peak of the force, facilitating the collection of the variable. The device has two rods through which the bite forces are applied. The biosafety protocol was carried out using this methodology; 70% alcohol was used for sterilizations and latex gloves were used (Waripe, São Paulo).

Measurements were performed in the region of the first permanent left and right molars. All participants were instructed to tighten the dynamometer rods three times with maximum force. There was an interval of 2 min between each measurement, with the alternating sides.<sup>5,15</sup>

The maximum molar bite force on both sides was considered for analysis. The supervision of methodological applicability was carried out by a single trained professional. The analysis of initial molar bite force was conducted prior to the first acupuncture session, followed by a 15-day interval after treatment completion for the final collection of this measurement.

### Error of method

Dahlberg's formula was used to measure the method error<sup>16</sup> with a sample of five women. The interval between two sessions per week was stipulated to calculate the maximum bite force error. The error was 6.68%.

## Analysis of data

Normal data distribution was performed using the Shapiro-Wilk test in the SPSS version 22.0 program. (SPSS Inc., Chicago, IL, USA).

The repeated measures test, ANOVA, was used to compare the bite-bite of women with chronic pain in the cervical muscles before and after treatment with acupuncture. In the calculations,  $p < 0.05$  was considered statically significant.

## RESULTS

Significant differences were found in the maximal right and left molar bite-bite after acupuncture treatment in women with chronic cervical pain (Table 1).

An increase in the molar bite force on both sides after acupuncture treatment was observed. Notably, the post-treatment increase in molar bite force on both sides signifies a noteworthy improvement in the functional aspects of the stomatognathic system.

**Table 1:** Differences in mean values ( $\pm$  Standard Error) of molar bite force data (N) before and after acupuncture treatment.

Variables	Before Acupuncture	After Acupuncture	p-value	Control (no intervention)
Sample size (n)	23	23	NA	20
Bite force - Right	234.8 $\pm$ 134	284.5 $\pm$ 104	0.01*	273 $\pm$ 31
Bite force - Left	219.0 $\pm$ 109	279.7 $\pm$ 107	0.004*	287 $\pm$ 32

\*: Significant difference, repeated measures ( $p < 0.05$ ); **NA:** Not applicable.

## DISCUSSION

The hypothesis of this study was confirmed because treatment with acupuncture significantly influenced the pattern of maximum molar bite force in women with chronic neck pain. Dahlberg's formula was employed to assess the method error, which was found to be 6.68%.

This error reflects the variability due to measurement inconsistencies. Importantly, this percentage indicates a relatively low impact on the study's conclusions. It suggests that

measurement inaccuracies have a minimal effect on the observed bite force changes post-acupuncture treatment.

In the present study, women with chronic pain in the cervical muscles presented higher mean values for maximum bite force after treatment with acupuncture (284.5 N, right molar region; 279.7 N, left molar region) compared to the values before the stipulated procedure. In their research study, Palinkas *et al.*,<sup>5</sup> demonstrated the mean values of 273 N and 287 N for the same regions in healthy

dentate women. Our results differ from the study by Palinkas *et al.*,<sup>5</sup> due to differences in the studied population, and methodological approaches, underscoring the need to take these factors into account when interpreting the observed discrepancies.

It is important to emphasize that the maximum molar bite force in this study increased by more than 49 N in the right molar region and by 60 N in the left molar region after treatment with acupuncture.

The promotion of muscular strength, regulated by the central nervous system, results in the movement of the human body.<sup>17</sup> In the stomatognathic system, this action occurs through the relationship between the dental element, skeleton, and jaw-lifting muscles.<sup>18</sup> The bite force is conceptualized as an internationally recognized technique that assists in the diagnosis of structural and functional changes, which helps in understanding the function of the masticatory process.<sup>5,19</sup>

The use of acupuncture for the purpose of restoring muscle function helps to repair the physiological and metabolic activities, thus improving the performance of stretched skeletal muscles.<sup>20,21</sup> Studies suggest that trigger points, which are tensions in the musculature or fascia, can impair the functional performance of the human organism, promoting neuro-physiological responses that modify the production of strength.<sup>22</sup>

According to Fang *et al.*,<sup>23</sup> acupuncture treatment modifies occlusal forces in individuals with functional disorders in the stomatognathic system. In turn, this

technique, which is a practice of traditional Chinese medicine, has as purpose to insert needles in specific points of the energetic meridians promoting stimuli in the muscular nerve endings by stimulating the needles, recovers the tissue, remodeling the cytoskeleton with fibroblasts, and releasing chemical mediators of the inflammatory process and pain.<sup>14,24</sup>

Acupuncture is known to provide analgesia,<sup>25,26</sup> a fact verified in this research. Women with chronic cervical muscle pain reported a reduction in the painful symptoms after treatment with acupuncture. This may have contributed to the increase in the right and left molar bite-bite after the proposed treatment. However, this was probably due to the better anterior positioning of the head and neck which directly reflects in the postural position of the jaw, masticatory function, and occlusal strength.<sup>27</sup> The data is consistent with the study by Goiato *et al.*,<sup>7</sup> where they observed a decline in painful symptoms and improved molar bite strength through acupuncture treatment in women with myofascial pain. When comparing our results to their findings, a similarity emerges in the reduction of pain intensity and the increase in bite force after treatment. Nevertheless, variations in methodology, sample characteristics, and intervention pro-ocols could potentially contribute to the noted differences.

The harmonic balance of the structures involved in the masticatory process depends on the main association between muscle and function, which shows the absence of isolated conducts.<sup>28</sup> Adequate compensation that results from deficiencies



or situations that occur in the human organism, shows the neuromusculoskeletal and neurophysiological relationship between the sensorineural and craniocervical sensorimotor systems, with movements of the jaw, head, and neck.<sup>29</sup>

According to Iodice *et al.*,<sup>30</sup> the normal positioning of the neck is determined by the balance of forces between the muscles and their abnormality which can modify the dynamics of cranio-cervical and cranio-mandibular. In our study, painful symptoms were not quantified, and the degree of anterior head and neck posture was not measured.

Another factor that can alter muscle strength is the relationship between the circulatory system and muscle activity. This has the function of maintaining the redistribution and transport of various metabolites, adjusting the vasomotor tone in the distribution of blood flow necessary to maintain homeostasis.<sup>31</sup> The needling can promote biochemical changes related to painful symptoms and inflammation, restoring blood flow, inducing increase in strength.<sup>32</sup> This may have influenced the maximum molar bite force in women who participated in this study.

The magnitude of change in bite force post-acupuncture treatment holds potential implications for the overall well-being of the participants. Enhanced bite force can contribute to improved masticatory efficiency, which in turn might positively impact dietary choices and oral health. Additionally, the observed increase in bite force could also translate into better quality of life for individuals dealing with chronic

cervical pain, as it signifies an improvement in their ability to engage in daily activities that involve the stomatognathic system.

The increase in molar bite force following acupuncture treatment holds significant clinical importance for individuals with chronic cervical pain. It enhances muscle strength and coordination within the stomatognathic system, improving activities like eating and speaking. This improvement offers relief from discomfort during meals, potentially leading to better nutrition and a more enjoyable eating experience. Additionally, it could result in more confident and effortless speech, underscoring the transformative impact of acupuncture on daily life for those dealing with chronic cervical pain.

This study had some limitations, such as the inability to quantitatively measure pain symptoms and the anterior postural position of the head and neck. These factors could have confirmed the relationship between the absence of pain, body posture, and occlusal strength more accurately. The absence of these measurements limits our ability to precisely correlate changes in bite force with pain alleviation and posture.

These limitations highlight the need for further research to better comprehend the complex relationship between these factors and bite force improvement. Despite these limitations, our study still offers valuable insights into the potential benefits of acupuncture therapy for bite force enhancement in chronic cervical pain.

## CONCLUSION

This study underscores the improved functional capacity for generating maximum molar bite force in women with chronic cervical pain following acupuncture treatment.

These findings emphasize acupuncture's potential as a valuable therapeutic avenue for enhancing stomatognathic system functionality, specifically evident in the heightened molar bite force observed in individuals with chronic cervical pain.

The study significantly advances our understanding of acupuncture's impact on masticatory function within this group, thus presenting promising clinical implications for its adoption as an alternative treatment modality.



## CONFLICT OF INTERESTS

All the authors declare no conflict of interest in the execution of this project.

## ETHICS APPROVAL

Research and Ethics Committee of the Faculty of Dentistry of Ribeirão Preto of the University of São Paulo (process # 37033914.4.0000.5419).

## FUNDING

This study was supported by the FAPESP and National Institute and Technology - Translational Medicine (INCT.TM)

## AUTHORS' CONTRIBUTIONS

**Rêgo Bechara O and Palinkas M:** Conceptualization, methodology, information analysis, editing and revision of the manuscript, supervision, project management.

**Rêgo Bechara O, Palinkas M, Bataglioni C:** Conceptualization, methodology, information analysis, writing and preparation of the draft of the manuscript.

**Rêgo Bechara O, Regalo S, Palinkas M:** methodology, information analysis, writing and preparation of the draft of the manuscript.

**Siéssere S, Bataglioni C, Regalo S:** methodology, project management.

## ACKNOWLEDGEMENTS


The authors thank the National Institute and Technology - Translational Medicine (INCT.TM) and São Paulo and São Paulo State Research Support Foundation (FAPESP) for support during this study.

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## PEER REVIEW

This manuscript was evaluated by the editors of the journal and reviewed by at least two peers in a double-blind process.

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ISSN Print 0719-2460 - ISSN Online 0719-2479.

<https://www.joralres.com/index.php/JOralRes/issue/archive>

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