Journal of Orthopaedics and Clinical Research

Eller G, et al., 2023- J Orth Clin Res
Research Article

Craniomandibular Shoulder Pain-An Underestimated Cause of Refractory Progressive Pain

Gerhard Eller*, Ivan Kellermann, Max Kellermann, Kevin Maul, B Heinisch Röchert, A Arias, Ch Lee and S Weigel

Medical Center for Orthopaedics and Trauma Surgery, Osteopathy; Leipziger Platz 15, 10117 Berlin, Germany

***Corresponding Author:** Gerhard Eller, Medical Center for Orthopaedics and Trauma Surgery, Osteopathy; Leipziger Platz 15, 10117 Berlin, Germany.

Received Date: 03-27-2023

Accepted Date: 04-12-2023

Published Date: 04-26-2023

Abstract

Background: Shoulder pain may originate from tears, inflammation or trauma to the shoulder itself or from dysfunctions in other body regions. The temporomandibular joint is connected to the shoulder by the Nervus accessorius and its branches and hence, patients with craniomandibular dysfunction (CMD) and concomitant shoulder pain may benefit from treatment of CMD-related symptoms to alleviate the pain. We therefore aimed at assessing the impact of an osteopathic-manual intervention in the temporomandibular joint on shoulder pain in CMD patients.

Methods: 49 CMD patients with chronic shoulder pain persisting for at least four months were recruited and subjected to a weekly osteopathic CMD intervention for four weeks. Self-reported pain intensity, impact on daily activities and sleep, and maximum working height were assessed by questionnaires at baseline and after the intervention. Changes in motion (attainable position with the affected arm, shoulder function, abduction, flexion, external rotation) were assessed by two chiropractors. Statistical analysis was conducted with Chi-square test (answer frequencies) and Wilcoxon test (comparison of means before and after).

Results: Shoulder pain intensity on a scale from 0 (no pain) to 15 (strongest pain) was significantly reduced by the intervention from 9.7 ± 2.7 (range: 5-13.5) to 2.9 ± 2.7 (range: 0-11; $p<0.001$). Impairment of occupational and leisure activities due to shoulder pain was reduced from more than 50% impairment before the intervention to less than 50% impairment after the intervention ($p<0.001$). Working height was significantly increased by the intervention from belt height or chest height to crown height ($p<0.01$). A significant improvement of sleep disturbances due to the shoulder pain was noted, with most patients experiencing no such disturbances after the intervention ($p<0.01$). Flexion significantly increased from 97.8 degrees to 154.5 degrees ($p<0.001$), abduction from 86.7 degrees to 153.7 degrees ($p<0.001$), and external rotation from 33.6 degrees to 48.2 degrees ($p<0.001$).

Citation: Eller G, Kellermann I, Kellermann M, Maul K, Röchert BH, Arias A, et al. Craniomandibular Shoulder Pain-An Underestimated Cause of Refractory Progressive Pain. J Orth Clin Res. 2023;1(2):60-68.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(2)-008

Conclusion: The results demonstrate that shoulder pain concomitant with CMD may be alleviated by osteopathic-manual treatment of the temporomandibular joint, thereby reducing pain intensity and sleep disturbances, and improving quality of life.

Keywords: Craniomandibular dysfunction; Shoulder pain; Temporomandibular joint; Nervus accessorius.

Introduction

Shoulder pain may have very different causes, including rotator cuff tears, impingement, calcific tendonitis, tendinosis, adhesive capsulitis, arthritis and post-traumatic or post-operative capsule injury [1-4]. The pain often limits the motion of the rotator cuff and thereby impairs arm movement, which in turn limits activities carried out at work and during leisure time and impacts both physical and mental quality of life [5,6]. If the pain originates from dysfunction, inflammation, or trauma to the shoulder itself, structural alterations are visible in magnetic resonance imaging. If such imaging modalities do not reveal any obvious injury or trauma to the shoulder, the pain may be caused by dysfunctions of a different body with innervations to the shoulder such as the neck, the upper back, and the intervertebral discs [7,8]. A differential diagnosis of shoulder pain is therefore indispensable in preventing progression to a chronic dysfunction and alleviating the pain symptoms to restore or enhance quality of life. Hence, the affected shoulder should be carefully assessed, particularly if there is no structural damage obviated by imaging modalities, and the root cause must be identified. A potential correlation between craniomandibular dysfunction (CMD) and pain in other, more distant body parts has been reported, particularly in the neck [9-14]. A few studies also reported shoulder pain in patients with CMD [11-13], but as these were exclusively retrospective observational studies, a potential anatomical explanation for the link between the temporomandibular joint and the shoulder has yet to be investigated. The Nervus accessorius, a motor nerve supplying the Musculus trapezius and Musculi sternocleidomastoides, could be such a connection. This nerve consists of two parts, the Radix cranialis and the Radix spinalis. The cranial roots are located in the Nucleus ambiguus and exit the Medulla oblongata inferior to the Nervus vagus. The spinal roots emerge from the cervical medulla between the anterior and posterior roots, ascend through the Foramen magnum and enter the Fossa cranii posterior. In the Foramen jugulare, the Radix cranialis and Radix spinalis unite to form the accessory trunk. After exiting the Foramen jugulare, the Nervus accessorius divides into the Ramus medialis, which attaches to the Nervus vagus.

The Ramus lateralis exclusively innervates the Musculus sternocleidomastoideus. Moreover, nerve fibers originating from the Nervus accessorius innervate the superior and medial portions of the Musculus trapezius. Hence, targeting CMD-related symptoms in the temporomandibular joint with an osteopathic-manual approach could alleviate co-existing shoulder pain due to the connection of both body regions by the Nervus accessorius. Therefore, the aim of the present study was to assess the efficacy of an osteopathic-manual treatment of the CMD symptoms and its impact on chronic shoulder

Citation: Eller G, Kellermann I, Kellermann M, Maul K, Röchert BH, Arias A, et al. Craniomandibular Shoulder Pain-An Underestimated Cause of Refractory Progressive Pain. J Orth Clin Res. 2023;1(2):60-68.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(2)-008

pain in patients with both entities occurring concomitantly. We hypothesized that due to the nervous connection between the temporomandibular joint and the shoulder by the Nervus accessorius, manual treatment of CMD will reduce shoulder pain.

Methods

This interventional study was conducted on patients with shoulder pain that persisted for at least four months and concomitant CMD. 49 patients (31 men, 18 women) aged between 19 and 67 years were included. Of these, 20 (40.8%) experienced pain in the left shoulder, 29 (59.2%) in the right shoulder. 37 patients (75.5%) were right-handed, 12 (24.5%) left-handed. Magnetic resonance images showed that no structural damage was present in the shoulder of any of the patients. Some of the patients were using splints for therapy, yet the splints were not regularly worn. An orthopedic assessment was conducted to determine the range of motion in the impaired shoulder. CMD diagnosis was confirmed by an assessment of the jaw joint. Functional assessment of the jaw joint was conducted to diagnose dysfunction in the joint and the masticatory muscles. Functional orthopedic-manual assessment included identification of temporomandibular joint sounds, limitations in chewing motions, mouth opening, misaligned and fractured teeth, and grinding marks on the teeth. Following inclusion in the study, patients received osteopathic treatment once a week for a total of four weeks to alleviate the temporomandibular joint-related symptoms. Patients received a questionnaire before and after treatment with questions pertaining to the intensity of their shoulder pain, the impairments at work and in their leisure time due to the shoulder pain, the maximal attainable working height, sleep disturbances, the percentage of function of the impaired shoulder, and the extent to which certain positions could be taken up by the arm of the impaired shoulder. Two osteopaths assessed the range of motion of the impaired arm before and after therapy. Descriptive statistics were employed to determine the frequency of the genders, the side of the impaired shoulder, the severity of impairment at work and during leisure time, the attainable working height, sleep disturbances, and the attainable position with the impaired arm. Frequencies before and after the osteopathic intervention were compared with the Chi-square test. Pain intensity, impairments, working height, percentage of impairment, and ranges of motion (flexion, external rotation, abduction) were compared before and after the intervention using the Wilcoxon test. A significance level of $p<0.05$ was considered statistically significant.

Results

Pain

On a pain scale from 0=no pain to 15=most intense pain, the mean intensity of pain during the past week before the intervention was 9.7 ± 2.7 (range: 5-13.5), and significantly decreased after the osteopathic intervention to 2.9 ± 2.7 (range:0-11, $p<0.001$) (Figure 1).

Impairments at work and in leisure time

Patients were asked before and after the intervention to rate the impairment at work and during their leisure time due to the

Citation: Eller G, Kellermann I, Kellermann M, Maul K, Röchert BH, Arias A, et al. Craniomandibular Shoulder Pain-An Underestimated Cause of Refractory Progressive Pain. J Orth Clin Res. 2023;1(2):60-68.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(2)-008

shoulder pain on a 5-point scale from no impairment to complete impairment. Before treatment, most patients (n=18, 36.7%) reported being more than 50% restricted in their occupational activities, whereas after treatment this applied to only three patients (6.1%). Most patients (n=19, 38.8%) reported being less than 50% impaired in their occupational activities after treatment. These differences in the subjectively categorized impairment at work were statistically significant ($p<0.001$).

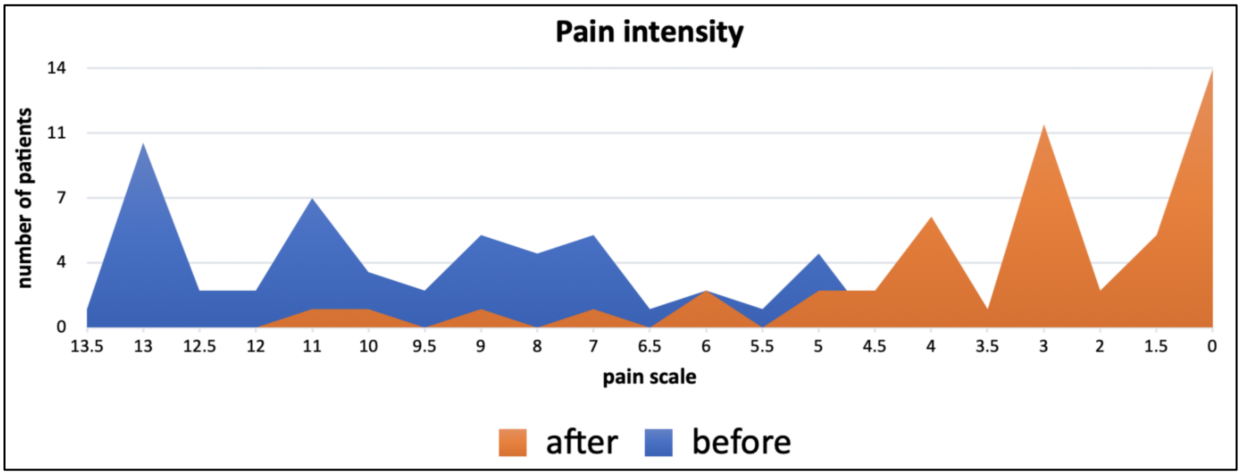

Figure 1: Pain intensity before and after treatment rated on a pain scale from 0 (no pain) to 15 (strongest pain).

The impairment due to the shoulder pain in leisure activities also changed significantly with treatment: Whereas before treatment most patients (n=18, 36.7%) reported that they were limited by more than 50% in their leisure activities, this was true for only one patient (2%) after treatment ($p<0.001$) (Figure 2).

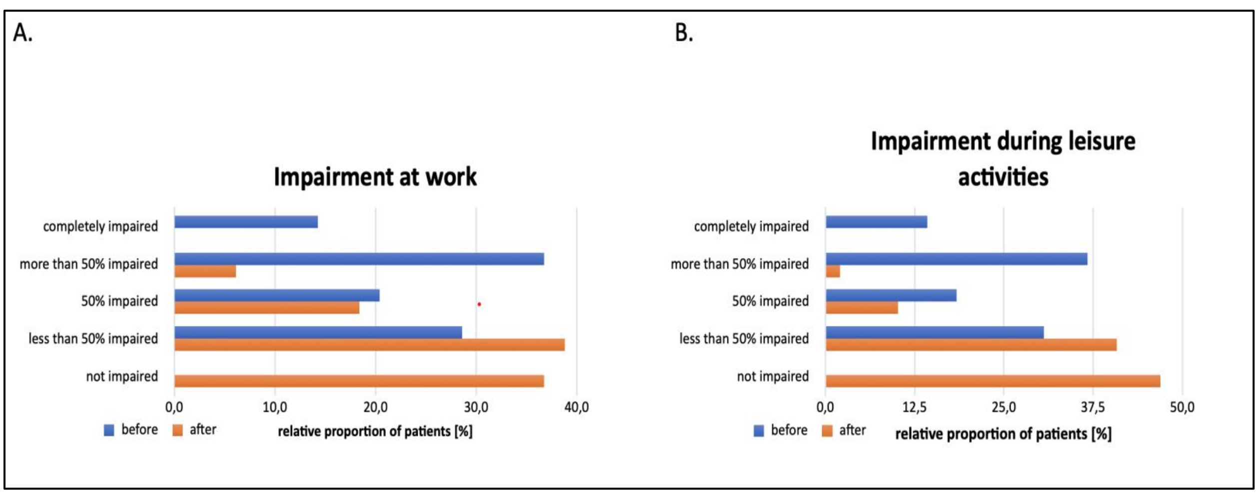

Figure 2: Impairment during work and leisure activities before and after treatment, presented as relative proportion of patients.

Eller G | Volume 1; Issue 2 (2023) | Mapsci-JOCR-1(2)-008 | Research Article
Citation: Eller G, Kellermann I, Kellermann M, Maul K, Röchert BH, Arias A, et al. Craniomandibular Shoulder Pain-An Underestimated Cause of Refractory Progressive Pain. J Orth Clin Res. 2023;1(2):60-68.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(2)-008

Maximum attainable working height

Figure 4 shows the change in the maximum achievable working height without limitations and pain before and after treatment. Before treatment, most patients could only perform activities up to belt height (n=15, 30.6%) or chest height (n=17, 34.7%), whereas after treatment, the majority (n=27, 55.1%) could perform activities up to crown height. Only two patients (4.1%) were able to perform activities above the head before treatment, while this percentage increased to 26.5% of patients (n=13) after treatment.

The differences in achievable working height were significant in the before-after comparison ($p<0.01$).

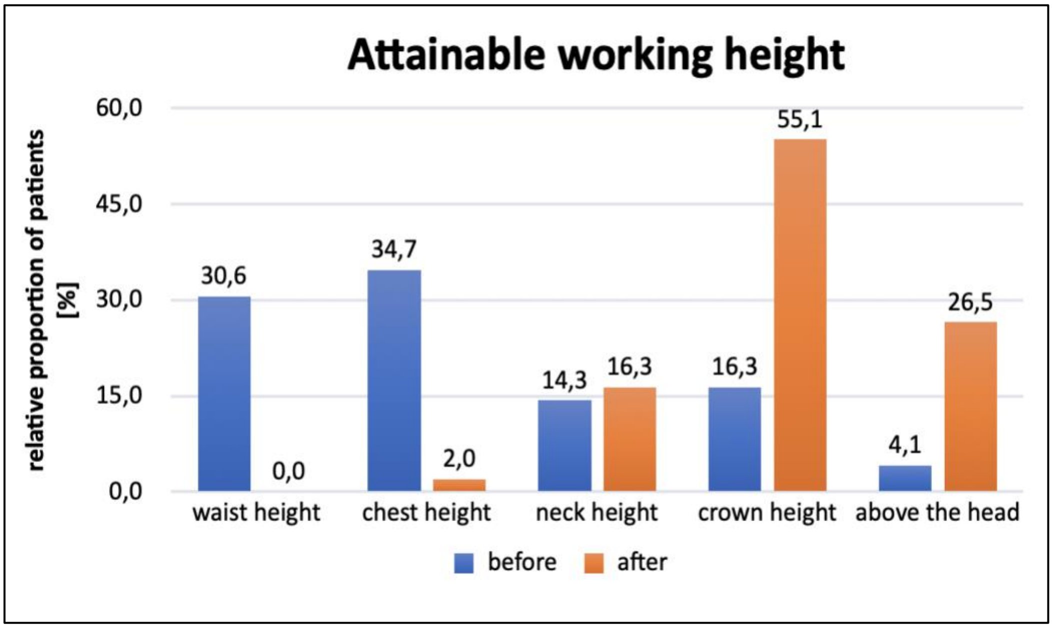

Figure 3: Attainable working height before and after treatment, presented as relative proportion of patients.

Sleep

Ten patients were not disturbed by their shoulder pain during sleep either before or after treatment (Table 1). Nearly half of the patients (n=24, 49%) reported waking up occasionally due to the pain before treatment, and 14 patients (28.6%) woke up regularly due to the pain before treatment.After the osteopathic intervention, there was a significant overall improvement in sleep ($p<0.01$), such that 22 patients (44.9%) reported that their sleep was occasionally affected by pain and no sleep disturbances were noted by 27 patients (55.1%).

Percentage of shoulder function

Assuming that 100% corresponded to a perfectly functional shoulder, this percentage averaged 58.9 ± 18.4% before treatment (range: 20-85%).

After treatment, the average function increased to 87.6 ± 12.1% (range: 60-100%). These differences were statistically significant in the before-after comparison ($p<0.001$).

Citation: Eller G, Kellermann I, Kellermann M, Maul K, Röchert BH, Arias A, et al. Craniomandibular Shoulder Pain-An Underestimated Cause of Refractory Progressive Pain. J Orth Clin Res. 2023;1(2):60-68.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(2)-008

Sleep disturbances		After		
		Not disturbed	Occasional disturbance	Regular disturbance
Before	Not disturbed	10 (20.4%)	1 (2.0%)	0
	Occasional disturbance	14 (28.6%)	10 (20.4%)	0
	Regular disturbance	3 (6.1%)	11 (22.4%)	0

Table 1: Sleep disturbances before and after the intervention.

Attainable position with the arm of the impaired shoulder

Patients were asked to assume different, increasingly difficult positions with the affected arm (position 1:behind the head, elbow in front; position 2:on the head, elbow in front; position 3:behind the head, elbow behind; position 4:on the head, elbow behind). The position with the greatest accessibility changed significantly after treatment p<0.01 (Figure 4).

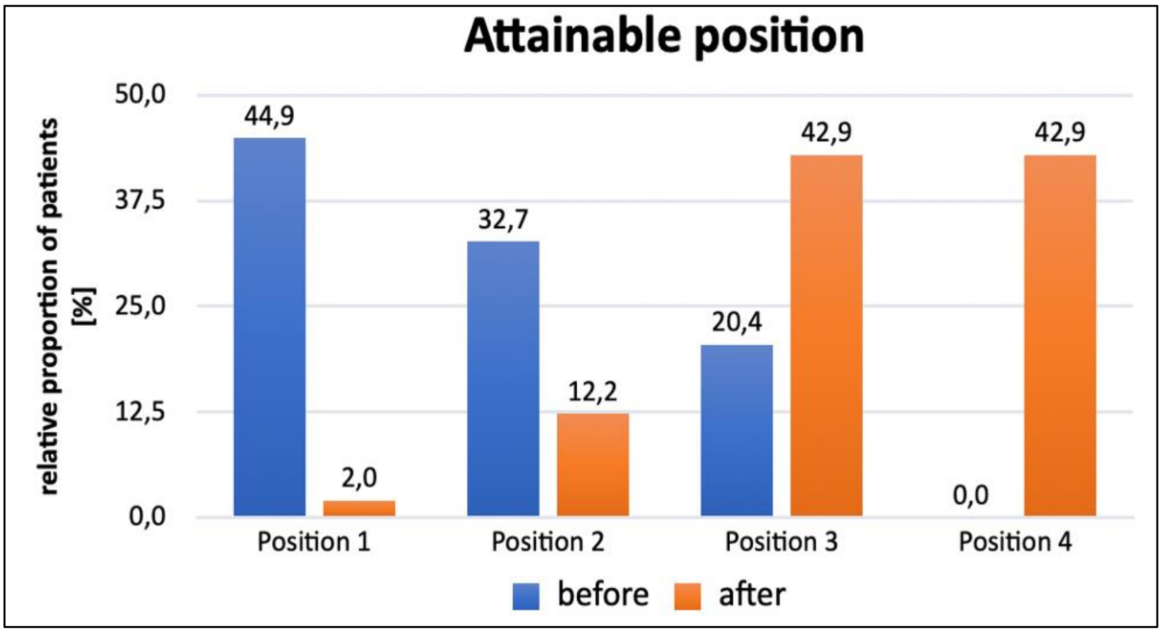

Figure 4: Maximal attainable position with the arm on the impaired side of the body before and after treatment, presented as relative proportion of patients. Position 1:arm behind the head, elbow in front; position 2:arm on the head, elbow in front; position 3:arm behind the head, elbow in the back; position 4:arm on the head, elbow in the back.

Flexion, abduction, and external rotation

Flexion averaged 97.8 degrees before treatment and 154.5 degrees after treatment p<0.001, (Figure 5A). Abduction also improved significantly after treatment from 86.7 degrees to 153.7 degrees, p<0.001, (Figure 5B), as did external rotation (before: 33.6 degrees, after: 48.2 degrees, p<0.001, (Figure 5C).

Citation: Eller G, Kellermann I, Kellermann M, Maul K, Röchert BH, Arias A, et al. Craniomandibular Shoulder Pain-An Underestimated Cause of Refractory Progressive Pain. J Orth Clin Res. 2023;1(2):60-68.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(2)-008

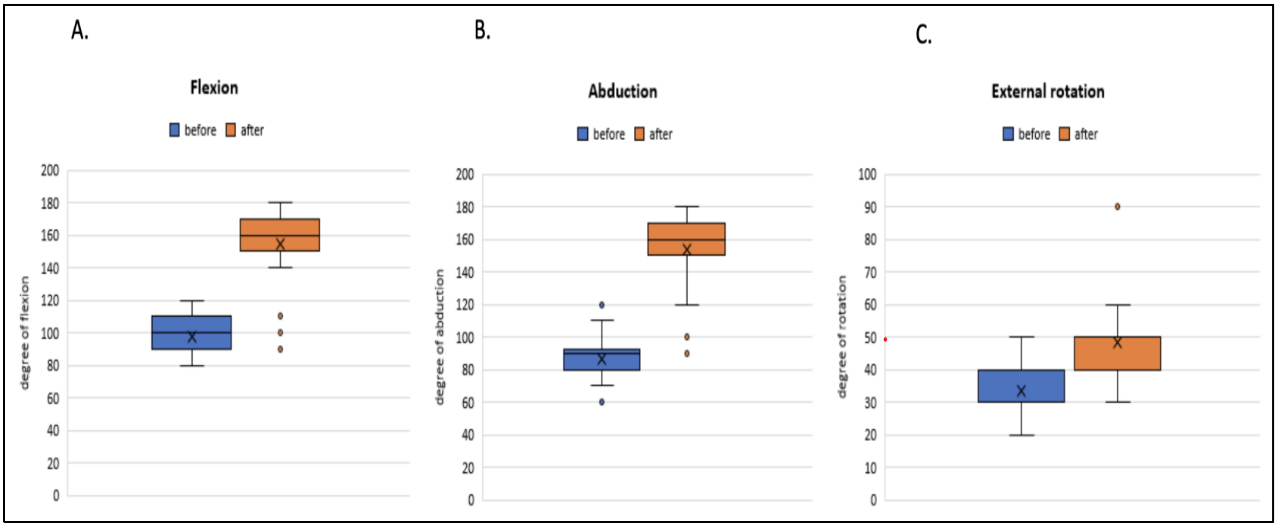

Figure 5: Flexion (A), abduction (B), and external rotation (C) and before and after treatment, presented as boxplots in degree of movement.

Discussion

Shoulder pain has been infrequently associated with CMD in previous studies, yet the underlying anatomical connection between the temporomandibular joint and the shoulder has not been investigated in detail in this context [11-13]. The present study demonstrates that persistent shoulder pain of patients with CMD can be alleviated by comprehensive osteopathic CMD treatment. All patients benefited from the intervention in terms of their pain intensity, the activities at work and in their leisure time, sleep quality, and shoulder function and range of motion. These findings indicate that dysfunction of the temporomandibular joint directly affects shoulder function. We propose the underlying anatomical connection as follows: Asymmetry of the temporomandibular joint, especially due to increased pressure on the Os temporale, the socket of the joint, causes internal rotation of the Os temporale. The Pars petrosa of the Os temporale frames the Foramen jugulare with the Os occipitale. This internal rotation leads to a "narrowing" of the Foramen jugulare, which compromises the structures that pass through it, including the Nervus vagus, the Nervus glossopharyngeus, and the Nervous accessorius.

The latter supplies the Musculus sternocleidomastoideus and the upper and middle portions of the Musculus trapezius. Irritation of the Nervus accessorius inevitably leads to shoulder elevation or to a rotational deviation of the skull, and retrogradely to a further narrowing of the Foramen jugulare due to the increased tension. Furthermore, the asymmetry of the bite leads to an increase in the tone of the neck muscles, which must balance the skull during the masticatory movement, but due to the displacement then completes the circulus vitiosus with headaches and neck pain or migraine of the tension headache type. The increase in muscle tone of the Musculus trapezius leads to a positional anomaly of the scapula and consequently to a control disorder of the

Citation: Eller G, Kellermann I, Kellermann M, Maul K, Röchert BH, Arias A, et al. Craniomandibular Shoulder Pain-An Underestimated Cause of Refractory Progressive Pain. J Orth Clin Res. 2023;1(2):60-68.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(2)-008

shoulder, after which an impingement-like symptomatology develops. According to our theory, the Nervus accessorius plays a vital role in CMD-induced shoulder pain. This concept is supported by reports of irritation of this nerve and its correlation with CMD-associated headache, neck, and back pain due to an altered muscle tone of the Musculus sternocleidomastoideus and the Muculus trapezius [15].

Moreover, dental occlusion and mandibular position affect the position of the spine and motion due to the innervation of associated muscles by the Nervus accessorius [16,17]. Of note, the intervention in the present study was administered for a comparatively short time but with noticeable benefits even after four sessions and could thereby provide a feasible option for CMD patients with chronic shoulder pain. Future studies should stratify CMD patients by type of and adherence to previous interventions to identify patients who would particularly benefit from osteopathic-manual treatment.

A limitation of the present study is the subjective nature of the obtained data, as pain intensity, impact on activities, and sleep disturbances were self-reported by the patients. Patients with shoulder pain may suffer from psychological distress, which causes them to provide inferior self-assessments on baseline outcome scales [18]. Therefore, the initially reported pain intensity and impact on their daily activities may have been categorized worse than it actually was, while after the intervention the psychological distress induced by the pain might have been alleviated and hence the post-interventional results may have been generally better.

Nonetheless, the shoulder function and range of motion were assessed objectively by two professional chiropractors before and after the intervention, and the fact that these measurements significantly improved after the intervention points towards a real benefit of the treatment for the patient.

Conclusion

CMD may be associated with shoulder pain without obvious structural abnormalities. Treatment of CMD symptoms by osteopathic manual therapy may concomitantly alleviate shoulder pain and thereby improve the patients range of motion and quality of life. The Nervus accessorius is a potential anatomical link between the dysfunction in the temporomandibular joint and the shoulder and hence should be considered as a target for osteopathic-manual therapy of CMD patients.

References

1. Murrell GA, Bhargav D. Shoulder Stiffness: Diagnosis. Aust Fam Physician. 2004;33(3):143-7. PubMed
2. Lewis J. Rotator Cuff Related Shoulder Pain: Assessment, Management and Uncertainties. Man Ther. 2016;23:57-68. PubMed | CrossRef
3. Liem D, Buschmann VE, Schmidt C, Gosheger G, Vogler T, Schulte TL, et al. The Prevalence of Rotator Cuff Tears: Is the Contralateral Shoulder at Risk? Am J Sports Med. 2014;42(4):826-30. PubMed | CrossRef
4. Moosmayer S, Smith HJ, Tariq R, Larmo A. Prevalence And Characteristics of Asymptomatic Tears of the Rotator Cuff: An Ultrasonographic and Clinical Study. J Bone Joint Surg Br. 2009;91(2):196-200. PubMed |CrossRef

Citation: Eller G, Kellermann I, Kellermann M, Maul K, Röchert BH, Arias A, et al. Craniomandibular Shoulder Pain-An Underestimated Cause of Refractory Progressive Pain. J Orth Clin Res. 2023;1(2):60-68.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(2)-008

5. Imagama S, Ando K, Kobayashi K, Seki T, Hamada T, Machino M, et al. Shoulder Pain has Most Impact on Poor Quality of Life Among Various Types of Musculoskeletal Pain in Middle-Aged and Elderly People: Yakumo Study. Mod Rheumatol. 2020;30(3):568-72. PubMed | CrossRef
6. Ackerman IN, Fotis K, Pearson L, Schoch P, Broughton N, Brennan-Olsen SL, et al. Impaired Health-Related Quality of Life, Psychological Distress, and Productivity Loss in Younger People with Persistent Shoulder Pain: A Cross-Sectional Analysis. Disabil Rehabil. 2022;44(15):3785-94. PubMed | CrossRef
7. Katsuura Y, Bruce J, Taylor S, Gullota L, Kim HJ. Overlapping, Masquerading, and Causative Cervical Spine and Shoulder Pathology: A Systematic Review. Global Spine J. 2020;10(2):195-208. PubMed | CrossRef
8. Bokshan SL, DePasse JM, Eltorai AE, Paxton ES, Green A, Daniels AH. An Evidence-Based Approach to Differentiating the Cause of Shoulder and Cervical Spine Pain. Am J Med. 2016;129(9):913-8. PubMed | CrossRef
9. Plesh O, Adams SH, Gansky SA. Temporomandibular Joint and Muscle Disorder-type Pain and Comorbid Pains in a National US Sample. J Orofac Pain. 2011;25(3):190-8. PubMed
10. Silveira A, Gadotti IC, Armijo-Olivo S, Biasotto-Gonzalez DA, Magee D. Jaw Dysfunction is Associated with Neck Disability and Muscle Tenderness in Subjects with and without Chronic Temporomandibular Disorders. Biomed Res Int. 2015:512792. PubMed | CrossRef
11. França Correia LM, Guimaraes A, Teixeira M, Rodrigues L. Evaluation of Body Painful Areas in Patients with Muscular Temporomandibular Disorder: A Retrospective Study. Revista Dor. 2015;16:249-53.
12. Hagberg C. General Musculoskeletal Complaints in a Group of Patients with Craniomandibular Disorders (CMD). A Case Control Study. Swed Dent J. 1991;15(4):179-85. PubMed | CrossRef
13. Inoue E, Maekawa K, Minakuchi H, Nagamatsu-Sakaguchi C, Ono T, Matsuka Y, et al. The Relationship Between Temporomandibular Joint Pathosis and Muscle Tenderness in the Orofacial and Neck/Shoulder Region. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2010;109(1):86-90. PubMed | CrossRef
14. Kim D, Ko S-G, Lee E-K, Jung B. The Relationship Between Spinal Pain and Temporomandibular Joint Disorders in Korea: A Nationwide Propensity Score-Matched Study. BMC Musculoskelet Disord. 2019;20(1):631. PubMed | CrossRef
15. Saha FJ. Kraniomandibuläre Dysfunktion Als Ursache Chronischer Kopf-Und Rückenschmerzen. Zeitschrift Für Komplementärmedizin. 2013;05(06):20-6.
16. Ohlendorf D, Seebach K, Hoerzer S, Nigg S, Kopp S. The Effects of a Temporarily Manipulated Dental Occlusion on the Position of The Spine: A Comparison During Standing and Walking. Spine J. 2014;14(10):2384-91.
17. Grondin F, Hall T, von Piekartz H. Does Altered Mandibular Position and Dental Occlusion Influence Upper Cervical Movement: A Cross-Sectional Study in Asymptomatic People. Musculoskelet Sci Pract. 2017;27:85-90. PubMed | CrossRef
18. Potter MQ, Wylie JD, Greis PE, Burks RT, Tashjian RZ. Psychological Distress Negatively Affects Self-Assessment of Shoulder Function in Patients with Rotator Cuff Tears. Clin Orthop Relat Res. 2014;472(12):3926-32. PubMed | CrossRef

Citation: Eller G, Kellermann I, Kellermann M, Maul K, Röchert BH, Arias A, et al. Craniomandibular Shoulder Pain-An Underestimated Cause of Refractory Progressive Pain. J Orth Clin Res. 2023;1(2):60-68.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(2)-008