Original Article

Effectiveness of ultrasound-guided intra-articular drug injections in treating sternoclavicular arthritis: a single-group observational study

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Background: Current treatments for non-suppurative sternoclavicular arthritis mainly include conservative therapy and surgery. For patients who are unresponsive to conservative treatment and unwilling to undergo surgery, ultrasound-guided intra-articular drug injections offer a minimally invasive alternative. Due to the lack of efficacy evaluation for this therapy, this study aims to objectively assess the effectiveness and safety of this treatment method.

Methods: A case-control study was conducted, including seven patients with sternoclavicular arthritis who underwent ultrasound-guided intra-articular drug injections at Yiwu City Dermatology Hospital between December 2020 and December 2023.The inclusion criteria specified patients aged 18 to 65 who had not responded to conservative treatments, including nonsteroidal anti-inflammatory drugs (NSAIDs) and physical therapy. Ultrasound examinations were conducted to assess sternoclavicular joint space width, and pain levels were measured using the visual analog scale (VAS) before and after treatment.

Results: The study population consisted of five males and two females with a mean age of 42.75±7.19 years. All patients presented with pain and swelling in the sternoclavicular joint. Ultrasound imaging revealed expanded sternoclavicular joint spaces with small effusions and thickened joint capsules in all patients. Following treatment, there was a significant reduction in the sternoclavicular joint space width ($P<0.01$), and VAS scores showed a marked decrease at both 1 week and 1-month post-procedure ($P<0.01$), indicating substantial pain relief. No major complications were reported following the procedure, with only minor transient local discomfort observed in two patients, which resolved without further intervention.

Conclusions: Ultrasound-guided intra-articular drug injections are effective and safe in the treatment of sternoclavicular arthritis. This technique not only significantly alleviates pain but also reduces the expansion of the sternoclavicular joint space, with a low risk of complications.

Keywords: Drug injections; sternoclavicular arthritis; ultrasound

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Introduction

Sternoclavicular arthritis is a condition that affects the sternoclavicular joint, which is the articulation between the clavicle and the sternum. This type of arthritis can manifest in various forms, including septic arthritis, inflammatory arthritis, and osteoarthritis (1). Differentiating between these types of arthritis is important, as the treatment approach varies depending on the underlying cause. Accurate identification of the etiology is key to tailoring treatment and improving patient outcomes. Accurate identification of the etiology and timely intervention are crucial for tailoring treatment and improving patient outcomes.

The sternoclavicular joint is a saddle-shaped synovial joint, representing the only connection between the shoulder girdle and the axial skeleton. This joint is formed by the sternal end of the clavicle, the clavicular notch of the sternum, and the costal cartilage of the first rib (*Figure 1*). Due to the contact area between the medial end of the clavicle and the sternum being less than 50%, the joint is inherently unstable (2). The blood supply to the sternoclavicular joint is primarily derived from the suprascapular artery and the internal thoracic artery, while innervation is provided by the superficial supraclavicular nerve and the deep nerve to the subclavius muscle. Sternoclavicular arthritis is typically unilateral, with the majority of cases occurring on the right side (3).

Sternoclavicular arthritis can result from bacterial infections, including *Streptococcus agalactiae*, *Parvimonas micra*, *Fusobacterium nucleatum*, or *Salmonella* (4-8). Although rare, septic arthritis can lead to severe complications, especially in high-risk patients such as those with diabetes, alcoholism, or undergoing hemodialysis (3,9). Prompt identification of the pathogen is crucial for effective antibiotic therapy and preventing complications like abscesses, osteomyelitis, or mediastinitis (10,11).

In contrast, sterile inflammation in sternoclavicular arthritis is not associated with pus formation and is often linked to autoimmune conditions, such as rheumatoid arthritis, or other inflammatory disorders like synovitis, acne, pustulosis, hyperostosis, and osteomyelitis (SAPHO) syndrome (12). This form of arthritis presents unique clinical challenges, as it typically involves chronic symptoms such as pain, swelling, and limited joint mobility. These symptoms can fluctuate over time, with periods of exacerbation and remission. Unlike septic arthritis, non-suppurative arthritis may also present with systemic symptoms like fatigue and low-grade fever, reflecting the underlying systemic inflammatory nature (13).

Patients with non-pyogenic sternoclavicular arthritis typically present with pain, swelling, and tenderness around the joint, located at the junction of the clavicle and sternum (14). These patients often experience chronic symptoms with periodic flare-ups and remissions. Due to the inflammatory nature of the condition, they may also experience morning stiffness and limited range of motion, which can significantly impact their quality of life (15). The diagnosis and treatment of non-suppurative sternoclavicular arthritis are particularly challenging. The clinical presentation can be subtle and diverse, necessitating comprehensive evaluation including clinical assessments, imaging studies, and laboratory investigations. Although magnetic resonance imaging (MRI) is generally useful in identifying signs of inflammation, such as synovial thickening and erosions (16), its use is limited in clinical practice due to budget constraints and convenience factors.

Once non-suppurative sternoclavicular arthritis is diagnosed, treatment focuses on symptom relief, inflammation reduction, and joint function improvement (17). Non-pharmacological interventions, such as physical therapy and lifestyle modifications, are essential in managing the chronic condition (18). Nonsteroidal anti-inflammatory drugs (NSAIDs) help alleviate pain and inflammation, but disease-modifying anti-rheumatic drugs (DMARDs) or biologics are often needed to address the underlying autoimmune process (19). In severe cases, surgical intervention may be required when conservative treatments fail (20). In cases where conservative measures and pharmacological interventions are insufficient to control symptoms and disease progression, surgical interventions may be warranted. Surgical options for non-suppurative sternoclavicular arthritis include joint debridement, synovectomy, or in severe cases, joint arthroplasty to restore joint function and alleviate pain (21,22).

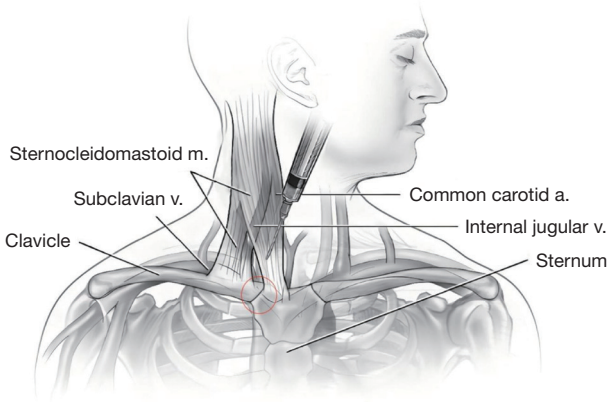

Figure 1 Anatomical illustration of sternoclavicular joint and surrounding structures. The red circle indicates the location of the sternoclavicular joint. m., muscle; v., vein; a., artery.

High-frequency ultrasound imaging is an effective diagnostic tool for assessing soft tissue structures, providing excellent image quality and dynamic observation capabilities. It clearly visualizes bone surfaces, ligaments, tendons, as well as foreign bodies and effusions in the joint cavity, primarily focusing on the triangular fibrocartilage complex (TFCC) (23). For sternoclavicular arthritis patients unresponsive to traditional conservative treatments, ultrasound-guided intra-articular injection therapy offers a minimally invasive alternative for symptom management. Previous studies have demonstrated that ultrasound-guided injections improve procedural accuracy, clinical outcomes, and cost-effectiveness in the treatment of inflammatory arthritis (23).

This study aims to evaluate the safety and efficacy of ultrasound-guided intra-articular drug injections in patients with sternoclavicular arthritis who have not responded to conservative treatment. The primary hypothesis is that this intervention will lead to significant pain reduction and improved joint function. We present this article in accordance with the STROBE reporting checklist (available at https://qims.amegroups.com/article/view/10.21037/qims-24-1657/rc).

Methods

Study design and setting

This self-controlled study was conducted at Yiwu City Dermatology Hospital and included patients who received ultrasound-guided intra-articular drug injections for sternoclavicular arthritis in the outpatient department between December 2020 and December 2023. The study was conducted in both outpatient visits and follow-up assessments, which were performed either at the hospital or via telephone interviews. The objective of the study was to evaluate the effectiveness and safety of ultrasound-guided intra-articular injections in alleviating symptoms and improving joint function.

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by ethics board of Yiwu City Dermatology Hospital (No. 2020KY001) and informed consent was taken from all the patients.

Study population

Inclusion and exclusion criteria were established to select participants. Inclusion criteria included: a clinical diagnosis of sternoclavicular arthritis, age between 18 and 65 years, both sexes, inadequate response to conservative treatments such as NSAIDs and physical therapy, and provision of informed consent. The ultrasound diagnostic criteria included the presence of at least one of the following: synovial proliferation (abnormal hypoechoic tissue in the joint cavity, immobile and difficult to compress, with potential Doppler blood flow signals), joint effusion (abnormal hypoechoic or anechoic tissue in the joint cavity, mobile and compressible, without Doppler signals), bone destruction (cortical discontinuity in two orthogonal planes), bone fusion (disappearance of joint space), or a positive blood flow signal detected by Doppler. Clinical symptom criteria included spontaneous pain, tenderness upon pressure by the index and middle fingers, and joint swelling. Exclusion criteria included conditions potentially interfering with diagnosis, such as cervical spondylosis, fractures, or dislocations, and patients treated without a prior clinical diagnosis of sternoclavicular arthritis.

Variables and data sources

The primary outcomes were pain levels [measured by the visual analog scale (VAS)] and sternoclavicular joint space length (L), both assessed before treatment, 1 week after treatment, and 1 month after treatment. Exposures included the administration of the ultrasound-guided intra-articular injection. The potential confounders considered included age, sex, and prior response to conservative treatments.

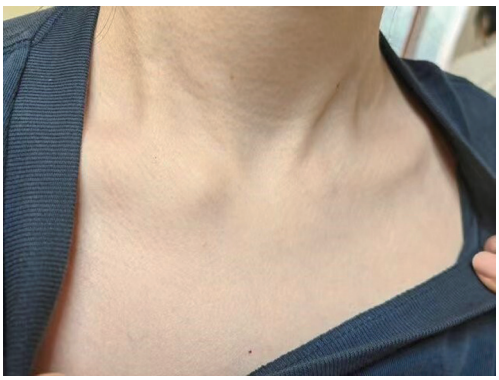

Figure 2 Outward protrusion of the sternoclavicular joint area. The image depicts a noticeable outward bulge in the right sternoclavicular joint area without any changes in skin color.

VAS scores were assessed by independent evaluators who were not involved in the study to minimize bias. Ultrasound diagnostic criteria served as the basis for inclusion, ensuring consistent diagnostic measures across participants.

Equipment and medications

The procedures utilized a GE Logiq E9 (Chicago, USA) ultrasound machine equipped with C12-5 MHz or L18-8 MHz probes. The medication mixture for injection consists of 1 mL of 1% ropivacaine hydrochloride, 1 mL of 5 mg/mL compound betamethasone, and 2 mL of saline. The local anesthesia agent used was 2% lidocaine hydrochloride.

Procedure

Patients were positioned supine with their shoulders relaxed and arms at their sides. After standard disinfection and draping, a high-frequency linear probe was placed over the sternoclavicular joint, aligned with the joint's transverse plane. The probe was moved slowly to visualize the manubrium, medial end of the clavicle, and the hypoechoic "V"-shaped joint space. A needle was inserted from the sternal towards the clavicular side into the joint space (*Figure 1*). After aspiration to confirm needle placement, the medication mixture, totaling 4 mL, was injected slowly. Real-time ultrasound monitoring ensured precise delivery into the joint space. Pain levels were assessed using the VAS (scores from 0 to 10), and follow-up assessments included sternoclavicular joint space length (L) and color Doppler flow. Follow-up was conducted through outpatient visits at 1 week and 1 month after treatment.

Bias and study size

Efforts to minimize bias included consistent use of ultrasound diagnostic criteria and standardized administration of injections under ultrasound guidance. Additionally, independent evaluators assessed the VAS scores to reduce measurement bias. The small sample size was due to the rarity of the condition, and the sample size was determined by the number of patients who met the inclusion criteria during the specified period.

Statistical methods

Statistical analysis was performed using SPSS (Chicago, USA). Pain levels were assessed using the VAS, and data were collected before treatment, at 1 week, and 1-month post-treatment. A paired *T*-test was used to compare pre- and post-treatment VAS scores and joint space width. Sensitivity analyses were conducted to account for the small sample size and to assess the robustness of the results. Missing data were addressed by contacting patients via telephone for follow-up, and any cases of non-response were excluded from the analysis. A P value of less than 0.05 was considered statistically significant.

Results

Study population

This study included a total of seven patients, consisting of five males and two females, aged between 38 and 62 years, with a mean age of 42.75±7.19 years. Regarding the location of the lesions, three patients had left-sided lesions, and four had right-sided lesions. All patients exhibited pain and localized swelling in the sternoclavicular joint area on the affected side, without any skin redness. Additionally, four patients experienced restricted shoulder elevation. No patients were lost to follow-up, and all completed the study. Refer to *Figure 2* for a photograph of a patient.

Ultrasonographic findings

Ultrasound examinations revealed varying degrees of sternoclavicular joint space expansion in all patients, accompanied by a small amount of joint effusion, thickened joint capsules, and hypoechoic areas. The joint capsule and TFCC exhibited increased vascular signals. Specifically, before treatment, the average sternoclavicular joint space width in the seven patients was 14.67±1.45 mm, with

thickened joint capsules and uneven echo patterns in the TFCC. Color Doppler flow imaging (CDFI) demonstrated enhanced blood flow signals (see *Figure 3*). One week after treatment, the average joint space width decreased to 7.91±1.82 mm, and further reduced to 6.16±1.15 mm after 1 month. There were no missing data for these measurements. Detailed ultrasonographic findings, including joint space width and pain scores at different time points, are illustrated in *Figure 4*.

Comparison of sternoclavicular joint space width and VAS scores before and after treatment

A self-controlled analysis was conducted on the seven patients who underwent treatment. The width of the sternoclavicular joint space was significantly reduced post-treatment (P<0.01). Additionally, the VAS scores showed a significant decrease at both 1 week and 1 month after the procedure, indicating substantial pain relief (P<0.01). Specifically, the mean VAS score at baseline was 7.29±0.49, which decreased to 3.29±0.45 after 1 week and further reduced to 2.57±0.49 at 1 month. These findings demonstrate the effectiveness of ultrasound-guided intra-articular drug injections in treating sternoclavicular arthritis. Sensitivity analyses were performed to account for the small sample size, confirming the robustness of the results. No confounders were adjusted for, as the study was self-controlled with no external factors considered.

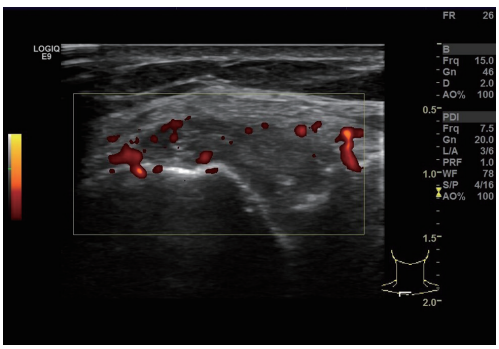

Figure 3 Pre-treatment ultrasound image of the sternoclavicular joint. Ultrasound image demonstrating swelling of the right sternoclavicular joint capsule with outward protrusion. There is a small amount of effusion within the joint cavity, and the swollen joint capsule shows abundant blood flow signals.

Procedure and follow-up

Under real-time ultrasound guidance, all seven patients successfully underwent intra-articular drug injections into the sternoclavicular joint space. The procedures were smooth, and no significant complications were observed. Post-procedural ultrasonography showed a reduction in joint space width and decreased blood flow signals, as depicted in *Figure 5*. All patients completed follow-up at both 1 week and 1 month, with no loss to follow-up.

Discussion

In this study, the seven patients included five males and two females, with ages ranging from 38 to 62 years and a mean age of 42.75±7.19 years. These findings align with

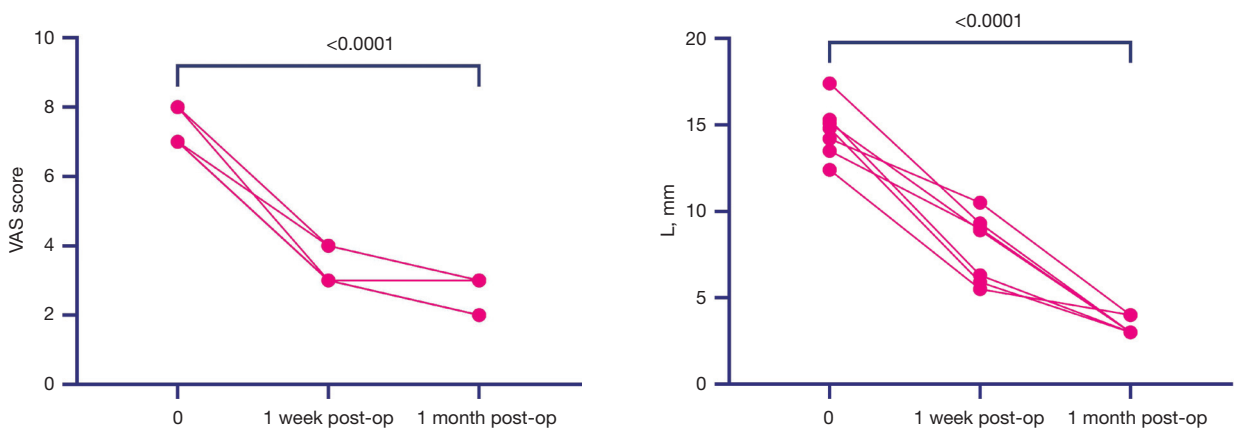

Figure 4 Analysis of post-operative trends in pain scores VAS and joint swelling length (L). VAS, visual analog scale.

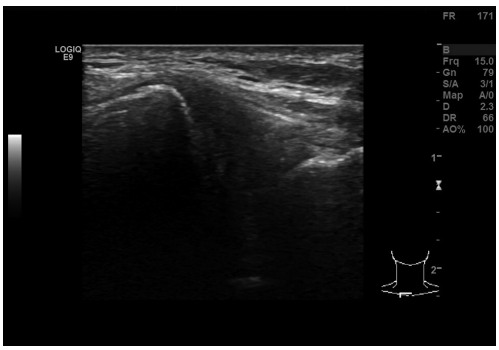

Figure 5 Post-treatment ultrasound image of the sternoclavicular joint. Ultrasound image showing no color Doppler signals, indicating the absence of active inflammation in the joint. The patient's symptoms, including pain, have also improved.

the epidemiology of this disease. Studies have shown that an average joint space expansion of approximately 14 mm (range, 10–20 mm) is more indicative of infection, whereas joint space expansion of around 5 mm (range, 3–8 mm) is more consistent with degenerative changes (24). In this study, the average sternoclavicular joint space width of 14.4 mm, coupled with the absence of inflammatory changes in aspirated samples, indicated the non-pyogenic nature of the condition. Musculoskeletal ultrasound, combined with interventional therapy, appears to be a preferred diagnostic modality for early detection of sternoclavicular arthritis.

Ultrasound-guided injections offer several advantages over traditional blind injections, particularly in terms of precision and safety. Previous studies have demonstrated that ultrasound guidance improves needle placement accuracy, reduces the risk of complications, and enhances clinical outcomes in joint injections (25). While blind injections are still used in clinical practice, they carry a higher risk of complications, such as incorrect needle placement or injury to surrounding structures. There is limited literature on the use of blind injections in the treatment of sternoclavicular arthritis, and further research is needed in this area.

There are some limitations in this study. First, the sample size was small, with only seven participants, limiting the generalizability of the findings. Second, the lack of a control group made it difficult to compare the efficacy of ultrasound-guided injections with other treatment modalities. Additionally, the short follow-up period may not have captured long-term treatment effects or symptom recurrence. While pain data were collected via telephone follow-up, joint space measurements and Doppler flow assessments were only conducted during in-person visits, which may have introduced some bias.

Despite these limitations, this study provides preliminary evidence supporting the efficacy and safety of ultrasound-guided intra-articular injections for the treatment of sternoclavicular arthritis. The combined use of local anesthetics and corticosteroids likely contributes to the rapid pain relief and reduction in inflammation observed in this study. Furthermore, the real-time visualization offered by ultrasound guidance ensures accurate needle placement, reducing the likelihood of procedural complications.

Given the small sample size and the specific characteristics of the patient population, the findings of this study may not be broadly applicable to all patients with sternoclavicular arthritis. Larger randomized controlled trials are necessary to confirm these findings and assess the generalizability of this treatment approach to a wider patient population. Future studies should focus on comparing the efficacy of ultrasound-guided versus blind injections in the treatment of sternoclavicular arthritis, especially in larger randomized controlled trials. Additionally, longer follow-up periods are needed to evaluate the durability of the treatment effects and monitor for any recurrence of symptoms.

Conclusions

In summary, ultrasound-guided intra-articular medication injection has emerged as an effective treatment option for sternoclavicular arthritis, particularly for patients who do not respond to conventional therapies. This technique offers the key advantages of precise targeting of the inflamed area, minimal invasiveness, reduced pain, and rapid recovery. Research indicates that this approach not only significantly alleviates symptoms but also effectively halts the progression of the disease, demonstrating considerable potential in clinical practice.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://qims.amegroups.com/article/view/10.21037/qims-24-1657/rc

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://qims.amegroups.com/article/view/10.21037/qims-24-1657/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by ethics board of Yiwu City Dermatology Hospital (No. 2020KY001) and informed consent was taken from all the patients.

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