

# Ultrasound-Guided Pain Management for Chronic Musculoskeletal Pain

CME  
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## INTRODUCTION

According to international studies, the prevalence of musculoskeletal pain ranges from 11% to 50%.<sup>[1]</sup> The etiology has not been fully determined.<sup>[2]</sup> Some theories suggest that the possible causes of low back pain are physical stress and prior back injury.<sup>[3]</sup> The main methods of pain relief are conservative treatments that often cannot effectively manage the pain. Local injections of pain-control medications, such as steroids, can be used to relieve symptoms. However, the effect is usually limited probably because the true cause cannot be identified by blind injections. The drug could be injected at the wrong site, thereby undermining the purpose of the treatment. To confirm the injection into the true area, imaging can guide the needle into the area with signs for pain control, such as the guidance of computed tomography, magnetic resonance imaging, ultrasound, and X-ray imaging. Ultrasound is unique in its radiation-free real-time imaging, portability, and cost-effectiveness. The use of color Doppler ultrasonography (CDUS) and elastography avoids vascular and nerve fascicle injuries. Each patient is examined by ultrasound to identify the site of painful compression to confirm the symptom. Injections include a mixture of 1 mL of shincort and 1 mL of 2% xylocaine for inflammatory signs such as bursitis and tenosynovitis; 15% dextrose solution for myositis, enthesopathy, tendinitis in some tendons, etc., and 5% dextrose solution for neuro-hydro dissection. Prolotherapy is used in clinical practice, especially in tendon or ligament injection therapy. A wide range of injectable drugs is available for prolotherapy, among which highly concentrated dextrose solution is the most commonly used drug in the current clinical applications.<sup>[4]</sup> The principle of highly concentrated dextrose solution therapy is to inject a high osmotic solution that causes dehydration of the cells owing to the differences in the tissue permeability gradient, which attracts inflammatory factors

such as granulocytes and macrophages. Growth factors and cytokines that induce an inflammatory response and promote tissue re-healing are released. Some studies have reported that this therapy would stimulate tissue growth and repair. Furthermore, some animal studies have shown the protective effect of prolotherapy on cartilage.<sup>[6,7]</sup> Previous studies have demonstrated this effect in knee osteoarthritis, rotator cuff tendinosis, chronic myofascial pain, and temporomandibular joint dysfunction.

## CHRONIC MUSCULOSKELETAL PAIN IN THE UPPER EXTREMITIES: CHRONIC SHOULDER, ELBOW, WRIST, AND HAND PAIN

Chronic shoulder pain is very common. The causes are varied and include rotator cuff tears, calcific tendinitis, subacromial bursitis, enthesopathy, myofasciitis, arthritis, and peripheral neuropathy. Rotator cuff tears may be complete or partial tears. Rotator cuff tear can be accurately diagnosed by ultrasound; diagnostic criteria include tendon loss, localized depression, localized defect, and localized thinning of the rotator cuff.<sup>[8]</sup> Rotator cuff tears usually require surgical therapy. Treatment of localized rotator cuff partial tears includes conservative rehabilitative therapy and local injections of hyaluronic acid or high concentration platelet plasma. Ultrasound images of subacromial bursitis would show fluid accumulation or thickening of the subdeltoid bursa. The recommended treatment regimen is the ultrasound-guided injection of a steroid and lidocaine mixture into the subdeltoid bursa.<sup>[9]</sup>

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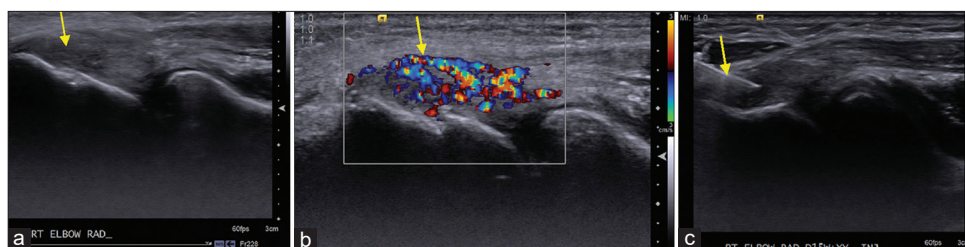
Calcific tendinitis of the rotator cuff is easily diagnosed by ultrasound and graded by CDUS.<sup>[10,11]</sup> The management of calcific tendinitis may vary in different stages; during the acute resorption phase, conservative treatment or ultrasound-guided injection of a steroid and lidocaine mixture into the subdeltoid bursa is recommended to relieve the pain. In the acute phase of cystic formation, ultrasound-guided fine-needle aspiration is recommended to relieve pressure and pain. In the chronic formative stage, the treatment consists of physical therapy, shock wave therapy, and fine-needle fracturing, followed by ultrasound-guided injection of a steroid and lidocaine mixture into the subdeltoid bursa. In the case of subdeltoid cysts, ultrasound-guided aspiration is recommended to relieve the pressure and eliminate the symptoms.<sup>[12]</sup> Pain due to enthesopathy is often seen in the area of the deltoid attached to the acromion, and it is suggested that the pain site of the bone junction be repeatedly needled under the guidance of ultrasound and 15% dextrose solution be injected. In terms of adhesive capsulitis of the shoulder, which is commonly known as frozen shoulder, if conservative treatments do not work, ultrasound-guided injection of saline and steroids is recommended to dilate the capsula articularis humeri. Patients should be asked to actively stretch and extend the range of rotation of their shoulder. Shoulder muscle pain is often caused by myofascitis. It is recommended to inject 15% dextrose solution under ultrasound guidance and perform myofascial dissection.<sup>[13]</sup>

Chronic elbow pain may be due to tendinosis or enthesopathy, such as tennis elbow, golf elbow, or intraarticular arthritis. Tennis elbow usually shows heterogeneous hypoechogenicity on ultrasound imaging and may be combined with calcified spots at the joints of the extensor digitorum tendon; CDUS may show high vascular supply in the acute phase [Figure 1]. Physical therapy is recommended as the primary treatment method. However, if it is not effective, focus extracorporeal shock wave therapy or ultrasound-guided injection of 15% dextrose solution or platelet-rich plasma into the area after repeated puncture with a fine needle can be effective.<sup>[14]</sup> In contrast to the tennis elbow, the golf elbow mainly affects the common flexor tendon of the medial cubital region. Ultrasound images would show heterogeneous hypoechogenicity, possibly in combination with calcified spots at the joints of the common flexor tendon; CDUS may show a high vascular supply

in the acute phase. The treatment is the same as for tennis elbow. Triceps tendinopathy and enthesopathy on ultrasound would show inhomogeneous hypoechogenicity and increased vascularity. Physical therapy and ultrasound-guided repeated fine-needle punctures followed by 15% glucose injections are effective in controlling this condition. The same treatment can be applied to patients with lateral collateral ligament degeneration on both sides of the periarticular joint. In patients with rheumatoid arthritis, the systemic treatment has led to the localized recurrence of arthritis at the elbow or wrist, resulting in arthritis or tenosynovitis. Ultrasound images would show joint effusion and increased blood flow supply, and ultrasound-guided steroid injections are recommended. Cubital tunnel syndrome is often caused by compression of the ulnar nerve at the elbow joint, resulting in the fourth and fifth finger paralysis and pain. Ultrasound-guided injection of 5% dextrose solution for neuro-hydro dissection of the ulnar nerve could be the choice of management.

Carpal tunnel syndrome is often caused by compression of the carpal nerve in the narrow carpal tunnel, resulting in painful numbness of the carpal joint and the first to third fingers. Ultrasound-guided injection of 5% dextrose solution for neuro-hydro dissection of the median nerve could be the choice of management.

De Quervain syndrome presents as a focal thickening of the first compartment tendon sheath of the wrist. Ultrasound images would show reduced echogenicity and increased blood flow in the tendon sheath of the first compartment.<sup>[15]</sup> Conservative physical therapy is preferred, but if this does not work, repeated ultrasound-guided puncture of the thickened tendon sheath and injection of a mixture of steroids and lidocaine into the tendon sheath is recommended. Localized noninfectious tenosynovitis, often occurring in the tendon sheaths of the wrist or palmar extensor tendons in patients with rheumatoid arthritis, presents on ultrasound as a thickened tendon sheath with or without fluid accumulation and a hyperemic state in CDUS. Ultrasound-guided aspiration of the fluid and steroid injection into the tendon sheath can be effective in controlling the condition. Chronic pain in the posterior shoulder, which is often due to muscle fatigue or myofascial adhesions caused by minor injuries, is diagnosed by ultrasound-guided tenderness, which mainly occurs in the infraspinatus and teres minor.



**Figure 1:** A 32-year-old male patient complaining of the right lateral elbow pain for approximately 1 month, (a) ultrasound showed uneven hypoechogenicity from the extensor digitorum tendon to the lateral epicondyle (arrow), (b) color Doppler ultrasound showed high blood flow (arrow), (c) the symptoms resolved after two injections of ultrasound-guided repeated puncture treatment combined with injection of 15% high-concentration dextrose solution (arrow)

Ultrasound-guided injection of 15% dextrose solution for perimysium dissection could be the choice of management.

## CHRONIC MUSCULOSKELETAL PAIN IN THE LOWER EXTREMITIES: HIP, KNEE, ANKLE, AND FOOT PAIN

Chronic hip pain may be due to hip arthritis, acetabular labral tendinosis, tendon sheath cysts, bursitis, enthesopathy, or associated nerve entrapment syndrome (e.g., entrapment syndrome of lateral femoral cutaneous nerves, and pudendal nerve). Hip arthritis may be caused by degenerative or rheumatoid inflammation, where rheumatoid inflammation is a systemic inflammatory disease, and if it is not well-controlled locally or recurs in the hip, ultrasound-guided hip injections with steroids may alleviate the symptoms. For degenerative hip arthritis, ultrasound-guided hip injections with 25% dextrose solution are recommended. Piriformis syndrome is an important cause of lower back pain, accounting for about 6%–8% of lower back pain. Diagnostic criteria include Lasegue's positive sign and pressure pain at the sciatic notch.<sup>[16]</sup> In our experience, correct localization of the piriformis with significant tenderness under ultrasound guidance is the most objective method of diagnosis. The current treatment methods include conservative rehabilitation, with local steroid or botulinum toxin injections if symptoms do not resolve and become severe. Ultrasound-guided steroid injection is a safe and effective treatment method. Ischial bursitis usually presents with heterogeneous hypoechogenicity and is accompanied by potential fluid accumulation. There is significant tenderness in the ischial tuberosity region and hypervascularity on color Doppler ultrasound in the acute phase. Ultrasound-guided aspiration of the fluid is recommended, followed by steroid injection. Infectious bursitis or abscess should be excluded when steroid injection is performed. For enthesopathy of the ischial tuberosity, repeated ultrasound-guided fine-needle puncture (especially of the ischial tuberosity) of the joints is recommended, followed by 15% dextrose infusion. The greater trochanter of the femur connects several gluteal muscles, such as the gluteus medius, gluteus minimus, piriformis, obturator internus, and gemellus. Therefore, bursitis or enthesopathy often occurs. Ultrasound images would show decreased echogenicity and significant tenderness in the area. The recommended treatment is repeated ultrasound-guided puncture followed by 15% dextrose infusion, which is effective in relieving the symptoms. In the anteromedial aspect of the hip, the adductor muscle is connected to the pubic region, producing an enthesopathy and causing medial inguinal pain. Ultrasound images would show decreased echogenicity and significant localized tenderness. The recommended treatment is repeated puncture under ultrasound guidance followed by 15% dextrose infusion into the pubic region of the symphysis, which can effectively relieve the symptoms. Most of the other hip enthesopathies also have uneven hypoechogenicity on ultrasound images and significant localized tenderness. The recommended treatment is repeated puncture under ultrasound guidance, followed by 15% dextrose infusion into the joint

area. Tenosynovial cysts may occur in the bursa, intermuscular, or due to a rupture of the fibrocartilage or joint capsule resulting in the leakage of joint fluid. The recommended treatment is to aspirate the cyst with an 18-gauge needle guided by ultrasound and steroid injection. If the tendon sheath cyst is caused by a ruptured glenoid labrum, the ruptured labrum must be repaired to stop the joint fluid leak. Ultrasound-guided aspiration can only temporarily relieve the symptoms as they can recur quickly. The diagnosis of gluteal nerve entrapment syndrome should be traced to its anatomic location. When comparing the sizes of the proximal and distal and contralateral nerves, the affected nerve usually presents with proximal swelling and localized tenderness. For example, lateral femoral cutaneous nerve entrapment, which usually occurs in the inguinal ligament and the sartorius muscle joining the anterior inferior iliac spine, is known as meralgia paresthetica. Ultrasound-guided injection of 5% dextrose solution and neurohydrodissection is the recommended treatment. Chronic knee pain may be due to degenerative joint disease, meniscal disease, periprosthetic enthesopathy, nerve compression syndrome, or crystal deposition. Ultrasound-guided injection of sodium hyaluronate into the knee may relieve the pain caused by degenerative joint disease.<sup>[5]</sup> Meniscal tears may result in parameniscal tendon sheath cysts, and surgical therapy is recommended. Knee pain is commonly caused by enthesopathy of the patellar tendons and ligamentous joints of the knee. Ultrasound images would show decreased echogenicity and tissue swelling with significant tenderness. A color Doppler ultrasound in the acute phase would show a higher blood supply. The recommended treatment is repeated ultrasound-guided puncture, followed by a 15% dextrose infusion into the joint area for good results. The main nerves in the region of the knee cap are the saphenous nerve, posterior tibial nerve, common peroneal nerve, and the peripheral plexus of the knee cap.

These intraneural lesions are recommended for surgical removal if they are caused by a tumor. Surgical release is also recommended if the nerve entrapment is caused by a clear scarring of the fibrous band. However, if the nerve entrapment is due to mild external pressure or mild swelling of the nerve caused by localized neuritis, the recommended treatment is ultrasound-guided injection of 5% dextrose solution neurohydrodissection. Chronic ankle pain can be caused by degenerative joint disease, patellar enthesopathy, nerve entrapment syndrome, tenosynovitis, and tendon sheath cysts. In degenerative arthritis of the ankle, the irregular bony spur would be visible on x-ray, and ultrasound images would show irregular cortical bone and bony spurs combined with joint effusion.

If conservative treatment and rest are not effective, ultrasound-guided injection of sodium hyaluronate or high concentration (25%) dextrose solution into the ankle joint is recommended to relieve the pain caused by a degenerative joint disease. Tendinitis of the tendons passing through the ankle may appear as tendon sheath effusion or tendon sheath thickening on the ultrasound imaging, and the color Doppler

ultrasound may show a high blood flow supply. The diagnosis and management of paratendinitis or tendinitis of the ankle is similar to that of the tendons of the wrist. Retrocalcaneal bursitis may cause severe pain in the heel. Ultrasound images would show effusion in the retrocalcaneal bursa, and color Doppler ultrasound may demonstrate a high parabursal blood supply. Ultrasound-guided steroid injections can be used to relieve the symptoms. Plantar fasciitis is also an enthesopathy. Ultrasound images would show a thickening in the adhesion of plantar fascia to the calcaneus (>4 mm thick) combined with decreased echogenicity. A color Doppler ultrasound may show increased vascularity. The treatment principle is to prioritize the conservative rehabilitation, but if it does not work, focus extracorporeal shock wave therapy, repeated puncture of the entheses and high concentration of dextrose or platelet-rich plasma injections under ultrasound guidance can be used to relieve the symptoms. Tarsal tunnel syndrome occurs in the medial ankle and is caused by compression of the posterior tibial nerve on the medial side of the ankle, such as fibrosis of the tissue surrounding the posterior tibial nerve, tendon sheath cysts, degenerative joint disease, or even neuroma. The most common cause is the compression of tendon sheath cyst. The recommended treatment is surgical excision or ultrasound-guided aspiration.

## CONCLUSION

In patients with chronic musculoskeletal pain, the patient's medical history should be first taken to understand the cause of the pain. To prevent the recurrence of the symptoms, the patients should try to avoid the triggering factors. The physical examination should focus on the origin and location of the pain. An auxiliary imaging examination, especially ultrasound, is important and can provide direct evidence for the correct diagnosis. However, ultrasound has its limitations, for example, the operator must have a good understanding of musculoskeletal anatomy, which involves a long learning curve. Careful physical examination, skilled ultrasound scanning techniques, and accurate anatomical knowledge can provide a fairly accurate diagnosis to help select the appropriate treatment. Finally, the treatment of chronic musculoskeletal pain is, in principle, conservative rehabilitation supplemented by pain medication. However, if this strategy is not effective, aspiration or injection using imaging guidance is preferred. However, infectious causes of tumors must be ruled out first, especially when steroid injections are used.

## Declaration of patient consent

The author certifies that he has obtained appropriate patient consent form. In the form, the patient has given his consent for the images and other clinical information to be reported in

the journal. The patient understands that his name and initial will not be published and due efforts will be made to conceal the identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

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