

CLINICAL NOTE

High-Resolution Ultrasound and Magnetic Resonance Imaging to Document Tissue Repair After Prolotherapy: A Report of 3 Cases

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High-resolution ultrasound imaging of musculoskeletal tissue is increasing in popularity because of patient tolerability, low cost, ability to visualize tissue in real-time motion, and superior resolution of highly organized tissue such as a tendon. Prolotherapy, defined as the injection of growth factors or growth factor production stimulants to grow normal cells or tissue, has been a controversial procedure for decades; it is currently gaining in popularity among physiatrists and other musculoskeletal physicians. This report describes imaging of tendons, ligaments, and medial meniscus disease (from trauma or degeneration). Although these tissues have been poorly responsive to nonsurgical treatment, it is proposed that tissue growth and repair after prolotherapy in these structures can be documented with ultrasound and confirmed with magnetic resonance imaging. Directions for future research application are discussed.

Key Words: Case report; Magnetic resonance imaging; Medial menisci; Rehabilitation; Sprains and strains; Tendinopathy; Ultrasound.

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THE TERM *PROLOTHERAPY* was coined by Hackett¹ in the 1940s and 1950s to imply proliferation of normal tissue at ligamentous and tendinous entheses; the procedure has been described by other terms, such as sclerotherapy, regenerative injection therapy, and stimulated ligament repair. More recently, Reeves defined prolotherapy as injection of growth factors or growth factor production stimulants to grow normal cells or tissue.² The proliferant solution and technique varies according to physician training and preference. Commonly reported proliferants include 10% to 15% dextrose, P2G (phenol, glycerin, glucose), and sodium morrhuate. Opponents of prolotherapy have proposed that improvements are related to the placebo effect³ and point out that randomized, controlled trials in low back pain (LBP) have had mixed results.⁴ How-

ever, proponents of prolotherapy argue that needling and injection of saline into a ligament or tendon is an active, not a placebo, treatment⁵ and that these injections have produced significant and sustained improvements in chronic LBP.⁶ Proponents also point out that randomized controlled trials of knee osteoarthritis, in which needle trauma is minimal, have shown significant benefit of dextrose over anesthetic injection⁷ and that machine measurements have shown tightening of ligaments objectively.⁸ One recent physiatric study⁹ reported full return to sport in 22 of 24 elite athletes with chronic groin pain and the inability to participate in their sport. Several crucial questions must be answered before prolotherapy can be accepted as a common medical practice. Does prolotherapy actually stimulate tissue growth? If so, is that tissue less organized (ie, scar) or more organized (ie, normal fibrous tissue)? Although definitions of prolotherapy imply growth of normal tissue, not scar, some are still using the term *sclerosing* to describe injection of proliferants,¹⁰ which does not suggest normal fibrous tissue. High-resolution ultrasound now provides an accessible, inexpensive method for serial studies of these tissues to objectively evaluate tissue quality. The purpose of this report was to determine if ultrasonography can be a useful tool in evaluating tissue healing and organization in response to prolotherapy.

CASE DESCRIPTIONS

Prolotherapy involves injections of small amounts (0.5–1.0mL) of the proliferative solution at multiple entheses points (for tendon, ligament, and fascia) and/or musculotendinous junctions. When joints are treated, an intra-articular injection is commonly performed. In most cases, 2 to 6 treatment sessions are required over 2 to 12 months to reach maximum effect.¹¹ Standard protocol includes restriction from nonsteroidal anti-inflammatory drugs 1 to 2 days before treatment and 10 to 14 days after treatment. All ultrasound imaging was performed by me, and I have more than 4 years of experience in musculoskeletal ultrasound imaging using real-time ultrasound equipment^a with 10- to 22-MHz, 8- to 16-MHz, and 5- to 10-MHz broadband linear transducers. At each follow-up ultrasound study, patient and joint position were reproduced. The previous ultrasound image was visible next to the ultrasound machine to allow the reproduction of the exact machine settings (power and gain) and near exact probe position and angulation (using bone landmarks). Magnetic resonance images were obtained before and after completion of all treatments with readings by a board-certified radiologist who specializes in musculoskeletal radiology.

A brief review of ultrasound terminology will assist in interpreting the images in this article. Tissue appearance on ultrasound is determined by the density and organization of the tissue. Black tissue on ultrasound is described as anechoic; the tissue reflects no sound wave back to the transducer. Dense tissue such as bone appears bright white and is described as highly echoic. Tissue deep to normal cortical bone

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