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CASE REPORT

Microperforation prolotherapy: a novel method for successful nonsurgical treatment of atraumatic spontaneous anterior sternoclavicular subluxation, with an illustrative case

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Alvin Stein[1]
Scott McAleer[2]
Marty Hinz[3]

[1]Stein Orthopedic Associates, PA, Plantation, FL, USA; [2]University of Central Florida, Orlando, FL, USA; [3]Clinical Research, Neuroresearch Clinics, Inc, Cape Coral, FL, USA

Background: Surgical repair of an atraumatic spontaneous anterior subluxation of the sternoclavicular joint (herein referred to as the "SCJ") is often associated with poor outcome expectations. With traditional treatment, successful conservative therapy usually incorporates major lifestyle alterations. This manuscript discusses a novel approach known as "microperforation prolotherapy". To illustrate the technique, the care of a patient who benefitted from this treatment is reviewed.

Purpose: To present a novel form of treatment with an illustrative case that demonstrates the potential efficacy of microperforation prolotherapy of the SCJ.

Patient and methods: A novel approach to treatment of bilateral subluxation of the sternoclavicular joint with microperforation prolotherapy is discussed. The clinical course of a 21-year-old male with bilateral subluxation of the SCJ, which seriously hampered the patient's athletic and daily living activities, is used as a backdrop to the discussion.

Results: Following microperforation prolotherapy, the instability of the SCJ was replaced by full stability, complete range of motion, and the opportunity to engage in all of the athletic endeavors previously pursued. There is no scar or other cosmetic defect resulting from the treatment received.

Conclusion: Anterior sternoclavicular joint subluxation has a poor record of complete recovery with surgical procedures or conservative measures with regard to providing restoration of full lifestyle function. This manuscript documents a novel microperforation prolotherapy treatment that induced healing and restored full stability to the ligament structures responsible for the condition in a completely safe and effective fashion, allowing the patient to resume full lifestyle activities without restriction. The exceptional response to treatment noted here is encouragement for further studies.

Keywords: sternoclavicular joint subluxation, shoulder pain, sternoclavicular instability, spontaneous instability, anterior subluxation

Introduction

Presentation and documentation of this successful microperforation prolotherapy outcome in the literature is novel, having never been previously done. The manuscript is intended to discuss this novel microperforation prolotherapy method with an illustrative patient history that documents the successful treatment of complete bilateral spontaneous anterior subluxation of the sternoclavicular joints (herein referred to as the "SCJs") which occurred during the course of repetitive insult from powerlifting and various martial arts.

Correspondence: Alvin Stein
6766 West Sunrise Blvd, Suite 100A, Plantation, FL 33313, USA
Tel +1 954 581 8585
Fax +1 954 316 4969
Email alvin@alvinsteinmd.com

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Understanding and mastery of anatomy is imperative for successful outcomes. The lead author of this paper has been performing prolotherapy for 16 years and orthopedic surgery for over 30 years before that. During this time, treatment of other cases of SCJ injury with surgery and then with prolotherapy had not warranted a case report or other paper documenting outcomes. Milder cases of SCJ instability responded to prolotherapy with successful relief of pain and return to full activity. A persistently painful postoperative case was rendered pain-free by prolotherapy.

The degree of instability experienced by this patient was so severe that its resolution by prolotherapy warranted a write up of the case. It is felt that the dramatic result obtained was due to the novel microperforation technique used.

Past medical history

The patient is a 21-year-old college student who gave a history of being active in various forms of high impact athletics, including powerlifting, Brazilian jiu-jitsu, mixed martial arts, and a long history of freestyle bicycle motocross (BMX), stemming from youth. No specific episode could pinpoint the etiology for the presenting condition, but the patient had crashed many times while engaging in freestyle BMX. In addition, though not identifying any defining event while powerlifting, there was suspicion that heavy bench press exercises may have contributed to the problem affecting the patient's SCJs.

During the course of warm-ups for the various workout sessions, the patient started to experience a clunking sensation at the sternoclavicular joints bilaterally. The SCJs would visibly sublux and then spontaneously reduce without any discomfort. One day after a workout the patient came home, laid down on the floor to play with his dog, placed his right arm under his chest and, upon moving, experienced a catching sensation followed by an audible ripping sound and locking of the SCJ as forward flexion of the right arm was attempted. The pain associated with this event was severe and persisted for several weeks.

From that point on, the joints became increasingly unstable and each subluxation event became excessively painful. The painful sensation was isolated to the right SCJ, while the left side continued to be hypermobile, but without any associated discomfort. Considering the degree of reported instability and immense pain, it is probable that the right SCJ suffered a complete dislocation with concomitant injury to the articular disc.

Upon seeking medical attention, the patient had such anxiety over the possibility of a painful episode that there was refusal to put the arm through a normal range of motion; thus, the extent of instability was not fully appreciated by the first examining physician. A subsequent consultation with a second doctor revealed the true extent of instability, and it was speculated that he had torn away the anterior capsule of the SCJ. As the initial severe pain started to subside, the splinting of the area associated with the initial injury also subsided. This allowed the full extent of the instability to be recognized clinically. This was a major instability with the joint separation in excess of 2 cm on reclining and relaxing the shoulder girdle tension. X-ray studies of the SCJs failed to demonstrate any pathology.

The patient was advised by two separate competent shoulder surgeons that surgical intervention for atraumatic anterior SCJ instability was not recommended and carried a large risk of complications. Unhappy over the prospect of being unable to get relief of symptoms and the problem, the patient actively researched other options for treatment. This led to articles about prolotherapy and, eventually, to a prolotherapist.

Methods and materials

The basic premise of joint instability can be attributed to ligaments failing to keep the bones in proper approximation with each other. Ligaments are avascular structures composed of collagen that accumulate microtears when stretched from 4% to 8% of their original length. Macroscopic tears may be observed when a ligament is stretched past 8%, with complete rupture occurring around 12%.[1–3] Under these parameters, a 1-cm long ligament can stretch 1.2 mm and be completely torn. In a joint such as the SCJ, where maximum strength and complete restoration of physiological length is needed to regain the full stability, conservative therapy, without prololiferative stimulation, has little chance of regaining this full strength and stability. The avascular nature of ligaments decreases their healing potential and under the best circumstances a damaged ligament may heal to its original length, but only 50%–75% of its original tensile strength.[1,2,4] Other tissues, such as muscle and bone, have an abundant blood supply that enables them to bleed when injured. This bleeding acts as a humoral message to the body which identifies the area of damage and initiates the wound healing cascade.[1,2,4–13]

The microperforation prolotherapy injection process creates an acute, controlled local inflammation and an osmotic type of bruise on the cells at the fibro-osseous junction between the ligaments and the bony attachments and within those ligamentous tissues themselves.[1,2,4,5,9] This initiates

the healing process. The objective is to bring activity into an indolent and unresponsive healing process that fails to restore normal tissue turgor and strength to the damaged areas.[1–6,8,9,14–16]

Multiple punctures of the fibro-osseous junction around the joint at the sternal margins and on the clavicular head at the attachments of the capsular ligaments were done. The capsular tissues were also perforated. At each perforation, enough proliferant solution was injected into the tissues to create the inflammatory response to induce healing. There is a clear attempt to get all of the tissues involved in the healing process. A hiatus between treatments is usually 3 weeks to allow some tissue healing to take place and then the process is reactivated until the desired healing has occurred. It can be done more frequently or less frequently as circumstances demand without losing the beneficial effects of the treatment.[9] The patient's healing ability, including their nutritional status and the extent of the damage, determines the speed of resolution of the problem.

The solutions used are hypertonic osmotic proliferants (dextrose and glycerin), irritants (dextrose, phenol, guaiacol, tannic acid, and plasma quinine urea), particulates (pumice), or chemotactics (sodium morrhuate arachadonic acid from cod liver oil). The injections place the hypertonic solution at the ligament level. The body attempts to neutralize the hypertonic solution by adding more fluid to the area. This creates the localized irritation and inflammation that summons the reparative process to the area so that healing may begin. The other additives serve to enhance the initiation of the reparative process.[1–5,9,16] The process activates the normal physiological principles of wound healing where the inflammation stimulates the migration of platelets with their platelet-derived growth factors (PDGF). Neutrophils, macrophages, and proteases become active debriding the damaged tissues. These PDGFs represent cytokines that stimulate the chemotaxis, mitosis, and the production of extracellular matrix, angiogenesis, and cell proliferation required to support healing. Other growth factors that are part of any normal tissue healing process are, theoretically, activated by this process.[1–5,7,10,11,14,16] This phase lasts 3–5 days and sets the stage for the proliferative stage to occur.[5,10,11]

In the proliferative stage, collagen is laid down. Fibroblastic proliferation predominates and is oriented in the direction of the ligaments that are healing. Movement is encouraged, and it directs the fibroblastic proliferation that forms the new ligaments.[1–5,7,10,11,14,16] This proliferative stage lasts from the end of the inflammatory stage upward to 3 months.[5,10,11]

The third stage is the remodeling stage, where the new ligament tissue increases its cross-linking and its fiber orientation to form the new ligaments that are developing to repair the damaged structures. Tissues contract to their physiological length restoring the stability and integrity to the joint treated.[1–5,7,10,11,14,16] This stage can last up to 2 years.[5,7,10,11] With prolotherapy, chronic indolent injuries are converted into acute injuries that go on to heal the damaged area.

In treatment, platelet rich plasma (PRP) may be used. It is a concentrate of the platelets in the patient's own blood and is harvested from a peripheral vein and concentrated to extract platelets in a reduced quantity of plasma that is injected back into the damaged tissues. This brings a high volume of platelets into the area immediately instead of waiting for the body to deliver platelets to the damaged area. This procedure stimulates a greater healing response.[3,12,13]

A histological study of prolotherapy-treated ligaments displayed an increased number of active fibroblasts, greater amounts of collagen, and an increase in collagen size and variation.[14,17] These changes are accompanied by increased thickness, mass, and ligament-to-bone-junction strength in animal models.[18,19]

Results

At the patient's first visit, approximately 4 months after the painful subluxation-dislocation episode, examination revealed extreme instability in the SCJs, especially on the right side. The separation was in the vicinity of 2 cm with abduction elevation movements of the right upper extremity. In recumbency, the medial end of the clavicle moved anterior approximately 2 cm confirming clinically that this was indeed a major instability of these joints. The pectoralis muscle was tight from the patient's unwillingness to move the arm, and it could not be stretched out without disrupting the SCJ on the right side. The same movement on the left side caused the joint to sublux.

Microperforation prolotherapy is indicated for ligament laxity, degeneration, and disruption if the damage is in a confined space. The patient's SCJ constituted a confined space, and the capsular and ligament tissues were readily identifiable as to location for injection. The joint separation made access to all parts of the joint capsule most accessible without any extraordinary techniques. The patient was considered a candidate for this treatment.

The technique described above was employed by injecting the hyperosmotic proliferant 22% dextrose and procaine approximately 9 mL into each SCJ capsular and ligament tissue. Heat and gentle exercise were recommended, and the

patient was told to avoid any anti-inflammatory medication during the healing process.

The patient had a very mild tightness in the SCJ area and did not have any severe pain. After 5–6 weeks, he felt some reduction in the popping and could realize more freedom of movement without the anxiety associated with the subluxations.

The patient was a student, whose combined travel and treatment time in clinic encompassed a full day away from school. As a matter of convenience, he had three treatment sessions with each of two different prolotherapists closer to school who used a more traditional form of prolotherapy treatment. The patient did not feel that he made an acceptable amount of progress with those six treatments.

This lack of progress made the patient realize that the more aggressive treatment yielded a better outcome and he returned to the clinic 4 1/2 months later for reevaluation. The right side was still hypermobile but was not popping. The left side was popping. Both sides were still painful.

Platelet-rich plasma injection using the same microperforation technique was employed at this time. It was obtained using the Harvest® method with 60 mL of blood yielding 10 mL of PRP, which was injected into the ligament structure around each SCJ following the same technique as our original session.

Progressive improvement was observed at each subsequent visit with increasingly greater levels of stability observed over the intervening weeks. Several additional sessions of the microperforation prolotherapy treatment were administered using hypertonic 22% dextrose plus 1 mL of the chemotactic sodium morrhuate and procaine.

The sixth and final microperforation prolotherapy treatment was given 13 months after the initial injection session. The patient had much more stability and experienced no popping. When the patient was lying down, he felt that the joints separated more than normal. This was confirmed on examination. Close examination showed some tenderness at the posterior part of the SCJ on palpation of that area. As a result, another microperforation prolotherapy treatment was given, especially injecting the SCJ posterior capsular area. To easily and safely access this area, a bent needle technique was utilized that allowed controlled access to the joint capsule from the anterior direction with the needle directed anterior keeping all vital structures safely out of harm's way. A solution of 5 mL of 22% dextrose with procaine was used in each joint. A 4-month hiatus of treatment was recommended to allow the tissues to continue to heal without further stimulation.

The patient was last examined in February 2011, 20 months after he first presented in the clinic. At this visit he had complete stability of both sternoclavicular joints with no evidence whatsoever of tendency to subluxation and no weakness of the shoulder girdle or apprehension of upper extremity movement. He was content with the treatment and was pleased that he had not suffered any surgical incisions or complications from a surgical procedure. From every point of view the shoulder and the SCJs are completely normal with no clinical evidence of a problem having existed.

Discussion

Treatment – the standard surgical approach

Surgical treatment for atraumatic anterior dislocation/subluxation of the SCJ remains controversial, with no published studies demonstrating efficacy for a large sample size.[20–31]

Numerous authors have gone on the record recommending avoidance of surgery, especially for the type of dislocation described here.[23–28,32–35] Complications reported by various authors include, in no order of frequency, pneumothorax, repeat surgery for bony erosions, hardware failure and/or migration, severe postoperative pain and limited function, persistent instability, cosmetic defects, and nonunion.[21,26,28]

Rockwood and Odor stated: "Operative treatment for spontaneous anterior subluxation of the SCJ is rarely, if ever, indicated".[28]

Echlin et al stated: "Operative repair is reserved for either posterior dislocation or nonremittent symptoms that significantly affect either daily or athletic activities".[23]

Treatment – the standard conservative approach

A case of a swimmer with bilateral SCJ subluxation reported in the literature states that a successful resolution relied on physical therapy and alternative sports like jogging and cycling.[23] The therapy was not described as curative, and the patient continued to have instability of the SCJs, necessitating the cessation of all sports requiring exaggerated overhead movements. In a case report by DiFabio et al,[22] they described complete resolution of bilateral SCJ subluxation through the use of immobilization followed by 9 months of physical therapy. There was no mention of sporting activity.

Treatment – microperforation prolotherapy

Wound healing follows physiological principals starting with inflammation which serves to clear out the damaged tissue. As vascularity increases, growth factors, enzymes, and other

cells required for this debridement are summoned to the area of damage. Cleansing takes place during the 3–5 days of inflammation and is followed by a period of laying down new collagen.[1–5,7,10,11,14,16] The collagen process starts anywhere from 3 to 5 days of inflammation upwards to 3 months. Maturation of the collagen occurs over a period of time, progressively upwards to almost 2 years as tissues become more oriented, stronger, and contract to physiological length and strength.[5,7,10,11] The end result of the healing process stimulated by prolotherapy techniques is the thickening of the ligament structures and the return of the tensile strength to normal.

In 2002, Chen et al[7] reported on a ligament healing response technique called microperforation. In this article, the authors demonstrated a technique for treating laxed ligaments, especially the medial collateral ligament area of the knee, with open surgery. The procedure uses a rake shaped like a paddle with 14 sharp teeth to create multiple acute rips and microperforations along the course of the medial collateral ligament of the knee at the time of doing open surgery on an anterior cruciate ligament. The approach specified that "the spikes must be driven into the bone to achieve a better bleeding response". Review of the approach indicated that the patient should be advised of increased bruising and ecchymosis and pain as a result of this type of surgery to stimulate the medial collateral ligament into an acute healing process. "Microperforation, despite its trauma remains less invasive than conventional surgical procedures and avoids their complications". The positive ideas of this technique are to avoid denervation of the ligament and devascularization of the ligament tissue, preserve physiometric attachments, and avoid pressure necrosis from hardware insertion. The procedure would create an acute healing environment for laxed ligaments and future developments could foresee using this procedure for other weakened ligaments in the body. It was advised that the procedure be reserved to certain classes of injury to the medial collateral ligament, but that future investigation may find other uses for the procedure.[7]

In actuality, the technique takes a relatively avascular damaged structure and forces it into an acute inflammatory response. These tissues then progress through the phases of healing, which include inflammation, debridement, new collagen lay down, and maturation. This is the body's physiological response to damage.

Microperforation prolotherapy offers the opportunity to do precisely what is described by this previous peer-reviewed article. However, we do it in a far more elegant fashion with much less necessity for bleeding and sheer tissue damage than has been created by this type of surgical procedure.

It is performed elegantly with a fine needle inserted through the skin and into the subcutaneous tissue. The needle is then directed to the ligament structures where multiple perforations accompanied by injection of the appropriate amounts and types of solutions create the tissue injury that impels the final healing. Multiple sessions without the need for open surgery and anesthesia accomplish the same goals as the open surgery described above. We accomplish regeneration and maturation of ligaments, thereby eliminating instability, and we restore normal function without surgical scars and without any prolonged period of confinement. It is all done in a clinic setting.

Torretti and Lynch[31] reviewed the current literature relating to SCJ injuries. The authors analyzed many types of treatments and clearly recognized the importance of the posterior sternoclavicular capsular ligament as the main anteroposterior component for stability. The authors reviewed the relative strength of the various repairs and summarized that "although there has been a small but significant advancement in the cumulative knowledge of the sternoclavicular joint, there still remains a number of unanswered questions. Controlled comparisons of a variety of treatment methods will be needed to reliably assess clinical outcomes".[31]

It is hypothesized that microperforation prolotherapy be seriously considered as a proper treatment for the ligamentous injuries of anterior sternoclavicular dislocation and other applications where significant ligamentous injury is involved in a confined space.

Conclusion

This manuscript describes and presents a novel form of microperforation prolotherapy used to treat bilateral atraumatic spontaneous anterior dislocation of the SCJ that was causing severe morbidity. Results of this novel microperforation prolotherapy, applied to the capsular ligaments about the SCJ, appear to be a completely satisfactory alternative to surgery. The treatment has allowed the patient to return to full, normal function with no residual observable findings indicating the previous presence of this problem. This novel microperforation prolotherapy has been able to accomplish a complete return to full functional stability of the SCJs, without any scar or complication, in an acceptable time frame. Based on the positive results obtained in this difficult case, further study and more extensive use of microperforation prolotherapy are indicated. It is the purpose of this writing to share observations and spark interest in further studies of this technique.

Disclosure

The authors report no conflicts of interest in this work.

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