Case Study

Resolution of Frozen Shoulder in a 68-Year-Old Male Following Chiropractic Care: A Case Study

Michael Drzewiecki, DC[1]

1. *Private Practice of Chiropractic, Chicago, IL*

Abstract

Objective: To describe the outcomes following chiropractic care on a man with frozen shoulder and vertebral subluxation.

Clinical Features: One patient with previously diagnosed frozen shoulder complicated by cervical and glenohumeral degenerative joint disease (DJD) along with vertebral subluxations.

Intervention and Outcome: Chiropractic care directed at removing subluxations of the spine and upper extremity in conjunction with passive rehabilitation. The patient showed an increase in range of motion of the left shoulder, measured using a single hinge goniometer. The patient also experienced a decrease in pain, recorded using a variation of the standard VAS pain scale.

Conclusion: Improvements in subjective and objective findings were noted while receiving chiropractic and rehabilitative care. Further investigation with a larger sample size over a longer period of time must be conducted to confirm a relationship between frozen shoulder and chiropractic care with functional rehabilitation.

Key Words: *Chiropractic, adjustment, manipulation, frozen shoulder, DJD, rehabilitation, subluxation, laser, tape*

Introduction

The purpose of this paper is to illustrate how chiropractic care can be effective in management of one patient with previously diagnosed frozen shoulder, complicated by cervical and glenohumeral degenerative joint disease (DJD). Frozen shoulder is a common shoulder condition that is often insidious in onset, causing severe pain with limited passive and active ranges of motion, most commonly abduction and external rotation.[1,2]

Between two and three percent of the general population and between 10% and 19% of the diabetic population are affected with this condition.[3,4] Women are affected slightly more often than men, with symptoms most commonly arising in the sixth decade. Bilateral involvement occurs in 20% of cases.[5] Although frozen shoulder syndrome and adhesive capsulitis are commonly used terms to describe this condition, it has also been called periarticular adhesions, pericapsulitis, irritative capsulitis, periarthritis of the shoulder, scapulohumeral periarthritis, humeroscapular fibrositis, bursitis calcerae, Duplay's syndrome, shoulder portion of shoulder-hand syndrome, and stiff and painful shoulder.[6]

The etiology and consensus definition of frozen shoulder has been elusive to healthcare professionals though Zuckerman et al[7] proposed a definition and classification system in which the condition has been described as both idiopathic in origin (Primary) or due to a known systemic, intrinsic, or extrinsic cause (Secondary).

The definition, "Frozen shoulder is a condition characterized by functional restriction of both active and passive shoulder motion for which radiographs of the glenohumeral joint are essentially unremarkable except for the possible presence of osteopenia or calcific tendonitis," was supported by 82% of polled clinicians. Within the classification proposed and accepted by 85% of polled clinicians, intrinsic factors are those limited to pathology of the supporting structures of the shoulder girdle. One article in the literature suggests that an intrinsic factor contributing to dysfunction of the shoulder complex is the incorrect placement of vaccine injections into the deltoid bursa.[8] Extrinsic factors include an abnormality, trauma, or surgery remote to the shoulder. Systemic factors include physiological pathologies of the system including, but not limited to, metabolic disorders,[7] diabetes being most common.[3]

The pathogenic process of frozen shoulder is not specifically known. Although, in patients who were not responsive to conservative care, immunocytochemistry biopsies of the coracohumeral ligament and anterior superior joint capsule revealed fibroblasts, proliferating fibroblasts, and myofibroblasts. The presence of fibroblasts indicates a fibrotic or scarring condition, while the presence of myofibroblasts indicates contractile ability leading to nodule formation much like that of a Duputryn contracture of the hand.[9]

Omari et al[10] confirmed the gross thickening of the coracohumeral ligament with scar tissue formation and vascularization of the tissue. Other immunocytochemistry studies have confirmed this finding of fibroblastic activity along with discovery of chronic inflammatory cells, lymphatics, and nerve formations. This has supported the theory that frozen shoulder is an inflammatory condition and may explain why the associated pain is so significant.[11]

Patients affected by this condition typically encounter three phases of involvement: 1) The painful freezing phase – an acute inflammatory stage lasting 10 to 36 weeks. 2) The adhesive phase – where the joint stiffens, lasting 4 to 12 months. 3) The resolution phase – where some range of motion is restored lasting 12 to 42 months.[1,2]

Although the final phase of frozen shoulder has been known as the resolution phase, there is conflicting evidence in the literature concerning time frame of resolution and whether complete resolution is ever achieved. Bulgen et al[12] reported no significant difference between non-treatment groups and groups with physiotherapy, intra-articular steroidal injections, and mobilization. Other studies have found that within 24 months, non-treatment groups had a better complete resolution rate than treatment groups, comparatively.[13,14] Other studies refute this evidence finding that at 22 months, subjective accounts of resolution were high, although objectively there are still limitations of the affected shoulder.[15] More so, Hand et al[5] found that at greater than seven years after onset of symptoms, 35% of patients still report mild to moderate symptoms with 6% reporting severe symptoms.

Diagnosis

Due to the nature of the syndrome, a diagnosis of frozen shoulder is primarily based on the history and physical exam of the patient.[16] The patient typically presents with a history of gradual loss of shoulder range of motion with worsening pain, an inability to sleep on the affected shoulder, and trouble with the task of putting on or taking off of shirts or jackets.[17] Frozen shoulder should be considered when a patient presents with limited shoulder mobility and a history that includes diabetes mellitus[3] or thyroid conditions, as they are known complicating factors.[18]

The physical exam of frozen shoulder typically reveals a patient with an adducted and internally rotated arm, and disuse atrophy of the supraspinatus and deltoid muscles depending on how long the patient has been unable to use their arm prior to presenting to the clinic. There may be pinpoint tenderness over the insertion of the deltoid muscle on the humerus, as the deltoid may be overworked acting as a splint for the dysfunctional shoulder complex.[2]

As one of the main components of frozen shoulder is a decrease in range of motion of the upper extremity,[1] proper objective evaluation of the limb is warranted. The literature is conflicting when it comes to evaluation tools for range of motion. Gajdosik et al[19] found that a full circle single hinge goniometer is the preferred instrument in assessing extremity range of motion when used consistently by the clinician, while Pringle et al[20] found the single hinge goniometer reliable yet not valid for clinical use due to a consistent measurement outside of the textbook normals. While all ranges of motion can be decreased, abduction and external rotation are most commonly affected,[1,21] with complete loss of external rotation of the humerus being pathognomonic for frozen shoulder.[2]

As frozen shoulder is primarily a soft tissue disorder,[21] the use of plain radiographs is not helpful in the diagnosis of the condition. The only remarkable radiographic evidence of frozen shoulder is local osteopenia and erosions of the glenohumeral joint due to disuse of the joint complex.[16,21] Arthroscopic immunocytochemistry biopsy has been proven to find inflammatory cells,[11] fibroblasts, and myofibroblasts,[9] which could be diagnostic in nature, but the procedure is surgical and not typically used as a diagnostic tool.[16]

It is important for the clinician to rule out other possible disorders of the shoulder complex prior to diagnosing a patient with frozen shoulder.[22] Because active and passive ranges of motion are decreased in frozen shoulder,[1] a presentation that allows passive external rotation of the humerus may indicate a possible rotator cuff tear.[2] If the patient has pain and/or restriction of abduction that improves with local anesthetic administered in the subacromial bursa, or still has available external rotation of the humerus, an impingement syndrome[16] or bursitis[22] may be more likely.

The upper extremity is largely innervated by the nerves passing through the cervical spine therefore cervical radiculopathy must be ruled out[22] as a cause of muscle atrophy.[23] The clinician must also rule out the possibility of neoplasm, which can give rise to nocturnal pain, and systemic autoimmune disorder, such as rheumatoid arthritis or systemic lupus erythematosus, which may also cause pain and decreased shoulder range of motion.[22] Although frozen shoulder is thought to be an inflammatory condition,[11] the presence of effusion, warmth, or erythema is not normally associated with frozen shoulder.[16]

Traditional Treatment

Due to the final stage of frozen shoulder being one of resolution, there are conflicts in the literature as to how a patient with frozen shoulder should be managed. Most sources agree that conservative, non-surgical care should be first in the management plan.[6,13,24,25] The current, least invasive form of treatment is supervised neglect,[13,25] which is a commonly used because the natural course of frozen shoulder is often spontaneous resolution. The use of non-steroidal anti-inflammatory drugs (NSAIDs), oral steroidal anti-inflammatory drugs,[26] intra-articular distension with administration of steroids,[27,28] and suprascapular nerve blocks[29,30] have all been useful in the treatment of frozen shoulder. Mitra et al[31] proposed a new protocol for treatment of frozen shoulder consisting of a suprascapular nerve block followed by intra-articular steroidal injection, brisement volume dilation to a fixed end point, and shoulder manipulation.

When conservative measures fail and the patient is not resolving, surgical procedures, including manipulation under anesthesia with rehabilitation,[32] manipulation under anesthesia with arthroscopic arthrolysis,[33] or open surgical release of the shoulder have been useful in increasing functional range of motion. There is evidence that manipulation under anesthesia accounts for ligament, capsule, or bone disruption in 5-20% of cases[32] and has been reported to potentially cause scapular fractures at the glenoid fossa.[34]

Chiropractic and Rehabilitation

There are many models and theories to describe what a subluxation is[35] and the role of a chiropractor in removing it. The subluxation, is defined in the book *Foundations of Chiropractic*, as "A motion segment in which alignment, movement integrity, and/or physiologic function are altered although contact between the joint surfaces remains intact."[36] In this case study, the patient's subluxations were addressed using multiple assessment and treatment techniques. The assessment protocol that was utilized was the P.A.R.T. system of chiropractic analysis as described by Medicare guidelines.

This analysis is broken down into four distinct parts to describe the subluxation; 1) Pain and tenderness – describing the location, quality, and severity of the pain through use of percussion, palpation, and/or provocation. The pain is often described using a visual analog scale (VAS) or auditory analog scale. 2) Asymmetry – describing differences that are observed in the patient's posture, gait, static palpation, or motion palpation that are indicative of joint misalignment. Diagnostic imaging may also be used to detect asymmetry in the joints. 3) Range of Motion – describing the motion of a joint that is patient induced (active) and/or clinician induced (passive). Instruments such as a goniometer or inclinometer may be used to objectively measure the range of motion in the joint or series of joints. 4) Tissue or Tone Changes – describing soft tissue findings throughout the system. The tissue may be described as hypertonic, hypotonic, taut, rigid, flaccid, inflamed, swollen, and/or in spasm. The length and strength of the muscle or groups of muscles may also be described.[37]

As a subjective tool to measure pain throughout treatment, a variation of the Visual Analog Scale (VAS) was utilized. On the VAS, 0 is rated as no pain and 10 is rated as the worst pain imaginable. The Quadruple Visual Analog Scale[38] is a measuring tool of pain over the treatment time of the patient.

There are four questions regarding pain using the VAS and one qualifying questions regarding length of pain. 1) What is your pain right now? 2) What is your typical or average pain? 3) What is your pain at its best (How close to "0" does your pain get at its best)? 4) What is your pain at its worst (How close to "10" does your pain get at its worst)? The one qualifying question is, what percentage of your awake hours is your pain at its best?

Proper neuromuscular control, or intact afferent and efferent neurological pathways[39] were tested utilizing relative muscle tests of the upper extremity as described in, *Advanced Principles of Upper Extremity Adjusting.* These manual muscle tests were not used to test maximal muscle strength, rather to assess the neuromuscular control of the upper extremity with ability to adapt to an input from the intern and stabilize the joint to which stress is being added.[40] The test of the system is not to use more than 50% of the patient's total power.[41] These muscle tests were used to determine the misalignment in the joints of the shoulder complex. After manual high velocity, low amplitude thrusts were administered to the affected joints in the upper extremity, the relative muscle test was used again to verify that the proper neuromuscular control had returned to the affected series of joints.[42]

The mechanical force, manually assisted short lever adjusting instrument (Activator IV), is an FDA approved device used by many chiropractors to reduce subluxations.[43] This instrument was used for adjusting the subluxations in the patient's spine. The Activator IV can be held by one hand of the clinician and is used to deliver a specific, spring-loaded force to the anatomy of the patient. The device has a rubber tip on the contacting surface to reduce point tenderness to site being adjusted. There are four variable settings that may be used depending on the thickness of the anatomical structure.[44] Although there is an assessment technique that is often used in conjunction with the instrument, they are not dependent on each other in order to be effective.[45] The instrument produces less peak force, in less time, compared to other manual adjusting techniques[46] but produces enough energy for relative movement of a bone when utilized correctly.[47]

As part of the rehabilitation process, an FDA approved 904nm gallium arsenide low level laser system (Multi Radiance Medical Inc. MR4) was utilized. This device has been used to treat many musculoskeletal disorders.[48.49] The device utilizes a LaserShower LS50 emitter to deliver a super pulsed laser (50,000 mW) with ability to emit photons that reach structures as deep as 10-13 cm below the skin's surface.[50]

Along with the low level laser therapy, light elastic therapeutic tape, also known as kinesiology tape, was applied to the patient's shoulder at the end of each visit in attempt to give functional stability to the joint. Although this has become more popular in recent years for use in treating musculoskeletal injuries, it is not well researched.

Kinesiology tape differs from standard athletic tape in that it has elastic properties, which allow range of motion of a joint or series of joints, rather than restricting motion as many rigid athletic tapes do. The tape has heat activated acrylic glue that typically lasts for several days, and can be worn through normal daily activities as it is breathable and not affected by water.[51]

Case Report

Patient History

A 68-year-old male presented to the chiropractic clinic with a chief complaint of left sided shoulder pain and stiffness. The patient was previously diagnosed with frozen shoulder by his medical doctor after noticing a decreased range of motion and progressing pain but wanted to have the condition treated conservatively prior to any surgical procedures. The pain originally started 20 years prior to presentation to the clinic following two falls off his road bicycle. One fall resulted in the patient landing on his upper back, while the second resulted in the left shoulder being driven into the side of a car in the process of the fall.

The patient reported increased aching of the shoulder over the last three years on long bicycle rides but had not ridden since the stiffness started four months prior to presentation to the clinic. The pain and stiffness had been rapidly progressive in nature. The patient first noticed the stiffness when he could not put on his shirt without assistance from his wife. When asked about the location of his pain the patient pointed to the left upper trapezium, left lower cervical region, and left posterior glenohumeral joint.

The patient denied any radiating pain. Driving, working, and exercise, including running, were provocative, while chiropractic care, stretching, massage, and rest were palliative. The patient self-managed the pain with non-steroidal anti-inflammatory drugs (NSAIDs) along with boswellian and arnica topical creams applied daily which were reported to alleviate "some" of the pain and stiffness. The patient stated that while working out he performs seated rows and often hears a "loud pop" in his shoulder which is painful at first but has noticed great relief from the pain and stiffness for several hours following the "pop."

Previous care included a diagnosis of frozen shoulder from his medical doctor along with chiropractic adjustments to the spine and shoulder prior to presenting. The patient saw some improvement but decided to change care for unknown reasons.

The patient's history includes hypertension that was originally diagnosed in 1983 and has been managed with 50mg of Losartan daily, prescribed in 2009. In 2004, the patient was diagnosed with non-metastasizing prostate cancer treated using unknown surgical procedures. He experienced a relapse and underwent radiation therapy to the prostate in February 2013, resulting in full remission. In 2009, the patient was diagnosed with left lower cervical degenerative joint disease.

The patient also presented to the clinic with secondary complaints of low back pain, right 1st metatarsophalangeal joint pain, and left knee pain associated with a click upon movement of the knee.

Physical Examination

Observation of the patient's posture revealed internal rotation of the left upper extremity, superior elevation of the left shoulder, a hyperkyphotic thoracic curve, anterior head translation, and rightward head rotation. The patient had a noticeable decrease in left arm swing upon gait analysis. Palpation of the left shoulder region revealed wasting of the supraspinatus muscle and deltoid muscle compared to the right, with a taut upper trapezius muscle and tenderness in the bicipital groove and posterior deltoid muscle on the left.

Cervical active range of motion testing revealed a decrease in left lateral flexion without pain. All other cervical ranges of motion, both passive and active, were painless and within normal limits. Lumbar range of motion testing was within normal limits but revealed 3/10 pain on the Numeric Pain Rating Scale (NPRS), which was used as a verbal description of pain throughout the exam, over the left trapezium during left and right lumbar lateral flexion.

Active and passive ranges of motion of the left shoulder were measured using a single hinge, full circle goniometer as described in the textbook, *Measurement of Joint Motion: A Guide to Goniometry*,[52] and are shown in Table 1. Pain was elicited upon all shoulder ranges of motion and rated a 7/10 on the NRPS. All orthopedic tests of the shoulder were positive due to pain and stiffness in the shoulder. Biceps, brachioradialis, and triceps reflexes were graded normal +2 bilaterally using the Wexler's Reflex Grading Scale. Deltoid, wrist extension, triceps, finger flexion, and interossei muscle tests were graded 5/5 on the Oxford Manual Muscle testing scale. The patient's QVAS scores at time of presentation were 7,7,4,9 with the qualifying score of 70%.

Chiropractic Examination

Static palpatory findings revealed taut muscle fibers at C1, C3-C5, T8, L3-L5, and around the left sacroiliac joint. Upon palpation, tenderness was noted at C3-C4 and L2-L4 vertebral levels. Using motion palpation techniques, a decrease in end range motion was felt at C1, C4, T8, L3 and in the left sacroiliac joint. C1 was fixated in (-)pitch and (+)yaw; C4 in (-)itch, (+)yaw and (+)roll; T8 in (-)pitch and (+)yaw; L3 in (-)pitch and (-)yaw; and the left sacroiliac joint in (+)pitch. An anterior humeral head and anteromedial sternoclavicular joint were found while performing relative muscle tests of the upper left extremity, as demonstrated in *Advanced Principles of Upper Extremity Adjusting.*

Pectoralis major superior division and anterior deltoid muscles were weak, such that immediate joint stabilization did not take place. The pectoralis major clavicular test was performed with the patient supine, with the left arm straight up in the air, elbow fully extended. The patient was instructed to point his thumb down toward his toes. The posterior aspect of the wrist was contacted while stabilizing the opposite anterior superior iliac spine of the ilium.

Pressure was applied out and slightly down, or inferior from the patient, pulling the insertion away from the origin. The anterior deltoid relative muscle test was performed with the patient supine, arms flexed forward to 45 degrees, palms facing the floor. The intern placed his hand on the posterior aspect of the patient's forearm and applied pressure down towards the floor.[42] Pain in the shoulder joint was rated at a 7/10 on the NPRS scale during relative muscle testing of the left upper extremity.

Diagnostic Imaging

A plain radiograph series of the left shoulder in internal rotation, external rotation, and abduction was performed. Articular changes of the glenohumeral joint consisting of non-uniform loss in joint space, subchondral cysts, sclerosis, and osteophyte formation, particularly of the inferior humeral head were noted lending to a radiographic impression of degenerative joint disease.

Intervention and Outcome

The patient was adjusted three times per week, except for a period of two weeks while the patient was traveling, for a total of 16 visits. Mechanical force, manually assisted sort lever adjustments using an Activator IV Adjusting Instrument were delivered to the spine, while manual high velocity, low amplitude thrusts were delivered to the left shoulder complex. Although the Activator Adjusting Instrument was utilized to deliver the adjustments to the spine, the Activator Method assessment was not performed due to the fact that the patient could not raise his left arm over his head as the assessment protocol directs.[44]

Adjustments to the cervical spine, thoracic spine, lumbar spine, and pelvis were therefore delivered based on motion and static palpatory findings indicating subluxation that the patient presented with upon each visit. Adjustments to the sternoclavicular joint were delivered on each visit, in the posterior and lateral direction of thrust, based on weak pectoralis major superior division relative muscle test. Adjustments to the glenohumeral joint were delivered on each visit, with the intent to break capsular adhesions,[42] based on anterior deltoid weakness found using relative muscle testing.

The patient's arm was placed in forward flexion to end range of passive motion. Long axis traction at the patient's forearm was then administered while a thrust was delivered using the web of the interns had, which was placed at the most proximal aspect of the humerus, covering the anterior joint capsule.

Partnership Health Services located within the practice provided rehabilitative services for the patient through the duration of treatment. Low level laser therapy was administered over the left shoulder complex with emphasis on the supraspinatus and deltoid muscle. The 5-50Hz deep stimulatory setting for chronic pain and inflammation was programmed and the laser therapy was administered using the LaserShower LS50 emitter head for five minutes per session.

Light elastic therapeutic tape, also known as kinesiology tape, was applied to the left acromioclavicular joint and over the left deltoid muscle at the end of each patient visit. Two pieces of tape were placed on the acromioclavicular joint in a cross pattern directly over the joint. Two pieces of tape were also applied over the deltoid muscle, one from the distal attachment point on the humerus superior and anteriorly over the anterior deltoid, ending at the proximal attachment of the deltoid at the clavicle. The other was applied from the distal insertion point on the humerus superior and posteriorly over the posterior deltoid, ending at the proximal attachment of the muscle.

At the time of writing this case study, the patient was continuing care as described above, with hopes of regaining full range of motion and diminished pain. Passive and active ranges of motion had increased in all planes and are demonstrated in Table 2. The patient's pain had decreased significantly in his left shoulder as demonstrated with the QVAS scores of 4,3,0.5,7 with a qualifying score of 80%. The patient was excited to be able to put on his shirts and jackets without the need for assistance.

This case illustrates the effectiveness of chiropractic care in improving range of motion and decreasing pain in a patient with frozen shoulder. Further research should be done using a larger sample size over a longer period of time.

Discussion

Frozen shoulder affects between 2-3% of the general population in the United States,[3] but remains to be an enigma for much of the healthcare professions.[53] With an etiology that has been somewhat elusive[53] and a natural history that has been argued in the literature,[13] few aspects of the condition are agreed upon other than that conservative management should be considered first.[6,13,24,25] The patient in this case study presented with complicating factors of cervical and glenohumeral degenerative joint disease (DJD). It may be hypothesized that in addition to a history containing trauma and chronic pain to the left shoulder joint, degenerative changes in the spine and upper extremity may have played a role in the onset of the frozen shoulder.

DJD is a gradual progressive joint failure over time[54] characterized by pathologic changes in the articular cartilage and surrounding structures of the joint. Radiographically, DJD is defined as an asymmetrical loss in joint space with possible osteophytosis, subchondral sclerosis, subchondral cysts, intra-articular loose bodies, articular deformity, and joint subluxation.

Although DJD is a structural disorder, the soft tissue structures around the degeneration site are often affected.[55] It is well known that there are extensive anatomical associations between the cervical spine and shoulder complex. The primary muscles, acting as scapular stabilizers, which share attachment between the structures, are the levator scapulae, rhomboid major, rhomboid minor, and the trapezius.

The innervations of these muscles, along with the muscles of the upper extremity, are provided by the brachial plexus, which exits the cervical spine between the levels of C5 and T1.[56] Due to this extensive relationship between the cervical spine and upper extremity under optimal circumstances, there are also common consequences that may be observed between cervical spine and upper extremity in dysfunction.[57]

With a history of trauma involving the patient's left shoulder and upper back, it may be hypothesized that improper juxtaposition of the vertebral segments and glenohumeral joint caused a long-term dysafferentation throughout the system. It is thought that an imbalance between nociceptive and proprioceptive input, via the Type I and type II nociceptors and Type III and Type IV mechanoreceptors, found throughout the cervical facet joints[58] and their surrounding structures, leads to an imbalanced efferent signal to the motor units of the attached musculature.[35]

This imbalance in neuromuscular control may be the cause of pathology or a compensatory strategy related to instability due to a loss of strength, proprioception, and coordination in the shoulder complex.[59] As the biomechanics of the shoulder complex continue to degenerate, supporting structures such as the coracohumeral ligament, are placed under added stress. Kent describes a neurodystrophic hypothesis in that the stress of subluxation causes an increase in autonomic sympathetic tone, which decreases the normal immune response to the affected structures.[35]

As a result of this altered immune response, the inflammatory chemicals, bradykinins, cytokines, prostaglandins, and growth factors are released into the tissue, sensitizing neurons and setting the stage for chronic pain and inflammation.[60] The chronic inflammation phase of frozen shoulder is then followed by the migration of fibroblasts and myofibroblasts, causing scarring of the tissue[11] and contractibility of that tissue, leading to further stiffness throughout the glenohumeral joint capsule.[9]

Type I (A Alpha) and Type II (A Beta) afferent fibers, which are the primary afferents to respond to external inputs delivered to the joint,[44] fire at a much faster rate (35-65 m/s) than nociceptive Group IV (C) fibers (≤2.5 m/s).[61] Both mechanoreceptive and nociceptive fibers activate the same projection neuron that sends information to the sensory centers within the brain. As the gate theory of pain describes, non-myelinated nociceptive C-fibers located in joint capsules are inhibited by interneurons in the spinal cord. These interneurons are excited by myelinated, non-nociceptive A Beta fibers.

When nociceptive fibers are excited in absence of mechanoreceptive input, pain is perceived. In the presence of mechanoreceptive input, the interneuron inhibits the nociceptive input and pain is not perceived.[44] As described by Kent et al,[35] any chiropractic technique that produces movement of the joint and stretch within the joint capsule directly affects the joint mechanoreceptors, potentially inhibiting the perception of pain. It is theorized that this concept is responsible for the decrease in perceived pain seen on the QVAS pain scales.

In addition to the decrease in perceived pain, it is theorized that the increase in range of motion throughout the glenohumeral joint is a result of the chiropractic adjustments to the cervical spine, sternoclavicular joint, and glenohumeral joint. The mechanical force, manually assisted, short lever adjustments[47] delivered to the spine and the manual, high velocity, low amplitude thrusts delivered to the sternoclavicular and glenohumeral[62] joints may have decreased the juxtaposition misalignment,[63] improving biomechanics[64] and decreasing dysafferentation,[35] resulting in better range of motion. It is also believed that the manual high velocity, low amplitude thrusts delivered to the glenohumeral joint broke some of the contracted adhesions that were limiting range of motion of the joint.[42]

In addition to the chiropractic management of the patient, it may be hypothesized that the rehabilitation process also helped improve the condition of the patient. The use of low level laser therapy (LLLT) was used over the supraspinatus muscle, deltoid, and underlying structures. It has been found in the literature that LLLT has been useful in treating many musculoskeletal disorders [48] through photobiostimulation.

This interaction is thought to have an analgesic effect, anti-inflammatory action, and wound healing benefits.[49] It is thought to provide these benefits through the blocking of the conduction of Type IV (C) primary afferent fibers,[65] enhancing ATP-ADP metabolism, increasing mitochondrial ATP production, affecting phagocytic cell activity, increasing vasodilation leading to better microcirculation in tissues, and increasing the rate of cell division and cell growth.[66]

The second aspect of rehabilitation utilized for pain modulation and range of motion was that of light elastic therapeutic tape, also known as kinesiology tape. The exact mechanism under which kinesiology tape works remains unknown in the literature. Theories include the gate theory of pain control via mechanoreceptor activation, an increased number of motor units excited allowing more muscle activation, elastic pull on the joint through the range of motion due to the elastic properties of the tape, or placebo effect.[51] Therapeutic tape has been found as a useful treatment tool when utilized in conjunction with other physiotherapeutic treatment,[67] along with increasing immediate pain free range of motion when compared to sham treatments.[68]

With frozen shoulder having a natural history of spontaneous resolution,[1,2] a possible alternative explanation for the improvement seen in this case is that the condition was in the state of resolution. The author does not believe this to be the case, as improvements have been rapid following the beginning of care and the literature has shown a longer time needed for spontaneous resolution.[2] Due to the variables of the patient still being under care and the complicating factors of glenohumeral and cervical DJD, it is unknown if full range of motion will ever be obtained. It is the hope of the patient and the prediction of the intern that functional motion and use of the shoulder will be restored in this case. Although this case study of chiropractic and rehabilitative management for frozen shoulder shows positive results, future inquiry into this subject is needed.

Conclusion

Frozen shoulder has been a highly debated topic throughout the healthcare fields with many theories as to the etiology, natural history, and treatment of the condition.[7] There are two universally agreed upon concepts.

First, frozen shoulder causes a decrease in both active and passive ranges of motion of the upper extremity, most commonly in abduction and external rotation.[1,2,21] Second, a conservative approach to management must be considered prior to surgical intervention.[14,24,25,34] In this case, chiropractic management of frozen shoulder increased range of motion and decrease pain over a short period of treatment time.

Chiropractic care with rehabilitation of the shoulder complex should be considered as a viable conservative solution for management of frozen shoulder.

Due to the complexity of this condition and the inherent weakness of a single patient case study, it is recommended that further studies with larger sample sizes over longer periods of time are conducted to determine a true relationship between frozen shoulder and chiropractic care with rehabilitation.

References

1. Souza TA. Differential diagnosis and management for the chiropractor. 4th ed. Burlington (MA): Jones and Bartlett Learning; 2009.
2. Dias R, Cutts S, Massoud S. Frozen shoulder [Internet]. BMJ. 2005 Dec 17 [cited 2013 May 22];331(7530):1453-6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16356983.
3. Bridgman JF. Periarthritis of the shoulder and diabetes mellitus [Internet]. Ann Rheum Dis. 1972 Jan [cited 2013 May 22];3(1):69-71. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1005864/
4. Sattar MA, Luqman WA. Periarthritis: another duration-related complication of diabetes mellitus [Internet]. Diabetes Care. 1985 [cited 2013 May 22];8(5):507-10. Available from: http://www.ncbi.nlm.nih.gov/pubmed/4053938.
5. Hand C, Clipsham K, Rees JL, Carr AJ. Long-term outcome of frozen shoulder [Internet]. J Shoulder Elbow Surg. 2008 [cited 2013 May 22];17(2):231-6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17993282.
6. Kazemi, Adhesive Capsulitis: a case report [Internet]. J Can Chiropr Assoc 2000 [cited 2013 May 22]; 44(3):169-176. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2485523/pdf/jcca00015-0043.pdf.
7. Zuckerman JD, Rokito A. Frozen shoulder: a consensus definition [Internet]. J Shoulder Elbow Surg. 2011 Mar [cited 2013 May 22];20(2):322-5. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21051244.
8. Atanasoff S, Ryan T, Lightfoot R, Johann-Liang R. Shoulder injury related to vaccine administration (SIRVA) [Internet]. Vaccine. 2010 Nov 29 [cited 2013 May 22];28(51):8049-52. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20955829.
9. Bunker TD, Anthony PP. The pathology of frozen shoulder [Internet]. A Dupuytren-like disease. J Bone Joint Surg Br. 1995 Sep [cited 2013 May 22];77(5):677-83. Available from: http://www.ncbi.nlm.nih.gov/pubmed/7559688.
10. Omari A, Bunker TD. Open surgical release for frozen shoulder: surgical findings and results of the release [Internet]. J Shoulder Elbow Surg. 2001Jul-Aug [cited 2013 May 22];10(4):353-7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11517365.
11. Hand GC, Athanasou NA, Matthews T, Carr AJ. The pathology of frozen shoulder [Internet]. J Bone Joint Surg Br. 2007 Jul[cited 2013 May 22];89(7):928-32. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17673588
12. Bulgen DY, Binder AI, Hazleman BL, Dutton J, Roberts S. Frozen shoulder: prospective clinical study with an evaluation of three treatment regimens [Internet]. Ann Rheum Dis. 1984 Jun [cited 2013 May 22];43(3):353-60. Available from: http://www.ncbi.nlm.nih.gov/pubmed/6742895.
13. Vastamäki H, Kettunen J, Vastamäki M. The natural history of idiopathic frozen shoulder: a 2- to 27-year followup study[Internet]. Clin Orthop Relat Res. 2012 Apr [cited 2013 May 22];470(4):1133-43. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22090356.
14. Diercks RL, Stevens M. Gentle thawing of the frozen shoulder: a prospective study of supervised neglect versus intensive physical therapy in seventy-seven patients with frozen shoulder syndrome followed up for two years [Internet]. J Shoulder Elbow Surg. 2004 Sep-Oct [cited 2013 May 22];13(5):499-502. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15383804.
15. Griggs SM, Ahn A, Green A. Idiopathic adhesive capsulitis. A prospective functional outcome study of nonoperative treatment [Internet]. J Bone Joint Surg Am. 2000 Oct [cited 2013 May 22];82-A(10):1398-407. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11057467.
16. Anton HA. Frozen shoulder [Internet]. Can Fam Physician. 1993 Aug [cited 2013 May 22];39:1773-8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/8374364.
17. Dutton M. Orthopedic examination, evaluation, & intervention. United States: McGraw-Hill; 2004.
18. Milgrom C, Novack V, Weil Y, Jaber S, Radeva-Petrova DR, Finestone A. Risk factors for idiopathic frozen shoulder [Internet]. Isr Med Assoc J. 2008 May [cited 2013 May 22];10(5):361-4. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18605360.
19. Gajdosik RL, Bohannon RW. Clinical measurement of range of motion. Review of goniometry emphasizing reliability and validity [Internet]. Phys Ther. 1987Dec [cited 2013 May 22];67(12):1867-72. Available from: http://www.ncbi.nlm.nih.gov/pubmed/3685114.
20. Pringle RK. Intra-instrument reliability of 4 goniometers [Internet]. J Chiropr Med. 2003 Summer [cited 2013 May 22];2(3):91-5. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19674601.
21. Kelley MJ, Shaffer MA, Kuhn JE, Michener LA, Seitz AL, Uhl TL, Godges JJ, McClure PW. Shoulder pain and mobility deficits: adhesive capsulitis [Internet]. J Orthop Sports Phys Ther. 2013 [cited 2013 May 22];43(5):A1-A31. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23636125.
22. Ewald A. Adhesive capsulitis: a review [Internet]. Am Fam Physician. 2011 Feb15 [cited 2013 May 22];83(4):417-22. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21322517.
23. Pollack A, Harrison C, Henderson J, Britt H. Neuropathic pain [Internet]. Aust Fam Physician. 2013 Mar [cited 2013 May 22];42(3):91. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23529515.

24. Levine WN, Kashyap CP, Bak SF, Ahmad CS, Blaine TA, Bigliani LU. Nonoperative management of idiopathic adhesive capsulitis [Internet]. J Shoulder Elbow Surg. 2007 Sep-Oct [cited 2013 May 22];16(5):569-73. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17531513.
25. Chambler AF, Carr AJ. Aspects of current management The role of surgery in frozen shoulder [Internet]. J Bone Joint Surg [Br] 2003 [cited 2013 May 22]; 85-B(6):789-795. Available from: http://www.bjj.boneandjoint.org.uk/content/85-B/6/789.full.pdf.
26. Buchbinder R, Hoving JL, Green S, Hall S, Forbes A, Nash P. Short course prednisolone for adhesive capsulitis (frozen shoulder or stiff painful shoulder): a randomized, double blind, placebo controlled trial [Internet]. Ann Rheum Dis. 2004 Nov [cited 2013 May 22];63(11):1460-9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15479896.
27. Jacobs LG, Barton MA, Wallace WA, Ferrousis J, Dunn NA, Bossingham DH. Intra-articular distension and steroids in the management of capsulitis of the shoulder [Internet]. BMJ. 1991 Jun 22 [cited 2013 May 22];302(6791):1498-501. Available from: http://www.ncbi.nlm.nih.gov/pubmed/1855018.
28. de Jong BA, Dahmen R, Hogeweg JA, Marti RK. Intra-articular triamcinolone acetonide injection in patients with capsulitis of the shoulder: a comparative study of two dose regimens [Internet]. Clin Rehabil. 1998 Jun [cited 2013 May 22];12(3):211-5. Available from: http://www.ncbi.nlm.nih.gov/pubmed/9688036.
29. Jones DS, Chattopadhyay C. Suprascapular nerve block for the treatment of frozen shoulder in primary care: a randomized trial [Internet]. Br J Gen Pract. 1999 Jan [cited 2013 May 22];49(438):39-41. Available from: http://www.ncbi.nlm.nih.gov/pubmed/10622015.
30. Karataş GK, Meray J. Suprascapular nerve block for pain relief in adhesive capsulitis: comparison of 2 different techniques [Internet]. Arch Phys Med Rehabil. 2002 May [cited 2013 May 22];83(5):593-7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11994796.
31. Mitra R, Harris A, Umphrey C, Smuck M, Fredericson M. Adhesive capsulitis: a new management protocol to improve passive range of motion [Internet]. PM R. 2009 Dec [cited 2013 May 22];1(12):1064-8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20006315.
32. Castellarin G, Ricci M, Vedovi E, Vecchini E, Sembenini P, Marangon A, Vangelista A. Manipulation and arthroscopy under general anesthesia and early rehabilitative treatment for frozen shoulders [Internet]. Arch Phys Med Rehabil. 2004 Aug [cited 2013 May 22];85(8):1236-40. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15295746.
33. De Carli A, Vadalà A, Perugia D, Frate L, Iorio C, Fabbri M, Ferretti A. Shoulder adhesive capsulitis: manipulation and arthroscopic arthrolysis or intra-articular steroid injections [Internet]? Int Orthop. 2012 Jan [cited 2013 May 22];36(1):101-6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21833684.
34. Magnussen RA, Taylor DC. Glenoid fracture during manipulation under anesthesia for adhesive capsulitis: a case report [Internet]. J Shoulder Elbow Surg. 2011 Apr [cited 2013 May 22];20(3):e23-6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21397785.
35. Kent C, Models of vertebral subluxation: A review [Internet]. J of Vertebral Subluxation Research Aug 1996 [cited 2013 May 22]; 1(1):1-7. Available from: http://www.chiro.org/LINKS/FULL/Kent_Model_of_Subluxation.pdf.
36. Gatterman, M. Foundations of chiropractic subluxation. St. Louis: Mosby-Year Book; 1995.
37. ChiroCode Institute. 2012 ChiroCode deskbook. Phoenix: ChiroCode Institute; 2012.
38. Thomeé R, Grimby G, Wright BD, Linacre JM. Rasch analysis of Visual Analog Scale measurements before and after treatment of Patellofemoral Pain Syndrome in women. Scand J Rehabil Med. 1995 Sep;27(3):145-51.
39. Schmid AB, Brunner F, Luomajoki H, Held U, Bachmann LM, Künzer S, Coppieters MW. Reliability of clinical tests to evaluate nerve function and mechanosensitivity of the upper limb peripheral nervous system [Internet]. BMC Musculoskelet Disord. 2009 Jan 21 [cited 2013 May 22];10:11. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19154625.
40. Conable KM, Rosner AL. A narrative review of manual muscle testing and implications for muscle testing research [Internet]. J Chiropr Med. 2011 Sep [cited 2013 May 22];10(3):157-65. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22014904.
41. Donahue T, Bergmann T, Donahue S, Dody M. Manipulative assessment and treatment of the shoulder complex: case reports [Internet]. J Chiropr Med. 2003 Autumn [cited 2013 May 22];2(4):145-52. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19674612.
42. Hearon K. Advanced principles of upper extremity adjusting. Washington: Olympic Graphic Arts; 1991.
43. Polkinghorn BS. Chiropractic treatment of frozen shoulder syndrome (adhesive capsulitis) utilizing mechanical force, manually assisted short lever adjusting procedures. J Manipulative Physiol Ther. 1995 Feb;18(2):105-15.
44. Fuhr AW. The activator method. 2nd ed. St. Louis: Mosby; 2009.
45. Fuhr AW, Menke JM. Status of activator methods chiropractic technique, theory, and practice [Internet]. J Manipulative Physiol Ther. 2005 Feb [cited 2013 May 22];28(2):e1-e20. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15800504.
46. Colloca CJ, Keller TS, Black P, Normand MC, Harrison DE, Harrison DD. Comparison of mechanical force of manually assisted chiropractic adjusting instruments [Internet]. J Manipulative Physiol Ther. 2005 Jul-Aug [cited 2013 May 22];28(6):414-22. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16096041.
47. Smith DB, Fuhr AW, Davis BP. Skin accelerometer displacement and relative bone movement of adjacent vertebrae in response to chiropractic percussion thrusts. J Manipulative Physiol Ther. 1989 Feb;12(1):26-37.

48. Gur A, Sarac AJ, Cevik R, Altindag O, Sarac S. Efficacy of 904 nm gallium arsenide low level laser therapy in the management of chronic myofascial pain in the neck: a double-blind and randomize-controlled trial [Internet]. Lasers Surg Med. 2004 [cited 2013 May 22];35(3):229-35. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15389743.
49. de Carvalho Pde T, Leal-Junior EC, Alves AC, Rambo CS, Sampaio LM, Oliveira CS, Albertini R, de Oliveira LV. Effect of low level laser therapy on pain, quality of life and sleep in patients with fibromyalgia: study protocol for a double-blinded randomized controlled trial [Internet]. Trials. 2012 Nov 21 [cited 2013 May 22];13:221. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23171567.
50. Multi Radiance Medical. Multi Radiance Medical Laser Longevity [Internet]. Multi Radiance Medical; 2012 [cited 2013 May 22]. Available from: http://www.multiradiance.com.
51. Thelen MD, Dauber JA, Stoneman PD. The clinical efficacy of kinesio tape for shoulder pain: a randomized, double-blinded, clinical trial [Internet]. J Orthop Sports Phys Ther. 2008 Jul [cited 2013 May 22];38(7):389-95. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18591761.
52. Norkin C, White DJ. Measurement of joint motion: A guide to goniometry. 4th ed. Philadelphia: FA Davis Company; 2009.
53. Bunker TD. Frozen shoulder: unraveling the enigma [Internet]. Ann R Coll Surg Engl. 1997 May [cited 2013 May 22];79(3):210-3. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2502880/
54. van der Meijden OA, Gaskill TR, Millett PJ. Glenohumeral joint preservation: a review of management options for young, active patients with osteoarthritis [Internet]. Adv Orthop. 2012 [cited 2013 May22];2012:160923. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22536514.
55. Yochum TR, Rowe LJ. Essentials of skeletal radiology. 3rd ed. United States: Lippincott Williams & Wilkins; 2005.
56. Netter FH. Atlas of human anatomy. 5th ed. Philadelphia: Saunders; 2010.
57. Andersen LL, Hansen K, Mortensen OS, Zebis MK. Prevalence and anatomical location of muscle tenderness in adults with nonspecific neck/shoulder pain [Internet]. BMC Musculoskelet Disord. 2011 Jul 22 [cited 2013 May 22];12:169. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21777478.
58. McLain RF. Mechanoreceptor endings in human cervical facet joints [Internet]. Iowa Orthop J. 1993 [cited 2013 May 22];13:149-54. Available from: http://www.ncbi.nlm.nih.gov/pubmed/7820735.
59. Ballantyne BT, O'Hare SJ, Paschall JL, Pavia-Smith MM, Pitz AM, Gillon JF, Soderberg GL. Electromyographic activity of selected shoulder muscles in commonly used therapeutic exercises [Internet]. Phys Ther. 1993 Oct [cited 2013 May 22];73(10):668-77; discussion 677-82. Available from: http://www.ncbi.nlm.nih.gov/pubmed/8378423
60. Guyton AC, Hall JE. Textbook of medical physiology. 11th ed. Philadelphia: Elsevier; 2006.
61. Pickar JG. Neurophysiological effects of spinal manipulation [Internet]. Spine J. 2002 Sep-Oct [cited 2013 May22];2(5):357-71. Available from: http://www.ncbi.nlm.nih.gov/pubmed/14589467.
62. Brantingham JW, Cassa TK, Bonnefin D, Jensen M, Globe G, Hicks M, Korporaal C. Manipulative therapy for shoulder pain and disorders: expansion of a systematic review [Internet]. J Manipulative Physiol Ther. 2011 Jun [cited 2013 May 22];34(5):314-46. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21640255.
63. Murphy FX, Hall MW, D'amico L, Jensen Am. Chiropractic management of frozen shoulder syndrome using a novel technique: A retrospective case series of 50 patients [Internet]. J Chiropr Med 2012 [cited 2013 May 22]; 11:267-272. Available from: http://www.sciencedirect.com/science/article/pii/S1556370712001186.
64. Valli J. Chiropractic management of a 46-year-old type 1 diabetic patient with upper crossed syndrome and adhesive capsulitis [Internet]. J Chiropr Med. 2004 Autumn [cited 2013 May 22];3(4):138-44. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19674636.
65. Djavid GE, Mehrdad R, Ghasemi M, Hasan-Zadeh H, Sotoodeh-Manesh A, Pouryaghoub G. In chronic low back pain, low level laser therapy combined with exercise is more beneficial than exercise alone in the long term: a randomised trial [Internet]. Aust J Physiother. 2007 [cited 2013 May 22];53(3):155-60. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17725472.
66. Vladimirov YA, Osipov AN, Klebanov GI. Photobiological principles of therapeutic applications of laser radiation [Internet]. Biochemistry (Mosc). 2004 Jan [cited 2013 May 22];69(1):81-90. Available from: http://www.ncbi.nlm.nih.gov/pubmed/14972023.
67. Kneeshaw D, Shoulder taping in the clinical setting [Internet]. J Bodyw Mov Ther 2002 [cited 2013 May 22]; 6(1):2-8.
68. Simşek HH, Balki S, Keklik SS, Oztürk H, Elden H. Does Kinesio taping in addition to exercise therapy improve the outcomes in subacromial impingement syndrome? A randomized, double-blind, controlled clinical trial [Internet]. Acta Orthop Traumatol Turc. 2013 [cited 2013 May 22];47(2):104-10. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23619543.

Table 1. Pre-treatment Shoulder Ranges of Motion in Degrees

Motion	Normal	Active ROM	Passive ROM
Flexion	180	50	105
Extension	60	50	55
Abduction	180	40	40
Adduction	50	50	50
Internal Rotation	70	50	50
External Rotation	90	40	40

Table 2. Outcome Shoulder Ranges of Motion in Degrees

Motion	Normal	Active ROM	Passive ROM
Flexion	180	130	136
Extension	60	52	55
Abduction	180	112	115
Adduction	50	52	54
Internal Rotation	70	65	69
External Rotation	90	63	69