Suprascapular nerve block followed by Codman’s manipulation and exercise in the rehabilitation of idiopathic frozen shoulder

Mohja A. El-Badawy, Mahmoud Mohamed Fathalla

Introduction

In 1934, Codman described a painful shoulder condition characterized by an insidious onset of pain felt near the insertion of deltoid, inability to sleep on the affected side, restriction in both active and passive elevation as well as external rotation, atrophy of spinati, and normal radiologic appearance. Such painful condition was termed frozen shoulder or adhesive capsulitis [1]. It is a common problem in general practice characterized by inflammation of the synovial lining and capsule, with subsequent capsular contracture leading to shrinkage of the joint cavity [2,3].

Frozen shoulder may be primary idiopathic or secondary to other diseases, such as diabetes, hyperthyroidism, and trauma. It passes through four stages described as inflammatory, freezing, frozen, and thawing. In the inflammatory stage, passive range of motion (ROM) is increased with anesthesia, indicating that ROM is pain limited. Histologically, there are inflammatory infiltrates and hypervascular synovitis with a normal underlying capsule. The freezing stage differs in that passive ROM is similar with or without anesthesia and histologically shows hypertrophic, hypervascular synovitis with capsular scarring. In the frozen stage, pathological specimens show reduced synovitis and dense scar formation in the underlying capsule. The thawing stage represents resolution and no pathological specimens have been described [4,5].

Many treatment options for adhesive capsulitis have been described, including rest, NSAIDs, active and passive mobilization, physiotherapy, intra-articular corticosteroids, intra-articular hyaluronate injection, manipulation under anesthesia when conservative treatment fails, and finally arthroscopic capsular release [6–9]. One of the main goals of treatment is to restore shoulder function through manipulation and therapeutic exercises in which the patient must cooperate and take an active part. The most important factor limiting patients’ cooperation in exercise is pain. Hence, regional nerve block, attributable to its role in pain relief, can be used before the exercise

Background

Frozen shoulder is characterized by inflammation of the synovial lining and capsule, with subsequent generalized contracture of the glenohumeral joint causing shoulder pain and a gradual loss of both passive and active range of motion. Pain relief through suprascapular nerve block (SSNB) followed by manipulation and home exercises may be a suitable treatment option in such patients.

Objective

The aim of this study was to evaluate the role of SSNB followed by Codman’s shoulder manipulation and home exercises in the management of idiopathic frozen shoulder.

Patients and methods

Twenty patients with idiopathic unilateral frozen shoulder underwent SSNB followed by Codman’s manipulation of the glenohumeral joint and a home exercise program. Differences in range of motion, visual analog scale for pain, and Shoulder Disability Questionnaire were assessed before manipulation and at 1, 6, and 12 weeks after manipulation.

Results

The mean age of the patients was 52.1 years. Active range of motion increased significantly for flexion, abduction, internal rotation, and external rotation. Significant decrease in visual analog scale and Shoulder Disability Questionnaire scores between baseline and follow-up assessments was observed.

Conclusion

Manipulation under SSNB is a safe, effective, and minimally invasive procedure for relieving pain, improving range of motion, and decreasing disability in patients with idiopathic frozen shoulder.

Keywords:
adhesive capsulitis, Codman’s manipulation, frozen shoulder, manipulation, suprascapular nerve block

Egypt Rheumatol Rehabil 41:172–178
© 2014 Egyptian Society for Rheumatology and Rehabilitation
1110-161X
program [10]. Among various nerve block techniques, suprascapular nerve block (SSNB) is an effective and simple method for the management of shoulder pain, with no significant complications reported in over 2000 procedures apart from rare vasovagal episodes [11–14].

Multiple shoulder manipulation techniques have been described, including manipulation with steroid injection and manipulation under general or local anesthesia. Fracturing the humerus during shoulder manipulation is a common complication, in addition to shoulder dislocation, postmanipulation pain, hemarthrosis, tearing of the joint capsule or rotator cuff, and traction injury to nerves [15].

The Codman’s manipulation refers to a specific pattern of motion at the shoulder joint leading to an indirect humeral rotation without placing a rotational torque on the humerus, thereby reducing fracture risk during manipulation. This is achieved when the arm performs a closed-loop motion by three consecutive 90° rotations defined as Codman’s rotations, each around the respective coordinate axis. Such rotations will lead to an apparently indirect 90° rotation around the longitudinal axis of the humerus [1,16].

This study aimed to evaluate the role of SSNB followed by Codman’s shoulder manipulation and home exercises in the management of idiopathic frozen shoulder.

Patients and methods
The methodology of this prospective clinical study was approved by the research ethical committee of Ain Shams Faculty of Medicine and all patients provided written informed consent before participation. This study included 20 patients diagnosed clinically with unilateral idiopathic frozen shoulder. All patients were recruited from the Outpatient Clinic of Physical Medicine and Rehabilitation Department in Ain Shams University Hospitals.

Inclusion criteria were as follows: shoulder pain and stiffness in one shoulder for at least 4 weeks with a contralateral normal shoulder; restricted active and passive ROM at the glenohumeral joint; no history of recent trauma; no previous injection in the involved shoulder; no history of allergy to local anesthetics; no coagulation disorders; normal blood sugar level; and normal radiograph of the shoulder.

Exclusion criteria included secondary causes of frozen shoulder, such as diabetes mellitus, hyperthyroidism, radiation, surgery, trauma, etc.; bony or neurologic disorders that might be an alternative cause of the shoulder pain; previous open reduction internal fixation for fracture; hemiarthroplasties; total shoulder replacements; and infections.

Baseline assessment
Both shoulders (normal and affected) were clinically assessed for the ROM of abduction, flexion, and external rotation using goniometry, and internal rotation was assessed by the ability of patients to reach their back with their hand as high as possible, and the distance between their thumb and the caudal edge of the contralateral scapula was measured in centimeters [17]. Patients were assessed for pain using a 10 cm visual analog scale (VAS) and the Shoulder Disability Questionnaire (SDQ) was administered [18].

Suprascapular nerve block [14,19]

Solution preparation
A volume of 10 ml solution was prepared for injection (9 ml of 0.5% bupivacaine for nerve block and 1 ml of 0.4% dexamethasone sodium phosphate to increase the duration of nerve blockade).

Technique
Using the Dangoisse technique, a 21 G × 1.5” needle was introduced through the skin 2 cm superior to the midpoint of the scapular spine, parallel to the blade of the scapula and directed inferiorly toward the supraspinous fossa floor (Fig. 1). The needle was advanced in this plane until a bony contact was made with the floor of the supraspinous fossa. The needle must be aspirated to exclude the risk of intravascular
needle placement. Once in place, the 10 ml was injected slowly into the floor of the fossa, bathing the suprascapular nerve to produce SSNB. At this point, the suprascapular nerve gives branches to supply the glenohumeral joint, acromioclavicular joint, and supraspinatus muscle.

Codman’s manipulation [1,16]
Codman’s manipulation was started 15 min after injection to ensure the achievement of SSNB.

It includes three consecutive 90° rotations called elevation, swing, and descending movements.

(1) **Starting position**: The patient hangs his or her arm along the side with the thumb pointing forward and fingers pointing toward the ground.

(2) **Elevation (first move)**: The arm is elevated 90° in the sagittal plane without rotation about the humeral shaft axis (i.e. thumb points upward and fingers point forward).

(3) **Swing (second move)**: The arm is moved 90° to the coronal plane without rotation about the humeral shaft axis (i.e. fingers now point to the right or left for the right and left shoulders, respectively).

(4) **Descending (third move)**: Finally, the arm is lowered 90° downward (i.e. fingers point to the ground). After these three rotations, the patient will notice that the thumb points to the right or left (for the right and left shoulders, respectively), which means that the arm has rotated by 90°.

**Standing position**
The patient was asked to hold the affected arm with the sound one and perform arm flexion (attempt to lift the affected arm over the head with the help of the sound limb). The patient was asked to maintain this position for 2 min (Fig. 2).

**Sitting position**
The patient was asked to touch the scapula with the help of the other hand to gain internal rotation.

**Supine position**
The patient was asked to place both hands behind the head and attempt to gradually bring the elbows to the level of the bed to gain external rotation (Fig. 3).

Immediate postmanipulation evaluation of ROM was performed.

**Postmanipulation exercises**
Each postmanipulation exercise was performed for 10 repetitions.

**Home exercise program**
All patients were given verbal and written instructions regarding a home exercise program, which includes the same postmanipulation ROM exercises, in addition to pendulum exercises for the arm and stretching techniques for the shoulder joint. Home exercises were performed for 10 repetitions, three times daily for 12 weeks. Compliance with the exercise program was monitored through a training diary in which the exercises were documented.

Patients were not referred for physiotherapy and were advised to take only acetaminophen for pain relief.

**Figure 2**
The patient holds the affected arm with the sound one and attempts to lift the affected arm over the head with the help of the sound limb, performing arm flexion.

**Figure 3**
The patient places his hand behind the head and gradually brings the elbow to the level of the bed to gain abduction and external rotation.

**Outcome assessment**
Patients were reassessed after 1, 6, and 12 weeks following the procedure for ROM, SDQ scores, and
10 cm VAS scores for pain intensity at rest and on extreme movement.

The SDQ contains 16 items referring to situations that might be associated with functional limitations in patients with shoulder complaints (Table 1). All items refer to the preceding 24 h. Response options are 'yes', 'no', or 'not applicable'. The response option 'not applicable' was chosen when the condition had not occurred during the past 24 h. Patients completed the questionnaire after a short explanation of the response options. The final SDQ score was calculated by dividing the number of positive responses by the total number of applicable items and multiplying this score by 100. Consequently, the SDQ score can range from 0 to 100, with a higher score indicating more severe disability [18].

Pain was measured using VAS, which comprised a 10-cm line anchored at one end by '0' and at the other end by '10', signifying no pain and worst pain felt by the patient, respectively [20].

**Statistical analysis**

Outcome measures were assessed at baseline and 1, 6, and 12 weeks after manipulation. Before statistical analysis, the Kolmogorov–Smirnov test was performed to assess the normality of the continuous data. The data showed normal distribution; therefore, a parametric statistical method was performed to analyze the data. A comparison of baseline ROM between affected and nonaffected shoulders was performed using Student’s *t*-tests. Comparison analysis between ROM, VAS, and SDQ at baseline and their values at 1, 6, and 12 weeks after manipulation was performed using the paired *t*-test. Results were presented as means ± SD. *P* values less than 0.05 were regarded as statistically significant.

**Results**

This study included 20 patients with a male to female ratio of 40 : 60%. Their ages ranged from 40 to 60 years, with a mean of 52.1. The baseline clinical data of patients are shown in Table 2.

There was a marked restriction in the ROM of the affected shoulder in comparison with the contralateral side before manipulation (Table 3). One week after manipulation, the ROM was significantly increased (*P* < 0.05), whereas VAS at rest and SDQ were significantly decreased (*P* < 0.05), but VAS at activity was not decreased to a significant level (*P* > 0.05) (Table 4). At 6 and 12 weeks after manipulation, there was a significant increase in the ROM (*P* < 0.05), whereas VAS (at both rest and activity) and SDQ score were significantly decreased (*P* < 0.05) in comparison with baseline (Tables 5 and 6).

**Discussion**

Frozen shoulder causes pain, tenderness, and stiffness in the affected shoulder. Various treatment modalities, such as physiotherapy, oral cortisone, intra-articular steroid injection, manipulation under anesthesia, and arthroscopic release of adhesions, have been used in an attempt to shorten the duration of shoulder symptoms. However, some patients cannot wait an unpredictable

---

**Table 1 Shoulder disability questionnaire**

| Shoulder Disability Questionnaire (SDQ) | NA | Yes | No |
|---------------------------------------|----|-----|----|
| 1. I wake up at night because of shoulder pain. | ☐ | ☐ | ☐ |
| 2. My shoulder hurts when I lie on it. | ☐ | ☐ | ☐ |
| 3. Because of pain in my shoulder it is difficult to put on a coat or a sweater. | ☐ | ☐ | ☐ |
| 4. My shoulder hurts during my usual daily activities. | ☐ | ☐ | ☐ |
| 5. My shoulder hurts when I lean on my elbow or hand. | ☐ | ☐ | ☐ |
| 6. My shoulder hurts when I move my arm. | ☐ | ☐ | ☐ |
| 7. My shoulder hurts when I write or type. | ☐ | ☐ | ☐ |
| 8. My shoulder is painful when I hold the driving wheel of my car or handle bars of my bike. | ☐ | ☐ | ☐ |
| 9. When I lift and carry something my shoulder hurts. | ☐ | ☐ | ☐ |
| 10. During reaching and grasping above shoulder level my shoulder hurts. | ☐ | ☐ | ☐ |
| 11. My shoulder is painful when I open or close a door. | ☐ | ☐ | ☐ |
| 12. My shoulder is painful when I bring my hand to the back of my head. | ☐ | ☐ | ☐ |
| 13. My shoulder is painful when I bring my hand to my buttock. | ☐ | ☐ | ☐ |
| 14. My shoulder is painful when I bring my hand to my low back. | ☐ | ☐ | ☐ |
| 15. I rub my painful shoulder more than once during the day. | ☐ | ☐ | ☐ |
| 16. Because of my shoulder pain I am more irritable and bad tempered with people than usual. | ☐ | ☐ | ☐ |
length of time to regain their shoulder activity and undergo treatment with the aim of restoring normal shoulder function at the earliest possible time [21–25].

A simple and effective method for shoulder pain relief is the regional SSNB, which shows a greater relief from symptoms compared with placebo, and a faster and complete reduction in pain compared with intra-articular steroid injection [26]. In addition, Ozkan et al. [27] reported that SSNB may effectively increase patient’s pain tolerability, which in turn helps patients to tolerate physical therapy.

After SSNB, shoulder pain diminishes and an effective therapeutic exercise program can be performed. The suprascapular nerve provides sensory fibers to ∼70% of the shoulder joint and has afferent, efferent, and sympathetic fibers. The efferent fibers innervate the supraspinatus and infraspinatus muscles, whereas the afferent fibers distribute to the articular capsule, ligaments of the glenohumeral and acromioclavicular joints, the periosteum, and tendons of the scapula. Hence, significant pain relief can be achieved if the nerve block is performed before it gives its articular branches. The most appropriate site is around the suprascapular notch, in which the nerve can be located easily [28].

Table 2 Baseline clinical data

| Observations                              | Mean ± SD          |
|-------------------------------------------|--------------------|
| Pain duration at onset (months)           | 7.15 ± 2.83        |
| VAS score (at rest) (0-10)                | 6.95 ± 1.32        |
| VAS score (at extreme shoulder movement) (0-10) | 8.05 ± 1.23        |
| ROM                                        |                    |
| Shoulder flexion (°)                      | 81.05 ± 15.86      |
| Shoulder abduction (°)                    | 78.19 ± 12.63      |
| Shoulder internal rotation (cm)           | 31.89 ± 3.23       |
| Shoulder external rotation (°)            | 18.69 ± 2.29       |
| Baseline SDQ score (0-100)                | 83.40 ± 10.33      |
| ROM, range of motion; VAS, visual analogue scale; SDQ, Shoulder Disability Questionnaire

Table 3 Range of motion of affected shoulders compared to normal side before manipulation

| Observations                           | Affected shoulder (Mean ± SD) | Normal shoulder (Mean ± SD) | Significance |
|----------------------------------------|-------------------------------|-----------------------------|--------------|
| Flexion (°)                            | 81.05 ± 15.87                 | 165.50 ± 5.45               | 0.00         |
| Abduction (°)                          | 78.19 ± 12.63                 | 160.61 ± 10.40              | 0.00         |
| Internal Rotation (cm)                 | 31.89 ± 3.23                  | 3.50 ± 2.70                 | 0.00         |
| External Rotation (°)                  | 18.69 ± 2.29                  | 75.56 ± 2.90                | 0.00         |

Table 4 Comparison of ROM, VAS and SDQ at baseline and one week post manipulation

| Observations                           | Pre-manipulation (Mean ± SD) | One week Post-manipulation (Mean ± SD) | Significance |
|----------------------------------------|-------------------------------|----------------------------------------|--------------|
| Flexion                                | 81.05 ± 15.87                 | 110.40 ± 16.71                          | 0.00         |
| Abduction                              | 78.19 ± 12.63                 | 123.27 ± 14.15                          | 0.00         |
| Internal Rotation (cm)                 | 31.89 ± 3.23                  | 22.68 ± 4.24                           | 0.00         |
| External Rotation                      | 18.69 ± 2.29                  | 45.23 ± 5.92                           | 0.00         |
| VAS at rest                            | 6.95 ± 1.31                   | 5.79 ± 1.21                            | 0.00         |
| VAS at extreme movement                | 8.05 ± 1.23                   | 7.91 ± 1.23                            | 0.07         |
| SDQ                                    | 83.39 ± 10.33                 | 53.18 ± 10.24                          | 0.00         |

Table 5 Comparison of ROM, VAS and SDQ at baseline and 6 weeks post manipulation

| Observations                           | Pre-manipulation (Mean ± SD) | Post-manipulation 6 weeks (Mean ± SD) | Significance |
|----------------------------------------|-------------------------------|---------------------------------------|--------------|
| Flexion                                | 81.05 ± 15.87                 | 131.81 ± 16.40                        | 0.00         |
| Abduction                              | 78.19 ± 12.63                 | 145.55 ± 12.79                        | 0.00         |
| Internal Rotation (cm)                 | 31.89 ± 3.23                  | 14.39 ± 3.75                          | 0.00         |
| External Rotation                      | 18.69 ± 2.29                  | 55.18 ± 5.95                          | 0.00         |
| VAS at rest                            | 6.95 ± 1.31                   | 2.67 ± 0.73                           | 0.01         |
| VAS at extreme movement                | 8.05 ± 1.23                   | 2.67 ± 0.73                           | 0.01         |
| SDQ                                    | 83.39 ± 10.33                 | 26.23 ± 6.62                          | 0.00         |

Table 6 Comparison of ROM, VAS and SDQ at baseline and 12 weeks post manipulation

| Observations                           | Pre-manipulation (Mean ± SD) | Post-manipulation 12 weeks (Mean ± SD) | Significance |
|----------------------------------------|-------------------------------|----------------------------------------|--------------|
| Flexion                                | 81.05 ± 15.87                 | 143.27 ± 15.20                        | 0.00         |
| Abduction                              | 78.19 ± 12.63                 | 153.61 ± 12.45                        | 0.00         |
| Internal Rotation (cm)                 | 31.89 ± 3.23                  | 7.75 ± 2.90                           | 0.00         |
| External Rotation                      | 18.69 ± 2.29                  | 63.03 ± 4.71                          | 0.00         |
| VAS at rest                            | 6.95 ± 1.31                   | 1.54 ± 0.57                           | 0.00         |
| VAS at extreme movement                | 8.05 ± 1.23                   | 1.28 ± 0.56                           | 0.01         |
| SDQ                                    | 83.39 ± 10.33                 | 10.11 ± 2.77                          | 0.00         |

VAS (visual analogue scale); SDQ (Shoulder Disability Questionnaire)
Various SSNB techniques have been described in which Dangoisse et al. [14] performed indirect SSNB using an anatomical landmark approach that is easy, decreases the risk of pneumothorax, can be performed by most trained specialists as it has a short learning curve, and can be performed without the need to image the area by ultrasound or fluoroscopy [11–14,27]. Hence, the Dangoisse technique for SSNB was used in our study and it was safe and well tolerated by our patients.

Local steroid injection blocks transmission through nociceptive C fibers, thus prolonging the effect of the local anesthetic through alteration of the function of K channel on the excitable tissue [29,30]. Hence, steroids were added to the anesthetic used in SSNB in our study.

The only adverse event during the course of our study was with one female patient who experienced a vasovagal collapse following SSNB. She recovered quickly, and manipulation was carried out successfully.

In the treatment of frozen shoulder, the physician attempts to relieve discomfort for the patient and restore motion and function. When conservative treatment fails, manipulation of the shoulder under general anesthesia is performed. Any rotational torque placed on the arm during manipulation can cause fracture humerus. Codman’s technique prevents any rotational torque to the humerus, thus reducing the risk for humerus fracture [31]. In our study, instead of manipulating the shoulder under general anesthesia in the operating room, Codman’s manipulation following SSNB was used in the outpatient clinic, thus reducing the risk of general anesthesia, patient discomfort, and treatment cost. Our results were as good as those of Hollis et al. [31] who used general anesthesia for the reduction of pain and disability and improvement of ROM. In addition, in our study no complications were encountered and patients tolerated the procedure well.

The results of our study showed that patients with idiopathic frozen shoulder benefit from SSNB using bupivacaine and dexamethasone followed by Codman’s manipulation and active assisted ROM exercises at home. There was a statistically significant improvement of ROM, in addition to a significant reduction in pain and disability as measured by VAS and SDQ, respectively. In addition, pain relief extended for 12 weeks after injection, thus extending beyond the pharmacological effect of the drug. There are many possible explanations, including a decrease in central sensitization of dorsal horn nociceptive neurons. In addition, depletion of substance P and nerve growth factor in the synovium and afferent C fibers of the glenohumeral joint after the blockade may also contribute to the long-term relief. In addition, a ‘wind down’ (a reduction in peripheral nociceptive input) has been suggested [32–34].

In 2009, Khan et al. [35] used manipulation for the glenohumeral joint other than Codman’s following SSNB and intra-articular local anesthesia in patients with idiopathic frozen shoulder, showing a significant decrease in VAS and increase in ROM; however, shoulder disability was not assessed. Our results were similar to that of Khan and colleagues, although we used a different type of manipulation: no intra-articular anesthesia was used and shoulder disability was assessed using SDQ in our study.

An additional study was performed by Mitra et al. [36] on patients with frozen shoulder in whom SSNB was performed followed by intra-articular shoulder injection with steroid and local anesthetic, and finally manipulation was performed in flexion and abduction movements only. The results of our study are in accordance with those of Mitra and colleagues, although our patients were not subjected to the risk of intra-articular injection and the manipulation technique used in our study included rotational movements, thus improving ROM in internal and external rotations, in addition to flexion and abduction, in contrast to the study by Mitra and colleagues in which only flexion and abduction showed improvement.

In 2014, Ozkan et al. [27] reported an improvement in shoulder pain following SSNB. Their study varied from ours, as they included only 10 patients with frozen shoulder secondary to diabetes mellitus, which was excluded from our study; no manipulations were performed and shoulder disability was not assessed. Yet, the results of Ozkan and colleagues support our results and provide hope for the management of pain in frozen shoulder.

According to the results of our study, SSNB followed by Codman’s manipulation and home exercises accelerates the recovery of idiopathic frozen shoulder. This combined approach is effective and safe to be administered in outpatient clinics by a well-trained physician and reduces the time spent at a hospital; further, there are economic benefits as patients are able to return to work sooner without the need for hospitalization or spending time in physical therapy sessions. However, this needs to be proved by a longer follow-up study involving a larger patient sample.
References
1 Codman EA. The shoulder. Boston: Mass: Thomas Todd; 1934. 216–224.
2 Anton HA. Frozen shoulder. Can Fam Physician 1993; 39:1773–1778.
3 Thierry D. Adhesive capsulitis. Emmedicine 2005; 11:7.
4 Hamryan DT, Lazarus MD, Rozencwaig R. The stiff shoulder. In: Rockwood CA, Matsen FA, Wirth MA, Lippitt SB, editors. The shoulder. 3rd ed. Philadelphia: Saunders; 2004.
5 McGinty JB, Burkart SS, Johnson DH, Jackson RW, Richmond JC. Operative arthroscopy. 3rd ed. Lippincott Williams and Wilkins, 2002. p. 558–569
6 Dias R, Cutts S, Massoud S. Frozen shoulder: clinical review. Br Med J 2005; 331:1453–1456.
7 Fernandes MR. Arthroscopic treatment of refractory adhesive capsulitis of the shoulder. Rev Col Bras Cir 2014; 41:30–35.
8 Fateeemee MM, Huisstede BM, Koes BW. Frozen shoulder: the effectiveness of conservative and surgical interventions – systematic review. Br J Sports Med 2011; 45:49–56.
9 Lorbach O, Anagnostakos K, Scherf C, Seil R, Kohn D, Pape D. Non operative management of adhesive capsulitis of the shoulder: oral cortisone application versus intra-articular cortisone injections. J Shoulder Elbow Surg 2010; 19:172–179.
10 Benglum J, Bartholdy A, Hautopp H, Krogsgaard MR, Jensen K. Ultrasound-guided continuous suprascapular nerve block for adhesive capsulitis: one case and a short topical review. Acta Anaesthesiol Scand 2011; 55:242–247.
11 Iqbal MJ, Anwar W, Rahman N, Kashif S, Khan A. Suprascapular nerve block in the treatment of frozen shoulder. J Surg Pak 2012; 17:27–31.
12 Yasar E, Vural D, Safaz I, Balaban B, Yilmaz B, Goktepe AS, Alaca O. Which treatment approach is better for hemiplegic shoulder pain in stroke patients: intra-articular steroid or suprascapular nerve block? A randomized controlled trial. Clin Rehabil 2011; 25:80–88.
13 Dahan THM, Forlin L, Pelletier M, Petit M, Suissa S. Double trial randomized clinical trial examining the efficacy of bupivacaine suprascapular nerve blocks in frozen shoulder. J Rheumatol 2000; 27:1464–1469.
14 Dangoisse MJ, Wilson DJ, Glynn CJ. MRI and clinical study of an easy and safe technique of suprascapular nerve blockade. Acta Anaesthesiol Belg 1994; 45:49–54.
15 Hamdan TA, Al-Ensia KA. Manipulation under anesthesia for the treatment of frozen shoulder. Int Orthop 2003; 27:107–109.
16 Cheng PL. Simulation of Codman’s paradox reveals a general law of motion. J Biomech 2006; 39:1201–1207.
17 Kivimaki J, Pohjalainen T, Malmivaara A, Kannisto M, Guillaume J, Seitsalo S, Nissinen M. Manipulation under anesthesia with home exercises versus home exercises alone in the treatment of frozen shoulder: a randomized, controlled trial with 125 patients. J Shoulder Elbow Surg 2007; 16:722–726.
18 Van der Heijden GJ, Leffers P, Boutier LM. Shoulder Disability Questionnaire design and responsiveness of a functional status measure. J Clin Epidemiol 2000; 53:29–38.
19 Movafeh A, Rezazian M, Hajimashhadif M, Meysamie A. Dexamethasone added to lidocaine prolongs axillary brachial plexus blockade. Anesth Analg 2005; 102:263–267.
20 Gallagher EJ, Liebman M, Bijur PE. Prospective validation of clinically important changes in pain severity measured on a visual analogue scale. Ann Emerg Med 2001; 38:633–638.
21 Winters JC, Sobel JS, Groenier KH, Arendzen HJ, Meyboom-de Jong B. Comparison of physiotherapy, manipulation and corticosteroid injection for treating shoulder complaints in general practice: randomized, single blind study. BMJ 1997; 314:1320–1325.
22 Buchbinder R, Hoving J, 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. Ann Rheum Dis 2004; 63:1460–1469.
23 Arol B, Goodyear-Smith F. Corticosteroid injections for painful shoulder: a meta-analysis. Br J Gen Pract 2005; 55:224–228.
24 Loew M, Heichel TO, Lehner B. Intra-articular lesions in primary frozen shoulder after manipulation under general anesthesia. J Shoulder Elbow Surg 2005; 14:16–21.
25 Castellarin G, Ricci M, Vedovi E, Vecchini E, Sembenini P, Marangon A. Manipulation and arthroscopy under general anaesthesia and early rehabilitative treatment for frozen shoulders. Arch Phys Med Rehabil 2008; 89:1326–1340.
26 Abdelshafi ME, Yosry M, Elmulla AF, Al-Shahawy EA, Adou Aly M, Elewa EA. Relief of chronic shoulder pain: a comparative study of three approaches. Middle East J Anesthesiol 2011; 21:83–92.
27 Ozkam K, Ozceke AC, Sarar S, Cilt H, Feyza Ozkam U, Unay K. Suprascapular nerve block for the treatment of frozen shoulder. Saudi J Anaesth 2012; 6:52–55.
28 Shanahan AM, Ahern M, Smith M, Wetherall M, Bresnihan B, FitzGerald O. Suprascapular nerve block (using bupivacaine and methylprednisolone acetate) in chronic shoulder pain. Ann Rheum Dis 2003; 62:400–406.
29 Shrestha BR, Maharjan SK, Shrestha S. Comparative study between tramadol and dexamethasone as an adjuvant to bupivacaine in supraclavicular brachial plexus block. J Nepal Med Assoc 2007; 46:158–164.
30 Colombo G, Padera R, Langer R, Kohane DS. Prolonged duration local anesthesia with lipid–protein–sugar particles containing bupivacaine and dexamethasone. J Biomed Mater Res A 2007; 85:168–167.
31 Hollis R, Lahav A, Hugh S, West JR. Manipulation of the shoulder using Codman’s paradox. Orthopedics 2006; 29:14–19.
32 Birklein F, Schmelz M. Neuropeptides, neurogenic inflammation and complex regional pain syndrome (CRPS). Neurosci Lett 2008; 437:199–202.
33 Schaible HG. Peripheral and central mechanisms of pain generation. Handb Exp Pharmacol 2007; 177:3–28.
34 Chan CW, Peng PW. Suprascapular nerve block: a narrative review. Reg Anesth Pain Med 2011; 36:358–373.
35 Khan JA, Devkota P, Acharya BM, Pradhan NMS, Shrestha SK, Singh M, Mainali L. Manipulation under local anesthesia in idiopathic frozen shoulder – a new effective and simple technique. Nepal Med Coll J 2009; 11:247–253.
36 Mitra R, Harris A, Umphrey C, Smuck M, Fredericson M. Adhesive capsulitis: a new management protocol to improve passive range of motion. PM R 2009; 1:1064–1068.