Cohort Study

Ultrasound-Guided Block of the Suprascapular Nerve in Breast Cancer Survivors with Limited Shoulder Motion – Case Series

Sibel Caglar Okur, MD[1], Ozden Ozyemisci-Taskiran, MD[2], Yasemin Pekindogan, MD[1], Murat Mert, MD[3], and Nil Sayiner Caglar, MD[1]

From: [1]Physical Medicine and Rehabilitation Unit, Istanbul Training and Research Hospital, Istanbul, Turkey; [2]Koc University, Department of Physical Medicine and Rehabilitation, Istanbul, Turkey; [3]Yeni Yüzyıl University, Department of Orthopedics and Traumatology, Istanbul, Turkey

Address Correspondence: Ozden Ozyemisci-Taskiran, MD Physical Medicine and Rehabilitation Unit, Istanbul Training and Research Hospital, Istanbul, Turkey E-mail: otaskiran@ku.edu.tr

Disclaimer: There was no external funding in the preparation of this manuscript. Conflict of interest: Each author certifies that he or she, or a member of his or her immediate family, has no commercial association (i.e., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted manuscript.

Manuscript received: 03-17-2016 Revised manuscript received: 05-15-2016 Accepted for publication: 07-21-2016

Free full manuscript: www.painphysicianjournal.com

Background: Suprascapular nerve block is performed in the management of chronic shoulder pain and frozen shoulder.

Objective: To investigate the effects of ultrasound-guided suprascapular nerve block in restoration of shoulder motion in breast cancer survivors.

Study Design: A cohort study.

Setting: A training and research hospital, outpatient setting.

Methods: A total of 18 breast cancer survivors with limited shoulder motion, pain, and difficulty in positioning the upper extremity for radiation treatment following surgery were enrolled in this study. Ultrasound-guided suprascapular nerve blocks were performed while the patients were seated in a chair without a backrest. After visualization of the suprascapular nerve under the transverse suprascapular ligament, 20 mg of triamcinolone and 4 mL of 0.5% bupivacaine were injected. Shoulder range of motion, pain, disability, and upper extremity circumference measurements were assessed in all participants before and 10 days after the block.

Results: A significant decrease was observed in severity of pain and disability 10 days after the block. The ranges of shoulder abduction, flexion, and external rotation were improved significantly. All patients were able to receive radiation therapy without delay.

Limitations: Absence of a control group and absence of randomization reduces the strength of our findings. Small sample size and absence of long-term follow-up are other limitations of this study.

Conclusions: This is the first study investigating the effect of ultrasound-guided suprascapular block on shoulder limitation in breast cancer survivors. The results demonstrate that it may be a promising treatment approach for rapid recovery of shoulder motion in women with breast cancer before radiation treatment.

Key words: Breast cancer, upper extremity, shoulder pain, range of motion, disability, ultrasound, injection, triamcinolone, local anesthetics

Pain Physician 2017; 20:E233-E239

Breast cancer is the most common malignancy in women. Breast cancer survival has improved over time due to advancing diagnostic and treatment modalities (1-3). However, upper extremity impairments still remain as a significant cause of disability. Although prevalence differs among studies, limited shoulder motion and pain is reported in up to 2/3 of patients and lymphedema is reported in

up to 1/3 of patients (4). Although current surgical and radiation approaches are less aggressive than they were before, they still contribute to limited shoulder motion and pain.

The prevalence of shoulder and/or arm pain following surgery was reported to be between 9% and 68% (4-6). About 20% of patients reported experiencing pain 3 years after surgery (7) and 2% – 5% of patients rated their pain as severe or refractory. Patients who underwent axillary lymph node dissection (ALND) had a poorer prognosis for arm pain than patients who underwent sentinel lymph node biopsy (SLNB) (5,8).

Pain may arise from muscle and ligament injuries following surgery (9). Pain is usually transient with the progression of the healing process. Pain arising from nerve injuries may be more persistent in nature (7).

Limitations in shoulder range of motion was reported in < 1% to 67% of patients following surgery and radiation (4,10). Mastectomy compared to breast conserving surgery increases the risk of limited motion (5). ALND compared to SLNB had higher rates of early postoperative shoulder restriction (8). Patients treated with radiation were slightly more prone to shoulder restriction than patients not treated with radiation (5).

Limited shoulder motion and pain may profoundly affect many aspects of daily living (11), cause psychological distress, sleep problems (10), and reduce quality of life. Limited shoulder motion may cause a delay in radiation therapy.

Exercise and other rehabilitation interventions can result in improvements in shoulder mobility and function (9,12-14). Early postoperative implementation of exercise is more effective in restoration of shoulder movements (15). Pain control through pharmacological and nonpharmacological interventions also helps in recovery of shoulder movements (12). Invasive treatment approaches are usually not preferred, except for selected refractory cases. Guidelines usually recommend proper hygiene and avoidance of trauma such as injections or intravenous access in the affected upper extremity to minimize risks of infection and lymphedema following surgery. However there is little scientific evidence to support these precautions (12,16).

There are few studies investigating the intervention techniques in limited number of patients. Stellate ganglion block in patients with lymphedema (17), ultrasound-guided trigger point injections in myofascial pain syndrome (18), and intraarticular shoulder injection in patients with frozen shoulder are few examples for interventional treatment approaches in the field of breast cancer related upper limb problems (19).

The suprascapular nerve block may also be performed. The suprascapular nerve passing below the suprascapular ligament enters the supraspinatus fossa and provides articular branches to the acromioclavicular and superior glenohumeral joints in the supraspinatus fossa. Then passing inferiorly to the infraspinatus fossa, it provides articular branches to the posterior superior glenohumeral joint (20). The suprascapular nerve carries both somatic afferent and autonomic fibers and its block helps to relieve pain in chronic shoulder pathologies (21), adhesive capsulitis (22), and shoulder pain following stroke (23).

The aim of this study was to investigate the effects of ultrasound-guided suprascapular nerve block in restoration of shoulder motion in breast cancer survivors.

Methods

This retrospective study was conducted in the Physical Medicine and Rehabilitation Outpatient Clinic at Istanbul Training and Research Hospital between February 2015 and November 2015. The study protocol was approved by Clinical Research Ethics Committee. Consent was obtained from all participants after the explanation of the procedure and possible complications.

Participants

A consecutive series of breast cancer survivors referred for limited shoulder motion and pain following surgery by the oncology and radiation oncology department were identified retrospectively and reviewed in this study. Inclusion criteria were as follows: 1) age ≥ 18 years, 2) diagnosed with primary breast cancer undergoing surgery (mastectomy or breast conserving surgery with ALND or SLNB), and 3) painful and limited shoulder motion hampering radiation to axilla due to the inability to position the upper extremity.

All patients with breast cancer undergo SLNB to identify axillary lymph node metastases. If metastasis is detected intraoperatively, ALND is performed by a surgeon. As a usual care following surgery, women are recommended to start gentle upper limb exercise (shoulder range of motion exercises, either active-assisted or active) on postoperative day 3. Women are provided instructions to prevent lymphedema. All women are evaluated at 3 weeks after surgery by a physiatrist and a home exercise program is provided. Then, patients are followed every 3 months for lymphedema development and an outpatient rehabilitation program can only be provided for those who developed lymphedema due to

long waiting rehabilitation lists.

Istanbul Training and Research Hospital is a tertiary care referral center with a waiting list of 3 to 6 months for rehabilitation. This waiting period does not allow a timely rehabilitation program for patients with limited shoulder mobility. The high number of daily outpatient visits to the radiation oncology department also prevents the department from rescheduling appointments missed because of pain or inability to be adequately positioned.

Exclusion criteria were 1) pre-existing shoulder dysfunction before breast surgery, 2) previous treatment (physical therapy, medical treatment or injection) for the incidental shoulder problem, and 3) lymphedema of the arm and breast following surgery.

Eighteen women with breast cancer who had painful and limited shoulders were included in this study.

Measures

Before and 10 days after the suprascapular nerve block, participants were assessed by measurements of upper extremity circumference, shoulder range of motion and pain, and a disability questionnaire.

Circumferential measurements were performed on both the affected and contralateral upper extremities at 5 different locations: at the level of metacarpophalangeal joint (MCP), wrist, lateral epicondyle, and 10 cm distal and 15 cm proximal to the lateral epicondyle (distal LE and proximal LE, respectively). A difference of > 2 cm between the circumferences of extremities at any reference point was defined as lymphedema (24).

Active ranges of shoulder motion (flexion, abduction, and external rotation) were measured using a 360° universal manual goniometer.

Severity of shoulder pain was measured using an 11-point numeric rating scale.

Quick Disability of Arm, Shoulder and Hand (quick-DASH) questionnaire, which is a valid and reliable instrument in breast cancer survivors, was used to assess pain, function, and disability (6). This 11-item, self-administered instrument asks patients to rate level of difficulty in performing several tasks including using a knife to cut food, doing heavy household chores, and severity of pain over the past week. Each item is scored from 1 to 5; 1 for activities performed with "no difficulty" and 5 for activities unable to perform or performed with "extreme difficulty." It is graded on a 100-point scale, with higher scores indicating a greater disability.

Procedure

Ultrasound-guided suprascapular nerve blocks were performed by a physiatrist experienced in musculoskeletal ultrasonography. Esaote Biomedica MyLab 5 system (Esaote S.p.A, Genoa, Italy) equipped with a 5 – 13 MHz linear transducer was used. Patients were asked to sit in a chair without a backrest and flex the cervical spine and adduct the affected arm (Fig. 1a-b).

The transducer was placed parallel to the spine of the scapula and moved slowly proximally until the su-

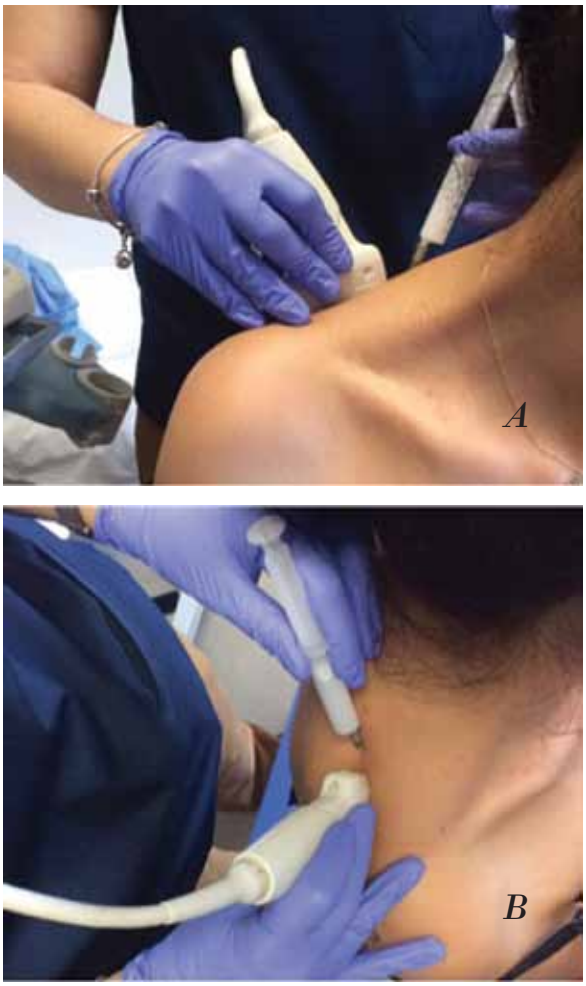

Fig. 1. *Direct in-plane technique. During axial scanning and suprascapular nerve block, the positioning of the needle and the transducer is demonstrated.*

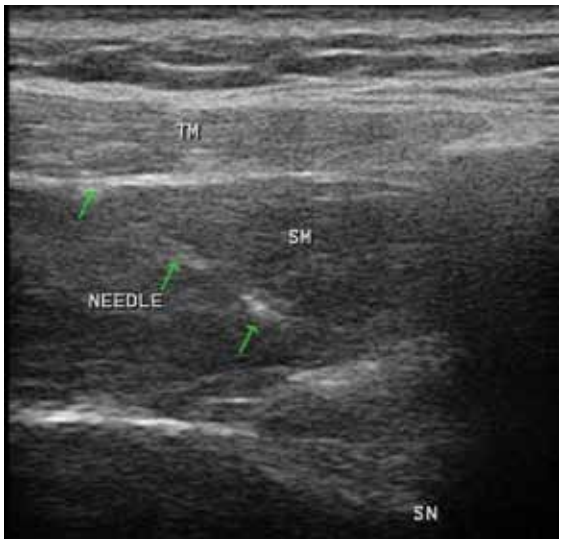

Fig. 2. *Sonographic image during injection. TM: trapezius muscle, SM: supraspinatus muscle, SN: suprascapular nerve, needle is shown by arrows.*

Table 2. *Range of shoulder motion and QuickDASH scores before and 10 days after the suprascapular nerve block.*

Variable	Before median (IQR 25 – 75)	After median (IQR 25 – 75)	*P*-value
Shoulder range of motion:			
Abduction	86 (70 – 95)	138 (125 – 163)	< 0.001
Flexion	95 (87 – 110)	130 (125 – 153)	< 0.001
External rotation	60 (46 – 70)	70 (65 – 81)	0.001
Shoulder pain (NRS)	7.00 (5.75 – 8.00)	4.00 (3.00 – 5.25)	< 0.001
QuickDASH score	69 (55 – 80)	49 (37 – 55)	< 0.001

IQR: interquartile range, NRS: 11-point numeric rating scale, QuickDASH: Quick disability of arm, shoulder and hand questionnaire

prascapular fossa was reached. Then the transducer was moved laterally to find the suprascapular notch. The suprascapular nerve was visualized at approximately 4 – 5 cm depth under the transverse suprascapular ligament as an ovoid hyperechoic structure (Fig. 2). Guided by B-mode, real-time ultrasonography, injections were performed with a 22-gauge 60-mm needle via an in-plane technique (Fig. 1b). A mixture of 20 mg of triamcinolone and 4 mL of 0.5% bupivacaine was injected. Patients were prescribed a home exercise program consisting of shoulder range of motion exercises after the nerve block.

Table 1. *Types of surgery, pathology, sides, and stages of breast cancer.*

Variable	Number of patients (n = 18)
Types of surgery	
Modified radical mastectomy + ALND	9
Breast conserving surgery + ALND	7
Simple mastectomy + ALND	2
Pathologic types of breast cancer	
Invasive ductal carcinoma	11
Invasive lobular carcinoma	2
Ductal carcinoma in situ	2
Medullary carcinoma	2
Mucinous carcinoma	1
Stages of breast cancer	
IIa	4
IIb	4
IIIa	3
IIIb	5
IVa	1
IVb	1
Side	
Right	6
Left	12

ALND: axillary lymph node dissection

Data were analyzed using the SPSS Statistics 22.0 software (SPSS Inc, Chicago, IL). Nonparametric Kruskal Wallis tests were used to assess changes in measurements before and after the intervention.

Results

Eighteen women with breast cancer were included in this study. Median age was 50.5 years (minimum and maximum age: 34 and 77 years, respectively). Types of surgery, pathology, and stages of breast cancer are presented in Table 1. All patients underwent axillary lymph node dissection followed by chemotherapy except 2 patients. Only 2 patients with stage IV breast cancer were operated on after chemotherapy. The median duration of time after surgery was 6.0 months (IQR (25 – 75) = 5.0 – 7.1 months).

Shoulder range of motion, severity of pain, and quickDASH scores before and after suprascapular nerve block are shown in Table 2. Decrease in severity of shoulder pain and disability was statistically significant 10 days after the suprascapular nerve block. The improvements in ranges of shoulder abduction, flexion, and external rotation were statistically significant. All

Table 3. *Upper extremity circumferences before and 10 days after the intervention.*

Upper extremity circumferences	Before median (IQR 25 – 75)	After median (IQR 25 – 75)	*P*-value
MCP	18.8 (17.9 – 21.1)	19.0 (17.9 – 21.6)	0.180
Wrist	15.8 (15.0 – 17.0)	16.0 (15.0 – 17.6)	0.518
Distal LE	23.3 (21.6 – 24.6)	23.5 (21.6 – 25.1)	0.914
Lateral epicondyle	27.0 (26.0 – 28.0)	27.0 (26.0 – 28.6)	0.829
Proximal LE	32.3 (28.0 – 35.6)	33.5 (28.0 – 37.0)	0.705

MCP: metacarpophalangeal joint, Distal LE: 10 cm distal to lateral epicondyle, Proximal LE: 15 cm proximal to lateral epicondyle

patients were able to receive radiotherapy after the improvement of shoulder range of motion.

No serious complications were observed. Median values of upper extremity circumferences did not change 10 days after the nerve block (Table 3). Only one of the patients had an increase in the measurements greater than 2 cm. The increase in circumference was transient and the patient responded successfully to the use of compression sleeve alone at the outpatient follow-up visits for lymphedema.

Discussion

The results of this preliminary study suggest that ultrasound-guided block of the suprascapular nerve can achieve rapid recovery of shoulder range of motion following surgery in breast cancer survivors. This intervention enabled women with breast cancer to minimize the delay of their scheduled axillary radiation treatment in addition to reducing pain and disability. The ultrasound-guided block of the suprascapular nerve is a relatively safe procedure for women with breast cancer 6 months following surgery.

Symptoms of frozen shoulder and joint pain in the upper extremity were self-reported in 20% and 51% of 150 women with breast cancer in a study. The mean quickDASH scores were 37 and 26 for women with frozen shoulder and joint pain, respectively (6). In our study, the median quickDASH scores were 69 at baseline and 49 after suprascapular block, both of which were higher than the scores of women in LeBlanc et al's study (6). Higher levels of disability observed in our study participants indicate higher levels of pain, motion restriction, or fear of activity.

In a prospective longitudinal cohort of 391 women who underwent ALND or SLNB, it was reported that ranges of shoulder motion were better than expected. The sole limited mobility was in shoulder extension and internal rotation, which improved 2.5 years after surgery. They thought that the implementation of standard postoperative rehabilitation program prevented the expected reduction in shoulder function after ALND (25).

Many factors may be responsible for limitation of shoulder motion after surgery. Incisional pain or strain in the muscles, fear of pain, or axillary web syndrome may be related to motion restriction (8,11). Incisional pain may lead to hesitations in upper limb use and protective posturing. Altered upper limb use may result in motor control adaptations which, in turn, causes motion alterations in scapulothoracic and shoulder girdle region and shoulder problems (11). Block of the suprascapular nerve might inhibit transmission of pain arising from secondary scapulothoracic dysfunction, thereby promoting shoulder motion without interfering pain. In our study population, the observed decrease in pain sensation together with improved range of motion after suprascapular nerve block support this mechanism of action.

Axillary web syndrome, also called cording, refers to the string-like structures originating in the axilla, sometimes extending to the arm, which is thought to be a result of impaired lymphatic flow (26). This usually resolves spontaneously 3 months after surgery and does not seem to be related to motion limitation at 6 months. A normal range of motion is achieved in almost all patients with axillary web syndrome (8). Hence, for our study participants, this seems unlikely. Another hypothesis is that following surgery, an inflammatory cascade may also be initiated resulting in activation of fibroblasts and collagen production and eventual fibrosis. Fibrosis may be more prominent with more extensive surgeries (19). Suprascapular nerve block may also have an influence on the suggested inflammatory and fibrotic response caused by surgical trauma via inhibiting transmission in autonomic nerve fibers (20). It is difficult to prove this hypothesis since the aim of our study was not to explain the underlying mechanism, but to observe the effects of the intervention; so the

study design is not appropriate to answer this question.

Placebo effect may not be ruled out, as sham injections were not applied. Possible emotional distress in women with recent diagnoses of cancer might play role in the pain perception and protective upper limb use. Placebo effects may have a profound impact on emotional state encouraging upper limb use.

Another interesting result reported by Sagen et al (25) is that the prevalence of pain and muscle strength was similar for affected and control upper limbs at baseline and after 2.5 years. They suggest that the underlying mechanisms are related to complex factors in addition to surgery.

Standard first line therapeutic approaches for shoulder limitation are patient education and gentle range of motion exercises and stretching. Education and exercise help to correct subtle changes in scapula position and stability and correct muscle recruitment imbalances (9). Prevention and management of shoulder limitations include implementation of gentle range of motion exercises in the postoperative first day and stretching exercises after first week (12,13). Some authors do not recommend restriction of upper limb activity for daily living since activity is not thought to be responsible for lymphedema development (27). In our study, participants were educated and exercise instructions were provided following surgery, however it is not possible to be certain about their adherence to the home exercise programs. Insufficient pain control or fear of pain might prevent efficient maintenance of the exercise program.

There is no sufficient information regarding other treatment approaches for shoulder limitation in the literature. This may be a result of guidelines underlying the importance of arm care and proper hygiene. However, prevention approaches are changing from conservative guidelines that recommend avoidance of upper limb use to more motivational advice for participating in physical activities (9). The results of a large, prospective cohort study showed no association between nonprecautionary behaviors such as ipsilateral blood draws, injections, blood pressure readings, and trauma to the at-risk arm, and the subsequent risk of lymphedema (16). Even interventional procedures such as stellate ganglion block are applied in patients with lymphedema (17). No significant adverse events were reported.

Intraarticular shoulder injections were administered together with manipulation under general anesthesia in 7 patients with frozen shoulder (19). The patients had symptoms for approximately a year, longer than that of our patients. Most of their patients underwent radiation before shoulder injections, which is also different from ours. Ultrasound-guided injections in breast cancer survivors are also reported scarcely in the literature. Trigger point injections in myofascial pain syndrome (18) and intercostobrachial nerve blocks (28) are successfully performed without complications. Real-time ultrasound helps the physician to precisely place the needle and correctly deliver the medication to the targeted site. This enables the physician to use lower doses of medications (5 mL) compared to blind injections (10 mL) (19,29) and to minimize complications.

In our study, it was observed that one among 18 participants developed transient arm swelling in the second evaluation. Swelling did not persist and resolved after a brief period of compression sleeve use. All women in our study undergoing axillary dissection were at high risk for developing lymphedema as the literature demonstrates higher incidence with more invasive treatment approaches. Breast cancer survivors have a life-long risk for lymphedema with an increased incidence over time in a 2-year follow-up (27). Lymphedema is acute in approximately 2/3 of women and the condition resolves with or without treatment in a-5 month or earlier period (9). It is thought that a larger sample size is needed to demonstrate whether there is a relation between the suprascapular block and arm swelling.

There are some limitations in this study. First, this is a cohort study and not a randomized, controlled treatment trial. Absence of a control group reduces the strength of our findings. However it is thought that a rapid recovery observed in range of motion enabling participants to commence radiation gives promise for future well-designed studies. Second, sample size is small. Third, long-term effects were not assessed. Yet to our knowledge, this is the first study investigating the effect of suprascapular block on shoulder limitation in breast cancer survivors.

Conclusions

The results of this study show that ultrasound-guided suprascapular nerve block may be a promising treatment approach for rapid recovery of restricted shoulder motion in women with breast cancer before radiation treatment.

References

1. Tsai RJ, Dennis LK, Lynch CF, Snetselaar LG, Zamba GK, Scott-Conner C. The risk of developing arm lymphedema among breast cancer survivors: A meta-analysis of treatment factors. *Ann Surg Oncol* 2009; 16:1959-1972.
2. Rietman JS, Geertzen JH, Hoekstra HJ, Baas P, Dolsma WV, de Vries J, Groothoff JW, Eisma WH, Dijkstra PU. Long term treatment related upper limb morbidity and quality of life after sentinel lymph node biopsy for stage I or II breast cancer. *Eur J Surg Oncol* 2006; 32:148-152.
3. Land SR, Kopec JA, Julian TB, Brown AM, Anderson SJ, Krag DN, Christian NJ, Costantino JP, Wolmark N, Ganz PA. Patient-reported outcomes in sentinel node-negative adjuvant breast cancer patients receiving sentinel-node biopsy or axillary dissection: National Surgical Adjuvant Breast and Bowel Project phase III protocol B-32. *J Clin Oncol* 2010; 28:3929-3936.
4. Lee TS, Kilbreath SL, Refshauge KM, Herbert RD, Beith JM. Prognosis of the upper limb following surgery and radiation for breast cancer. *Breast Cancer Res Treat* 2008; 110:19-37.
5. Lauridsen MC, Overgaard M, Overgaard J, Hessov IB, Cristiansen P. Shoulder disability and late symptoms following surgery for early breast cancer. *Acta Oncol* 2008; 47:569-575.
6. LeBlanc M, Stineman M, DeMichele A, Stricker C, Mao JJ. Validation of Quick-DASH outcome measure in breast cancer survivors for upper extremity disability. *Arch Phys Med Rehabil* 2014; 95:493-498.
7. Ewertz M, Jensen AB. Late effects of breast cancer treatment and potentials for rehabilitation. *Acta Oncol* 2011; 50:187-193.
8. Leidenius M, Leppanen E, Krogerus L, von Smitten K. Motion restriction and axillary web syndrome after sentinel node biopsy and axillary clearance in breast cancer. *Am J Surg* 2003; 185:127-130.
9. Hayes SC, Johansson K, Stout NL, Prosnitz R, Armer JM, Gabram S, Schmitz KH. Upper-body morbidity after breast cancer: Incidence and evidence for evaluation, prevention, and management within a prospective surveillance model of care. *Cancer* 2012; 118:2237-2249.
10. Dahl AA, Nesvold IL, Reinertsen KV, Fossa SD. Arm/shoulder problems and insomnia symptoms in breast cancer survivors: Cross-sectional, controlled and longitudinal observations. *Sleep Med* 2011; 12:584-590.
11. Ebaugh D, Spinelli B, Schmitz KH. Shoulder impairments and their association with symptomatic rotator cuff disease in breast cancer survivors. *Med Hypotheses* 2011; 77:481-487.
12. Harris SR, Schmitz KH, Campbell KL, McNeely ML. Clinical practice guidelines for breast cancer rehabilitation: Syntheses of guideline recommendations and qualitative appraisals. *Cancer* 2012; 118:2312-2324.
13. McNeely ML, Campbell K, Ospina M, Rowe BH, Dabbs K, Klassen TP, Mackey J, Courneya K. Exercise interventions for upper-limb dysfunction due to breast cancer treatment. *Cochrane Database Syst Rev* 2010; 6:CD005211.
14. Kilbreath SL, Refshauge KM, Beith JM, Ward LC, Lee M, Simpson JM, Hansen R. Upper limb progressive resistance training and stretching exercises following surgery for early breast cancer: A randomized controlled trial. *Breast Cancer Res Treat* 2012; 133:667-676.
15. Galantino ML, Stout NL. Exercise interventions for upper limb dysfunction due to breast cancer treatment. *Phys Ther* 2013; 93:1291-1297.
16. Ferguson CM, Swaroop MN, Horick N, Skolny MN, Miller CL, Jammallo LS, Brunelle C, O'Toole JA, Salama L, Specht MC, Taghian AG. Impact of ipsilateral blood draws, injections, blood pressure measurements, and air travel on the risk of lymphedema for patients treated for breast cancer. *J Clin Oncol* 2016; 34:691-698.
17. Park JH, Min YS, Chun SM, Seo KS. Effects of stellate ganglion block on breast cancer-related lymphedema: Comparison of various injectates. *Pain Physician* 2015; 18:93-99.
18. Shin HJ, Shin JC, Kim WS, Chang WH, Lee SC. Application of ultrasound-guided trigger point injection for myofascial trigger points in the subscapularis and pectoralis muscles to post-mastectomy patients: A pilot study. *Yonsei Med J* 2014; 55:792-799.
19. Leonidou A, Woods DA. A preliminary study of manipulation under anaesthesia for secondary frozen shoulder following breast cancer treatment. *Ann R Coll Surg Engl* 2014; 96:111-115.
20. Jobe CM, Phipatanakul WP, J. CM. Gross anatomy of the shoulder. In: Rockwood CA, Matsen FA, Wirth MA, Lippitt SB, Fehringer EV, Sperling JW (eds). *The Shoulder*. Fourth ed. Ebook: Saunders, an imprint of Elsevier Inc, Philadelphia, PA 2009, pp 33-100.
21. Shanahan EM, 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.
22. Klc Z, Filiz MB, Cakr T, Toraman NF. Addition of suprascapular nerve block to a physical therapy program produces an extra benefit to adhesive capsulitis: A randomized controlled trial. *Am J Phys Med Rehabil* 2015; 94:912-920.
23. Allen ZA, Shanahan EM, Crotty M. Does suprascapular nerve block reduce shoulder pain following stroke: A double-blind randomised controlled trial with masked outcome assessment. *BMC Neurol* 2010; 10:83.
24. McLaughlin SA, Wright MJ, Morris KT, Giron GL, Sampson MR, Brockway JP, Hurley KE, Riedel ER, Van Zee KJ. Prevalence of lymphedema in women with breast cancer 5 years after sentinel lymph node biopsy or axillary dissection: Objective measurements. *J Clin Oncol* 2008; 26:5213-5219.
25. Sagen A, Kaaresen R, Sandvik L, Thune I, Risberg MA. Upper limb physical function and adverse effects after breast cancer surgery: A prospective 2.5-year follow-up study and preoperative measures. *Arch Phys Med Rehabil* 2014; 95:875-881.
26. Yeung WM, McPhail SM, Kuys SS. A systematic review of axillary web syndrome (AWS). *J Cancer Surviv* 2015; 9:576-598.
27. Sagen A, Karesen R, Risberg MA. Physical activity for the affected limb and arm lymphedema after breast cancer surgery. A prospective, randomized controlled trial with two years follow-up. *Acta Oncol* 2009; 48:1102-1110.
28. Wisotzky EM, Saini V, Kao C. Ultrasound-guided intercostobrachial nerve block for intercostobrachial neuralgia in breast cancer patients: A case series. *PM R* 2016; 8:273-277.
29. Boneti C, Arentz C, Klimberg VS. Scapulothoracic bursitis as a significant cause of breast and chest wall pain: Underrecognized and undertreated. *Ann Surg Oncol* 2010; 17:321-324.