Incidence of Myofascial Pain Syndrome in Breast Cancer Surgery: A Prospective Study

María Torres Lacomba, PhD,† Orlando Mayoral del Moral, PhD,‡ José Luís Coperias Zazo, PhD,§ Robert D. Gerwin, MD,‖ and Álvaro Zapico Goñí, MD¶*

Background: Pain after breast cancer therapy is a recognized complication found to have an adverse impact on patient's quality of life, increasing psychosocial distress. In recent years, case reports about myofascial pain syndrome are emerging in thoracic surgery as a cause of postsurgery pain. Myofascial pain syndrome is a regional pain syndrome characterized by myofascial trigger points in palpable taut bands of skeletal muscle that refers pain a distance, and that can cause distant motor and autonomic effects.

Objective: The objective of this study was to assess the incidence of myofascial pain syndrome prospectively 12 months after breast cancer surgery.

Methods: Each participant was assessed preoperatively, postoperatively between day 3 and day 5, and at 1, 3, 6, and 12 months after surgery. A physical therapist, expert in the diagnosis of myofascial pain syndrome, performed follow-up assessments. Pain descriptions by the patients and pain pattern drawings in body forms guided the physical examination. The patients were not given any information concerning myofascial pain or other muscle pain syndromes.

Results: One year follow-up was completed by 116 women. Of these, 52 women developed myofascial pain syndrome (44.8%, 95% confidence interval: 35.6, 54.3).

Conclusion: Myofascial pain syndrome is a common source of pain in women undergoing breast cancer surgery that includes axillary lymph node dissection at least during the first year after surgery. Myofascial pain syndrome is one potential cause of chronic pain in breast cancer survivors who have undergone this kind of surgery.

Key Words: myofascial pain syndromes, incidence, breast cancer, pain

(*Clin J Pain* 2009;00:000–000)

Pain after breast cancer therapy is a recognized complication found to have an adverse impact on patients' quality of life,[1–5] including impaired physical functioning and increased psychosocial distress.[4,6–8] Pain prevalence varies from 20% to 65% depending on the diagnostic criteria.[1,3,4,7–11] Different types of pain have been found after successful treatment of breast cancer including phantom breast pain,[12,13] scar pain,[14] neuropathic pain,[15] and complex regional pain syndrome,[16] although, at present, all these types of pain are usually found under the generic name of postmastectomy pain syndrome.[4,5,7,10] Besides postmastectomy pain syndrome, pain of vascular origin arising from the axillary web syndrome (AWS) has been found in the early postoperative period after axillary surgery.[17–21] The etiology of pain appearing after treatment that includes surgery, chemotherapy, and radiation therapy in breast cancer survivors varies and includes surgical damage of sensory nerves and axillary dissection,[9,13,22,23] postoperative complications,[18–20,24–28] and complications of radiotherapy[1,9,10] and chemotherapy.[29,30]

In recent years, case reports about myofascial pain syndrome (MPS) are emerging in thoracic surgery.[31–33] The MPS is defined as the signs and symptoms caused by active myofascial trigger points (MTPs). An MTP can be defined as a hyperirritable nodule of spot tenderness in a palpable taut band of skeletal muscle. The spot is a site of exquisite tenderness to palpation, that refers pain a distance, and that can cause distant motor and autonomic effects.[34] MTPs are considered to be localized muscle contractures occurring at dysfunctional motor endplates. Hence, MPS is classified as a myopathy associated with disordered neuromuscular junction function.[34,35] MTPs can be classified as active (symptom-producing) or latent (not spontaneously symptomatic).[34,35] Latent MTPs can be activated by acute or chronic overload,[34,35] by leaving the muscle in a shortened position for a long period of time,[34,35] by surgical scars[36] or by surgical drains,[31] among other causes. Latent or inactive MTPs were not considered in this study, as they do not cause spontaneous or activity-induced pain. MTPs can be identified by the objective tests of magnetic resonance elastography,[37] by specific electromyographic (EMG) examination,[38] by ultrasound technology (grayscale 2D ultrasound, vibration sonoelastography,

Received for publication April 3, 2009; accepted October 3, 2009.

From the *Alcalá de Henares University; †Physical Therapy Research Department, Department of Physical Therapy, Alcalá University; §Henares Hospital; ¶Príncipe de Asturias University Hospital, Madrid; ‡Provincial Hospital, Toledo, Spain; and ‖Department of Neurology, Johns Hopkins University School of Medicine, Baltimore, MD.

Sources of support: This clinical trial has been supported by Instituto de Salud Carlos III (Protocol PI071124), of Spanish Health Ministry.

Physical Therapy Department from Alcalá University and Principe de Asturias University Hospital provided the facilities to carry out the study.

Conception and design: María Torres Lacomba; provision of patients: Álvaro Zapico Goñi; provision of intervention: María Torres Lacomba (assessor); data analysis and interpretation: José Luís Coperias Zazo, María Torres Lacomba, Orlando Mayoral del Moral, Robert D. Gerwin; collection and assembly of data: Orlando Mayoral del Moral; manuscript writing: María Torres Lacomba, Orlando Mayoral del Moral, Robert D. Gerwin; and final approval manuscript: María Torres Lacomba, Orlando Mayoral del Moral, Robert D. Gerwin, José Luís Coperias Zazo, Álvaro Zapico Goñi.

Reprints: María Torres Lacomba, PhD, E.U.E. Fisioterapia, Universidad de Alcalá, Campus Externo, Ctra. Madrid-Barcelona Km. 33.600, 28871 Alcalá de Henares, Madrid (e-mail: maria.torres@uah.es).

TABLE 1. Recommended Criteria for Identifying Myofascial Trigger Points.[35]

Palpable taut band
Exquisite spot tenderness of a nodule in a taut band
Patient's recognition of current pain complaint by pressure on the tender nodule
Painful limit to full stretch range of motion was assessed in each patient, but was considered confirmatory, although not necessary to the diagnosis of MPS

MPS indicates myofascial pain syndrome.

and Doppler),[39] or by sophisticated microdialysis techniques assaying characteristic biochemical markers.[40] Central hypersensitization associated with MTP activation is objectively visualized on functional magnetic resonance imaging studies.[41] In the clinical setting, MTPs are identified by physical examination.[34] Recent studies have shown that clinicians with adequate training in muscle palpation techniques have a high degree of reliability in identifying MTPs, not only in the same muscle, but the same trigger point within the muscle. Thus, the most widely used diagnostic criteria[35] (Table 1) have shown a good overall interrater reliability.[42–44] The examiner in this study has had extensive experience in MTP examination and treatment. The objective of this study was to assess the incidence of MPS prospectively 12 months after breast cancer surgery.

.

METHODS

Patients

Women diagnosed with breast cancer between May 2005 and June 2007, and undergoing unilateral surgery with axillary lymph node dissection (ALND) at the Príncipe de Asturias Hospital in Alcalá de Henares, Madrid (Spain), were considered for inclusion in the study. Patients without ALND or with bilateral breast cancer, systemic disease, or local/regional recurrence were excluded. After biopsy confirmation of breast carcinoma, patients under the care of any one of 4 breast surgeons participating in the study were approached by the investigators for inclusion in the study. One hundred and twenty women out of 270 women who met the inclusion criteria agreed to participate, giving their written informed consent. The flow of patients through the phases of the study is shown in Figure 1.

Assessment

Each participant was assessed preoperatively then postoperatively on hospital discharge (between day 3 and day 5), 4 weeks, and 3, 6, and 12 months after surgery. In addition to these scheduled examinations, each patient was instructed to report if they experienced pain, and were assessed at that time. A physical therapist, expert in the diagnosis of MPS, performed follow-up assessments.

During the preoperative assessment, demographic data were collected on all patients including age, race, marital status, body mass index, job, educational level, socioeconomic status, information regarding breast cancer, and medical history. Patients were also asked an open question about whether they felt any pain. If they did, a physical examination was conducted to find the source of pain, including evaluation for active MTPs. Location, duration, and intensity of pain were recorded. The location was marked by every patient on a multiple-view diagram. Pain intensity was registered by visual analog scale. Patients who did not report pain were not examined for latent MTPs.

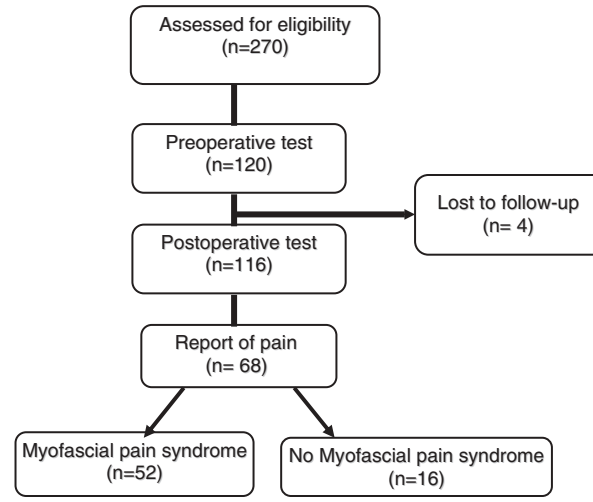

FIGURE 1. Patient flow chart.

In postoperative assessments, data were collected regarding the type of surgery performed, the number of lymph nodes removed, the use of adjuvant treatment, and the development of seroma, infection or pain. If there was pain, the patient was again examined to determine the cause, including assessment of active MTPs. Pain descriptions by the patients and pain pattern drawings in body forms guided the physical examination, to determine the cause of pain. The patients were not given any information concerning MPS or other muscle pain syndromes. The diagnosis of MPS was based on the major criteria proposed by Simons et al,[35] shown in Table 1.

Design

A prospective and longitudinal study was used. Príncipe de Asturias Hospital's Human Research Ethics Committee approved the study.

Specific physical therapy treatment for pain was made available for patients identified with MPS or with any other pain syndrome at any time during the study.

Data Analysis

Sample-size Calculations

To evaluate the incidence of MPS after ALND we recruited 120 women. Sample-size estimation was done assuming an incidence of MPS of 50% in the control group, according to the findings in earlier studies.[45–48] With such a sample size, an incidence difference of 20% can be detected with a power of 90%, setting the type 1 error at 0.05, and allowing for a 15% of drop-out rate.

Statistical Analysis

Statistical analyses were performed using Statistical Package for the Social Sciences software (SPSS for Windows , Version 12.0, SPSS Inc, Chicago, 2008). Data were collected in a questionnaire form and introduced in an ACCESS database (Microsoft Office, 2003, Microsoft

TABLE 2. Characteristics of the 116 Patients Who Underwent Breast Cancer Surgery

	All Sample		No MPS		MPS		
Valid Individuals	**116**	**100%**	**64**	**100%**	**52**	**100%**	***P*§**
Categorical Variables							
Surgical procedure							0.772
Quadrantectomy*	47	41%	25	39%	22	42%	
Modified mastectomy†	42	36%	25	39%	17	33%	
Lumpectomy‡	27	23%	14	22%	13	25%	
Postsurgical treatment							
Radiotherapy	93	80%	49	77%	44	85%	0.279
Chemotherapy	95	82%	49	77%	46	89%	0.098
Hormone therapy	72	62%	36	56%	36	69%	0.152
Axillary web syndrome	56	48%	25	39%	31	60%	0.028
Seroma	33	28%	17	27%	16	31%	0.617
Wound infection	11	9%	6	9.3%	5	9.6%	0.957
Working	47	41%	27	42%	20	39%	0.684
Numerical variables	Mean	SD	Mean	SD	Mean	SD	*P*‖
No. dissected lymph nodes	13.6	5.3	13.6	5.5	13.7	5.1	0.764
Age (y)	53.6	11.5	53.2	11.4	54.2	11.8	0.667
Body mass index	27.1	5.2	26.9	5.5	27.3	4.7	0.677
Days of drainage	4.3	2.2	4.6	2.5	4.0	1.6	0.261

*Excision of breast quadrant + pectoralis major fascia + lymphadenectomy.
†Mastectomy with excision of pectoralis major fascia + lymphadenectomy.
‡Excision of local tumor with margins + pectoralis major fascia + lymphadenectomy.
§*P* values from χ^2 test.
‖*P* values from *t* test and Mann-Whitney test.

Corporation, Seattle, Washington). These analyses included the 116 patients with ALND that completed baseline and 12-month follow-up assessments.

The one-sample Kolmogorov-Smirnov test was used to test the normal distribution of the variables. We used the nonparametric χ^2 test and Mann-Whitney test to analyze the association of the categorical and continuous variables. The sample-size and the incidence were estimated with the !NP, !NPD, and !CIP macros.[49,50]

RESULTS

One hundred and sixteen women completed all the follow-up assessments; 4 were excluded because they did not attend the first postsurgery assessment and were lost to follow-up. For a descriptive summary of the variables in the whole sample see Table 2.

TABLE 3. Cause of Pain

Cause of Pain	# Patients
Myofascial pain syndrome	52
Axillary web syndrome	56
Infection	3
Neuropathy	1
Fibromyalgia	2
Carpal tunnel syndrome	1
Supraspinatus tendonitis	3
Pneumothorax	1
Osteosarcoma	1
Chemotherapy allergic reaction	1
Herpes zoster	1
Not determined*	6

*Generalized pain associated with chemotherapy and hormonotherapy.

Incidence of MPS

The number of women detected with active MTPs was 52 out of the 116 (44.8%, 95% confidence interval: 35.6, 54.3). During the 12-month follow-up, other pain conditions were also found (Table 3). For a muscle-specific incidence of MPS see Table 4.

The incidence of MPS was not influenced either by the surgical procedure (χ^2 test, $P = 0.685$) or by radiotherapy (χ^2 test, $P = 0.171$), nor by the number of dissected lymph nodes (independent-samples *t* test, $P = 0.733$). The relationship between the incidence of MPS and chemotherapy did not reach significance in this study (χ^2 test, $P = 0.098$). MPS developed mainly during the 6-month period after surgery. The onset of MPS, expressed as mean (SD) was 6.1 (2.6) months (Fig. 2).

DISCUSSION

This is the first published study to address the incidence of MPS among breast cancer survivors. The

TABLE 4. Incidence of Involved Muscles With Active Myofascial Trigger Points

Muscles	N	%	95% CI
Latissimus dorsi	30	25.9	18.2, 34.8
Serratus anterior	28	24.0	16.7, 33.0
Pectoralis major	24	20.7	13.7, 29.2
Infraspinatus	22	19.0	12.3, 27.3
Trapezius	16	13.8	8.1, 21.4
Teres major	10	8.6	4.2, 15.3
Teres minor	10	8.6	4.2, 15.3
Pronator teres	6	5.2	1.9, 10.9
Levator scapulae	1	0.9	0.0, 4.7
Supraspinatus	1	0.9	0.0, 4.7

CI indicates confidence interval.

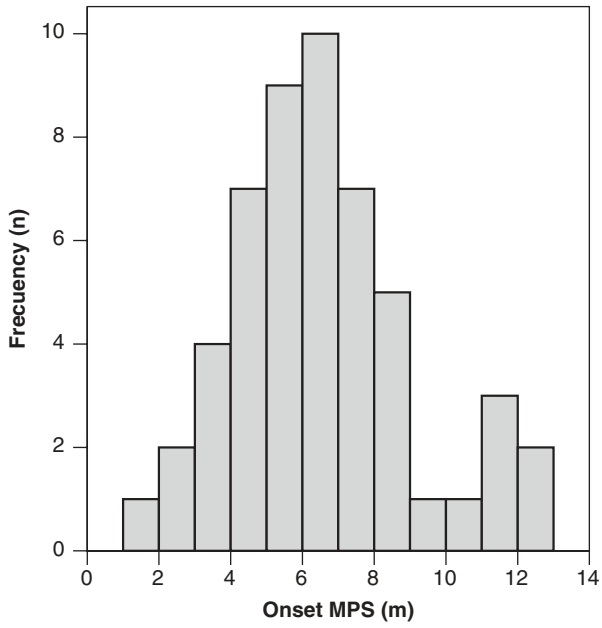

FIGURE 2. Onset distribution of myofascial pain syndrome in months after surgery.

results of this study give an insight into incidence of this underreported pain syndrome in women after surgical treatment of breast cancer. Fifty-two out of the 116 women (44.8%) experienced MPS, the majority having onset within the first 6 months after surgery. This high incidence supports the need for identifying and treating the often underdiagnosed and misdiagnosed MPS found in these patients.

Most patients with MPS had active MTPs in muscles of the shoulder girdle. This would be expected since the most likely activation factors in these patients would be related to positioning of the shoulder during surgery,[33] maintaining muscles in a shortened position after surgery,[34,35] the surgical scar,[36] the surgical drains,[31] the manipulation, and excision of pectoralis fascia during surgery or the adaptation of upper extremity movement after surgery.

Some of the muscles involved in our patients (pectoralis major, serratus anterior, and upper trapezius) have shown EMG abnormalities related with pain and dysfunction in shoulder activity after breast cancer treatment.[51] Active MTPs, by definition, always cause pain,[34,35] and muscle dysfunction is a well-known effect of both active and latent MTPs,[35,52] which could account for the reported EMG abnormalities. Studies are needed to find out whether the EMG abnormalities documented in muscles after breast cancer surgery have any relationship with either active or latent MTPs.

There are at least 2 possible reasons to explain the tightness that is often found in the pectoralis major muscle after surgery: (1) the ablation of the pectoralis major muscle fascia, and (2) the positioning of the arm in abduction and external rotation during surgery. Furthermore, the patients' efforts to protect their surgical sites through thoracic flexion and scapular protraction may account for the high presence of MTPs in the pectoralis major (Table 4). The pectoral tightness pulls the scapula into a protracted position, and the arm into internal rotation, increasing the risk of subsequent MTPs in shoulder rotators, and in scapula retractors, as well as in back and neck muscles. Radiation fibrosis of the pectoral muscles may produce greater tightness and contribute to the problem.[53–56]

As most MTPs were activated after the treatment had concluded, it is possible that radiotherapy and chemotherapy acted as activation factors. However, no statistically significant relationship could be found between these 2 therapies and the activation of MTPs.

Thirteen out of 52 patients (25%) had single muscle MPS, primarily involving latissimus dorsi or serratus anterior muscles. In addition to the activation factors already mentioned, the manipulation of the thoracodorsalis nerve and thoracicus longus nerve, respectively, that can occur during surgery[9,13] could put these muscles at further risk for developing MTPs. Some reports show how mechanical stress applied to the endplate region by tensing the motor nerve produces in rats the same type of EMG abnormalities found in MTPs.[57,58] In the case of serratus anterior muscle, the most likely source of MPS is scar formation where the muscle adheres to overlying skin.

The only nonshoulder girdle muscle we found involved in our patients was the pronator teres. This muscle presented active MTPs in 6 patients, all of which concurrently had AWS. The AWS is a self-limiting and frequently overlooked cause of significant morbidity in the early postoperative period after axillary surgery due to lymphovenus damage, hypercoagulation, superficial venous and lymphatic stasis as a result of the disruption of superficial lymphatics and vessels during axillary surgery. The AWS is characterized by painful cords of tissue extending from axilla into the medial arm made visible or palpable by shoulder abduction.[18–20,27,59] The reason for the concurrence of pronator teres MPS and AWS is unknown, although protective splinting by the muscle, to avoid painful stretch of tight lymphatic vessels at elbow level may be causative.

Postmastectomy syndrome refers to any pain persisting beyond the normal period of healing after breast cancer treatment, and is most often considered to be neuropathic in origin.[4,5,7,10,24] Some authors suggest the necessity of developing valid and reliable evaluation instruments,[12,60] and others state that studies are needed to assess neuropathic versus non-neuropathic pain as a cause of pain after treatment.[13,15,61,62] Currently, the first criterion considered necessary for the presence of neuropathic pain is "pain with a distinct neuroanatomically plausible distribution."[63] In most studies of postmastectomy syndrome[5,7,10] pain was evaluated by pain questionnaires without any physical examination. At present time, the only reliable way to identify an MTP clinically is by physical examination performed by a trained and experienced examiner.[34,42,43] Thus, questionnaires cannot identify MTPs among possible causes of postsurgical pain. Our findings suggest that it is rather likely that some cases diagnosed as postmastectomy syndrome in some studies,[5,7,10] were actually MPS caused by MTPs. Studies are needed to address this issue.

One of the limitations of this study is that there is presently no validated list of diagnostic criteria for MTPs.[34] The diagnostic criteria used in our study[35] are the most frequently used, both in clinical practice and in research studies. These criteria have shown to be highly reliable when used by trained and experienced examiners.[38,42,43] In our study, the examiner was a trained physical therapist with more than 10 years of experience in the diagnosis and

treatment of MTPs, who had previously shown reliability in identifying MTPs.[64]

Another limitation of the study is the fact that all patients came from a single hospital, although the patients were treated surgically by 4 different surgeons. Larger multicenter studies are needed to confirm that our results can be extrapolated to other samples.

Although we achieved very good results in the control of pain of our patients by means of a specific physical therapy treatment of MTPs (O. Mayoral, PT, unpublished data, 2007; M. Torres, PT, unpublished data, 2008), the fact that we did not have a control group to evaluate the effectiveness of our treatment does not allow any conclusion to be drawn regarding this issue. Controlled studies with longer follow-up are needed to evaluate the effectiveness of different specific treatments of MPS in these patients to be certain about the real contribution of MTPs to their pain.

CONCLUSIONS

MPS is a common source of pain in women undergoing breast cancer surgery that includes ALND, at least during the first year after surgery. Since the genesis of MPS among breast cancer patients could be multifactorial, a proper differential diagnosis and an adequate treatment approach are essential. Acknowledging the incidence of MPS is an important issue in this regard, as is the understanding of the severity and constancy of the pain that MPS can cause to these patients. Further studies, with longer follow-up, are needed to clarify if the MPS could be related, or even be the source of chronic pain in breast cancer survivors.

ACKNOWLEDGMENTS

The authors thank the staff and patients of Gynecology Service of Príncipe de Asturias Hospital from Alcalá de Henares (Madrid) and also thank the Physical Therapy Research Unit of the Physical Therapy Department, at Alcalà University in Madrid, Spain.

REFERENCES

1. Amichetti M, Caffo O. Pain after quadrantectomy and radiotherapy for early-stage breast cancer: incidence, characteristics and influence on quality of life. *Oncology*. 2003;65: 23–28.
2. Gulluoglu B, Cingi A, Cakir T, et al. Factors related to post-treatment chronic pain in breast cancer survivors: the interference of pain with life functions. *Int J Fertil Womens Med*. 2006;51:75–82.
3. Caffo O, Amichetti M, Ferro A, et al. Pain and quality of life after surgery for breast cancer. *Br Cancer Res Treat*. 2003;80: 39–48.
4. Carpenter J, Andrykowski P, Cunningham L, et al. Post-mastectomy/postlumpectomy pain in breast cancer survivors. *J Clin Epidemiol*. 1998;51:1285–1292.
5. Macdonald L, Bruce J, Scott N, et al. Long-term follow-up of breast cancer survivors with post-mastectomy pain syndrome. *Br J Cancer*. 2005;92:225–230.
6. Akechi T, Okuyama T, Imoto S, et al. Biomedical and psycosocial determinants of psychiatric morbidity among postoperative ambulatory breast cancer. *Br Cancer Res Treat*. 2001;65:195–202.
7. Stevens P, Dibble S, Miaskowski C. Prevalence, characteristics, and impact of postmastectomy pain syndrome: an investigation of women's experience. *Pain*. 1995;61:61–68.
8. Tasmuth T, Blomqvist C, Calso E. Chronic post-treatment symptoms in patients with breast cancer operated in different surgical units. *Eur J Surg Oncol*. 1999;25:38–43.
9. Poleshuck EL, Katz J, Andrus CH, et al. Risk factors for chronic pain following breast cancer surgery. A prospective study. *J Pain*. 2006;7:626–634.
10. Smith WC, Bourne C, Squair J, et al. A retrospective cohort study of postmatectomy pain syndrome. *Pain*. 1999; 83:91–95.
11. Wallace MS, Wallace AM, Lee J, et al. Pain after breast surgery: a survey of 282 women. *Pain*. 1996;66:195–205.
12. Dijkstra PU, Rietman JS, Geerzen JHB. Phantom breast sensations and phantom breast pain: a 2-year prospective study and methodological analysis of literature. *Eur J Pain*. 2007;11: 99–108.
13. Steegers M, Wolters B, Evers A, et al. Effect of axillary lymph node dissection on prevalence and intensity of chronic and phantom pain after breast cancer surgery. *J Pain*. 2008;1:1–10.
14. Macrae WA. Chronic pain after surgery. *Br J Anaesth*. 2001;87:88–98.
15. Jung B, Ahrendt G, Oaklander A, et al. Neuropathic pain following breast cancer surgery: proposed classification and research update. *Pain*. 2003;104:1–13.
16. Graham LE, McGuigan C, Kerr S, et al. Complex regional pain syndorme post mastectomy. *Rheumatol Int*. 2002;21: 165–166.
17. Ferrandez JC, Doyer M, Serin D, et al. Thromboses lymphatiques superficielles. In: Petiot S, Hérisson C, Pélissier J, eds. *Cancer Du Sein Traité et Médecine de Rééducation*. Paris: Elsevier-Masson; 2007:119–128.
18. Leidenius M, Leppanen E, Krogerus L, et al. Motion restriction and axillary web syndrome after sentinel node biopsy and axillary clearance in breast cancer. *Am J Surg*. 2003;185:127–130.
19. Moskovitz A, Anderson B, Yeung R, et al. Axillary web syndrome after axillary dissection. *Am J Surg*. 2001;181: 434–439.
20. Torres M, Cerezo E. Actuación fisioterapéutica en la trombosis linfática superficial tras cirugía mamaria con linfadenectomía. A propósito de un caso. *Cuest fisioter*. 2009;38:170–178.
21. Torres Lacomba M, Mayoral del Moral O. Les thromboses lymphatiques superficielles á l'origine du syndrome douloureux myofascial après curage de sein. *Kiné Scien*. 2008;494:25–28.
22. Tasmuth T, Kataja M, Blomqvist C, et al. Treatment related factors predisposing to chronic pain in patients with breast cancer. *Acta Oncol*. 1997;36:625–630.
23. Lee TS, Kilbreath SL, Refshauge KM, et al. Prognosis of the upper limb following surgery and radiation breast cancer. *Br Cancer Res Treat*. 2008;110:19–37.
24. Blunt C, Schmiedel A. Some cases of severe postmastectomy pain syndrome may be caused by an axillary haematoma. *Pain*. 2004;108:294–296.
25. Douay N, Akerman G, Clément D, et al. Seroma after axillary lymph node dissection in breast cancer. *Gynecol Obstet Fertil*. 2008;36:130–135.
26. Lumachi F, Brandes A, Burelli P, et al. Seroma prevention following axillary dissection in patients with breast cancer by using ultrasound scissors: a prospective clinical study. *EJSO*. 2004;30:526–530.
27. Torres M. Caso clínico 13: Dolor en la cara medial del brazo. In: Torres M, Salvat I, eds. *Guía de Masoterapia para Fisioterapeutas*. Madrid: Médica Panamericana; 2006:337–342.
28. Wilke L, McCall L, Posther K. Surgical complications associated with sentinel lymph node biopsy: results from a prospective international cooperative group trial. *Ann Surg Oncol*. 2006;13:491–500.
29. Argyriou AA, Polychronopoulus P, Koutras A, et al. Peripheral neuropathy induced by administration of cisplatin and paclitaxel-based chemotherapy. Could it be predicted? *Support Care Cancer*. 2005;13:647–651.
30. Argyriou AA, Polychronopoulus P, Koutras A, et al. Clinical and electrophysiological features of peripheral neuropathy

induced by administration of cisplatin plus paclitaxel-based chemotherapy. *Eur J Cancer Care*. 2007;16:231–237.
31. Cummings M. Myofascial pain from pectoralis major following trans-axillary surgery. *Acupunct Med*. 2003;21:105–107.
32. Hamada H, Moriwaki K, Kawamoto M, et al. Myofascial pain in patients with postthoracotomy pain syndrome. *Reg Anesth Pain Med*. 2000;25:302–305.
33. Hsin ST, Yin YC, Juan CH, et al. Myofascial pain syndrome induced by malpositioning during surgery: a case report. *Acta Anaesthesiol Sin*. 2002;40:37–41.
34. Simons DG. Review of enigmatic MTrPs as a common cause of enigmatic musculoskeletal pain and dysfunction. *J Electromyogr Kinesiol*. 2004;14:95–107.
35. Simons DG, Travell JG, Simons LS. *Myofascial Pain and Dysfunction. The Trigger Point Manual. Upper Half of Body*. 2nd ed. Baltimore: Williams and Wilkins; 1999.
36. Lewit K, Olsanska S. Clinical importance of active scars: abnormal scars as a cause of myofascial pain. *J Manipulative Physiol Ther*. 2004;27:399–402.
37. Chen Q, Bensamoun S, Basford JR, et al. Identification and quantification of myofascial taut bands with magnetic resonance elastography. *Arch Phys Med Rehabil*. 2007;88: 1658–1661.
38. Couppé C, Midttun A, Hilden J, et al. Spontaneous needle electromyographic activity in myofascial trigger points in the infraspinatus muscle: a blinded assessment. *J Musculoskelet Pain*. 2001;9:7–16.
39. Sikdar S, Shah JP, Gebreab T, et al. Novel applications of ultrasound technology to visualize and characterize myofascial trigger points and surrounding soft tissue. *Arch Phys Med Rehabil*. 2009;90:1829–1838.
40. Shah JP, Phillips TM, Danoff JV, et al. An in vivo microanalytical technique for measuring the local biochemical milieu of human skeletal muscle. *J Appl Physiol*. 2005;99: 1977–1984.
41. Niddam DM, Chan RC, Lee SH, et al. Central modulation of pain evoked from myofascial trigger point. *Clin J Pain*. 2007; 23:440–448.
42. Gerwin RD, Shannon S, Hong CZ, et al. Interrater reliability in myofascial trigger point examination. *Pain*. 1997;69:65–73.
43. Sciotti VM, Mittak VL, DiMarco L, et al. Clinical precision of myofascial trigger point location in the trapezius muscle. *Pain*. 2001;93:259–266.
44. Bron C, Franssen J, Wensing M, et al. Interrater reliability of palpation of myofascial trigger points in three shoulder muscles. *J Man Manip Ther*. 2007;15:203–215.
45. Fishbain DA, Goldberg M, Meagher BR, et al. Male and female chronic pain patients categorized by DSM-III psychiatric diagnostic criteria. *Pain*. 1986;26:181–197.
46. Gerwin RD. A study of 96 subjects examined both for fibromyalgia and myofascial pain. *J Musculoske Pain*. 1995; 3(suppl 1):121.
47. Skootsky SA, Jaeger B, Oye RK. Prevalence of myofascial pain in general internal medicine practice. *West J Med*. 1989; 151:157–160.
48. Sola AE, Rodenberger ML, Gettys BB. Incidence of hypersensitive areas in posterior shoulder muscles. *Am J Phys Med*. 1955;34:585–590.
49. Domenech JM, Bonillo A, Granero R. Sample SIZE: estimation of population proportion. Madrid. Available at: *www.metodo.uab.es/macros.htm*; 2005.
50. Domenech JM, Sesma R, Bonillo A, Granero R. Confidence intervals for proportions (exacts and asymptotics). Madrid. Available at: *www.metodo.uab.es/macros.htm*; 2007.
51. Shamley DR, Srinanaganathan R, Weatherall R, et al. Changes in shoulder muscle size and activity following treatment for breast cancer. *Br Cancer Res Treat*. 2007;106: 19–27.
52. Lucas KR, Polus BI, Rich PA. Latent myofascial trigger points: their effects on muscle activation and movement efficiency. *J Bodywork Mov Ther*. 2004;8:160–166.
53. Senkus-Konefka E, Jassem J. Complications of breast-cancer radiotherapy. *Clin Oncol*. 2006;18:229–235.
54. Bentzen SM, Dische S. Morbidity related to axillary irradiation in the treatment of breast cancer. *Acta Oncol*. 2000;39:337–347.
55. Herskind C, Bentzen SM, Overgaard J, et al. Differentiation state of skin fibroblast cultures versus risk of subcutaneous fibrosis after radiotherapy. *Radiother Oncol*. 1998;47:263–269.
56. Johansen J, Taagehoj F, Christensen T, et al. Quantitative magnetic resonance for assessment of radiation fibrosis after post-mastectomy radiotherapy. *Br J Radiol*. 1994;67: 1238–1242.
57. Liley AW. The effects of presynaptic polarization on the spontaneous activity at the mammalian neuromuscular junction. *J Physiol*. 1956;134:427–443.
58. Liley AW. An investigation of spontaneous activity at the neuromuscular junction of the rat. *J Physiol*. 1956;132: 650–663.
59. Ferrandez J, Serrin D. *Rééducation et Cancer de Sein*. 2nd ed. Paris: Elsevier Masson S.A.S.; 2006.
60. Rietman JS, Dijkstra PU, Hoekstra HJ, et al. Late morbidity after treatment of breast cancer in relation to daily activities and quality of life: a systematic review. *EJSO*. 2003;29: 229–238.
61. Lau B, Blyth F, Cousins M. Persistent pain after breast cancer surgery. *Pain Med*. 2007;8:611–618.
62. Stubblefield M, Christian M, Custodio M. Upper-extremity pain disorders in breast cancer. *Arch Phys Med Rehabil*. 2006;87(suppl 1):S96–S99.
63. Treede RD, Jensen TS, Campbell JN, et al. Neuropathic pain: redefinition and a grading system for clinical and research purpose. *Neurology*. 2008;70:1630–1635.
64. Staffel K, Mayoral del Moral O, Lacomba MT, et al. Factors that influence the reliability of clinical assessment for the classification of the myofascial pain syndrome. *J Musculoske Pain*. 2007;15(suppl 13):36.

