Chapter 44
Preserving and Restoring Function after Local Treatment

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Primary breast cancer treatment is associated with long-term musculoskeletal problems in up to one third of patients. Problems arise secondary to normal tissue damage inflicted through cancer removal and staging procedures. Nerves, muscles, stroma, and lymphatics fall within surgical and radiation treatment fields, leaving them vulnerable to inadvertent injury. Musculoskeletal problems may develop within, adjacent to, or distant from treatment fields, manifesting as impairments in strength, flexibility, and integrated movement patterns (1). Table 44.1 lists impairments associated with breast cancer treatments, some of which may persist as many as 10 years following treatment. At all time points, impairments are associated with disability and diminished health-related quality of life (2–9). The likelihood of long-term disability correlates directly with the intensity of breast cancer treatment. More surgery (e.g., axillary lymph node dissection [ALND] vs. sentinel lymph node biopsy [SLNB]) and more radiation (e.g., four-field vs. tangent beam configurations) increase the probability that patients will develop musculoskeletal problems (2,4,10–14). Empirical data now reinforce theoretical concerns that musculoskeletal pathology at surgical and radiation sites will not spontaneously resolve independent of treatment (1,15).

Despite the clear correlation between breast cancer treatment and musculoskeletal problems, tissue-level changes remain ill defined. Radiation-induced fibrosis has been implicated on the basis of long-term follow-up studies (16,17). Additional radiation-related problems include shoulder capsule and epimesial contractures, compromised arterial perfusion with resultant muscle ischemia (18,19), lymphostasis, (20), and muscle hypertonicity secondary to neural irritation. Surgical procedures, even when limited to local tumor excision and SLNB, can produce maladaptive changes in posture and movement patterns. These changes are mediated through pain, scarring, and adaptive positioning in the postoperative period. Adjuvant chemotherapy may also contribute to musculoskeletal problems by reducing muscle mass (1) and oxidative capacity (21). The relative contributions of different cancer treatments and pathological processes to functional problems remain poorly characterized, despite growing understanding of treatment-related late toxicities. Fortunately, manual treatments and therapeutic exercises effectively address most problems.

Successful management of musculoskeletal problems depends on patients' willingness to perform therapeutic exercises. Because treatments are active and must often be continued indefinitely, their success requires a high level of commitment. Patient "buy in" can be substantially enhanced by the strong endorsement of the entire breast cancer treatment team. With increasing appreciation of latent treatment toxicities, the performance of prophylactic stretching and strengthening activities is now accepted as an integral component of comprehensive survivorship care (22). In the absence of such preventative activities, breast cancer survivors, treated years previously, may become uniquely vulnerable to delayed morbidities that manifest when the musculoskeletal and other systems senesce (23). This chapter outlines the evidence base regarding the epidemiology and management of breast cancer treatment–related musculoskeletal morbidity.

EPIDEMIOLOGY

Functional disability following breast cancer treatment is primarily due to restricted range of motion (ROM), diminished strength, and persistent pain. Reported incidences of these problems vary widely depending on the type of breast cancer treatment, measurement technique, and duration of follow-up. Table 44.2 lists shoulder ROM deficits detected at different time points following surgery. Most patients experience an abrupt transient reduction in shoulder ROM after breast cancer surgeries (2,5). Two weeks postoperatively, incidences of restricted ROM as high as 86% have been reported following ALND and 45% following SLNB (24). At 6 weeks postoperatively the incidence of restricted shoulder abduction is substantially less, 26.5% after ALND and 24.8% after SLNB (25). Longitudinal studies suggest that restrictions in shoulder ROM gradually resolve and, in a majority of patients, ROM returns to baseline (7,26,27). Recovery may be gradual, requiring over 12 months for some patients. A significant minority of patients do not recover normal shoulder ROM in abduction, forward flexion, or external rotation. A history of ALND, modified radical mastectomy, and radiation therapy are associated with more significant and lasting limitations (6,7,25,27). Persistent deficits in ROM increase the likelihood that patients will report pain and difficulty performing activities of daily living that involve the shoulder (27).

Pain is a potentially disabling consequence of breast cancer treatment. Persistent shoulder pain 2 to 3 years following treatment is associated with poor mental and physical functioning (6). Pain is more common after ALND and axillary or supraclavicular radiation (4). Few studies differentiate musculoskeletal pain from neurogenic or lymphedema-related pain. As a consequence, the prevalence of posttreatment musculoskeletal pain is unknown. Table 44.3 lists reported pain prevalences. Reports do not specify pain etiologies nor do they report consistent outcome measures (e.g., presence or absence of pain vs. visual analog scores), making the data challenging to integrate. However, the table clearly demonstrates that a significant percentage of patients experience persistent pain in the shoulder or arm. In the authors' experience, symptomatic myofascial dysfunction and axillary webs are common primary sources of musculoskeletal pain following breast cancer treatment. The prevalence of myofascial dysfunction remains uncertain, however, axillary webs affect up to 72% of patients (24). Since breast cancer treatments may destabilize the balance of shoulder muscles, patients are placed at risk of secondary musculoskeletal problems (e.g., rotator cuff pathology and premature degenerative disease of the acromioclavicular and glenohumeral joints). However, the extent to which breast cancer treatment engenders these common problems has not been studied.

Strength deficits are less prevalent immediately following breast surgery but become increasingly problematic with time. This pattern has been appreciated for grip strength. In a longitudinal cohort, mean grip strength decreased by 16.9 nm at 6 weeks and by 41.3 nm at 24 months after ALND, relative to preoperative values (7,25). A similar pattern was noted after SLNB, although the reduction was less pronounced, 5.8 nm at 6 weeks and 17.2 nm at 24 months. These reductions agree with highly reported prevalences of impaired grip strength that range from 16% to 40% (3,13,27–30). The influence of lymphedema on grip strength remains inadequately characterized but may be an important mediating factor (31).

Table 44.1 PHYSICAL IMPAIRMENTS AFFECTING THE SHOULDER, CERVICAL SPINE, AND THORACIC SPINE FOLLOWING PRIMARY BREAST CANCER TREATMENT

Shoulder Complex
Restricted scapulothoracic motion
Glenohumeral joint contracture
Pectoralis major and minor muscle shortening
Muscle weakness
- Serratus anterior
- Middle trapezius
- Rhomboids
- Hand instrinsics

Myofascial dysfunction
- Middle trapezius muscle
- Rhomboid muscle

Maladaptive neuromuscular recruitment patterns

Cervical Spine
Exaggerated lordosis
Myofascial dysfunction
- Upper trapezius muscle
- Levator scapulae muscle

Restricted range of motion
- Lateral rotation
- Lateral bending

Thoracic Spine
Exaggerated kyphosis
Intercostal muscle contracture

Prevalences of reduced shoulder and arm strength are also high with self-reported limitations affecting up to 69% of patients (13). Objective reductions of 10 nm in shoulder abduction strength have been detected at 12 and 24 months following treatment (7,27). Shoulder strength deficits are more common following modified radical mastectomy (32). It has yet to be determined whether secondary musculoskeletal pain syndromes (e.g., rotator cuff tendinopathy) are responsible for shoulder strength deficits more than 2 years following treatment or if such deficits are confined to patients with reduced ROM. In the latter case, suboptimal muscle length–tension relationships could account for the finding.

TREATMENT

Shoulder function depends on the coordinated recruitment of multiple muscles to perform even basic activities. For this reason, although deficits may initially be discreet, few problems remain isolated. The onset of secondary problems occurs commonly when patients lose flexibility in shoulder extension due to pectoral muscle tightness. Secondary strength and biomechanical deficits develop in uninvolved muscles. The anterior deltoid and coracobrachialis muscles, for example, may adopt dysfunctional length-tension relationships and firing patterns, which cause weakness

Table 44.2 PREVALENCE AND SEVERITY OF SHOULDER RANGE OF MOTION DEFICITS AT DIFFERENT TIME POINTS FOLLOWING BREAST CANCER SURGERY

		Elapsed Time after Breast Cancer Surgery[a]											
		6 wks		3 mos		6 mos		9–12 mos		24 mos		>2 yrs	
Outcome Measure	Author (Reference)	ALND	SLNB	ALND	SLNB	ALND	SLNB	ALND	SLNB	ALND	SLNB	ALND	SLNB
Mean decrease from ipsilateral baseline AB	Rietman et al. 2003, 2006 (7,25)	26.4°	24.7°							21.0°	5.5°		
	Purushotham et al. 2005 (58)							6.3°	3.1°				
	Mansel et al. 2006 (26)			4.2°	1.9°	2.3°	1.5°	1.9°	2.5°				
Mean difference in AB relative to untreated shoulder	Hack et al. 1999 (3)											6.4°	
ROM <160° AB	Ernst et al. 2002 (32)							14.0%				8.0%	
ROM <20° normal value ≥1 plane	Langer et al. 2007 (51)											11.3%	3.5%
Self-reported limitation ROM	Leidenius et al. 2005 (52)											34.0%	16.0%
	Warmuth et al. 1998 (50)											8.0%	
	Veronesi et al. 2003 (49)					27.0%	0.0%			21.0%	0.0%		
ROM < normative values any plane	Lauridsen et al. 2008 (12)											35%	
Mean ROM (normal = 180°)	Rietman et al. 2004 (27)											156.6°AB	
	Gosselink et al. 2003 (2)			FF 126°	MRM 150°		BCT						
	Peintinger et al. 2003 (5)							143.8° AB		158.9° AB			

ALND, axillary lymph node dissection; SLNB, sentinel lymph node biopsy; FF, forward flexion; AB, abduction; BCT, breast-conservation therapy; MRM, modified radical mastectomy.
[a]For studies that did not collect data at specified intervals, the elapsed time after surgery is the cohort average.

Table 44.3 REPORTED PAIN PREVALENCES AND INTENSITIES FOLLOWING AT DIFFERENT TIME POINTS FOLLOWING BREAST CANCER SURGERIES

		Elapsed Time after Breast Cancer Surgery[a]									
		≤6 wks		6 mos		9–12 mos		24 mos		>2 yrs	
Outcome Measure	Author (Reference)	ALND	SLNB	ALND	SLNB	ALND	SLNB	ALND	SLNB	ALND	SLNB
Mean change in EORTC QLQ-C30 Pain Scale Score	Peintinger et al. 2003 (5)	20.2	–2			7.2	0.1				
VAS (0–100) change from preoperative baseline	Rietman et al. 2003, 2006 (7,25)	1.3	1.1					8.7	0.6		
VAS > 0	Ernst et al. 2002 (32)									50.7%[b]	
	Peintinger et al. 2003 (5)					11.3	6.8				
Mean VAS score (0–100)	Hack et al. 1999 (3) Rietman et al. 2004 (27)									17.3 25.0[b]	
Pain in neck, arm, or shoulder ≥2x/week	Lauridsen (2008)(12)									31.0%	
Severe or very severe axillary aching	Temple et al. 2002 (48)					19%	11%				
Sporadic or continuous axillary pain	Veronesi et al. 2003 (49) Warmuth et al. 1998 (50) Hack et al. 1999 (3)			91%	16%			39%	8%	 30.0% 31.1%	
Shoulder/arm pain	Langer et al. 2007 (51) Voogd et al. 2003 (8)									21.2% 28.3%[b]	8.1%
Arm pain	Leidenius et al. 2005 (52)									30.0%	12.0%

ALND, axillary lymph node dissection; SLNB, sentinel lymph node biopsy; EORTIC, European Organisation for Research and Treatment of Cancer; VAS, visual analog scale.
[a]For studies that did not collect data at specified intervals, the elapsed time after surgery is the cohort average.
[b]No distinction made between ALND and SLNB.

and further deviation from normal biomechanics (33). Over time clusters of related impairments may develop and produce global shoulder dysfunction. Addressing problems in isolation, whether primary or secondary will be limitedly successful at best. It is more clinically useful to treat generalized shoulder disability arising from multiple, interrelated impairments as an integrated whole.

Virtually all exercise and manual treatment-based approaches benefit musculoskeletal problems provided they are administered in a structured and monitored fashion (9–11,14,34–37). Regimens tested with randomized, controlled study designs are consistently superior to the common practice of providing patients with illustrated exercise sheets after surgery without formal follow-up. The fact that a variety of therapeutic techniques offer benefit reflects the straightforward treatment goals of restoring normal flexibility, strength, postural alignment, and biomechanics to the upper truncal quadrant. Positive results have been reported with therapist-directed programs emphasizing disparate approaches such as general kinesthetics (37) and pectoral muscle stretches (36). Although a wide range of structured regimens yield benefit, all therapy programs should have several essential elements, which are listed in Table 44.4 and described below.

Range of Motion Activities

ROM activities restore normal flexibility and influence scar formation to prevent restrictions. Distensive forces influence collagen deposition during scarring such that fibers align in an orderly fashion (38). With adequate traction, the resultant scar will be supple and distensible and will support normal musculoskeletal function. As mentioned previously, muscles within surgical and radiation fields are of greatest concern, however, adjacent and even remote muscle groups can also develop flexibility deficits. Therefore, comprehensive ROM activities should incorporate both treated and at-risk muscle groups.

Stretching can be performed in a variety of ways, and controlled studies have yet to shed light on which techniques are most effective in breast cancer populations. Several general caveats apply:

1. ROM activities should never be pulsatile, painful, or overly aggressive.
2. Pain or swelling following ROM activities mandates revision of the program.
3. Patients should breath deeply and consciously during ROM activities to reduce sympathetic tone.
4. ROM activities should continue in an abbreviated fashion long after normal flexibility has been restored to prevent latent fascial contractures.

Active ROM activities can begin 7 days after breast cancer surgeries provided patients have not undergone breast reconstruction. In the latter case, patients should clear all physical rehabilitation activities with their plastic surgeons. Initial stretches include shoulder shrugs; shoulder retraction; wall walking; rowing motions; cervical rotation, extension, and lateral bending; and cane-based overhead stretches. Most institutions have printed sheets illustrating these activities, which are provided to patients on hospital dismissal.

Once patients' drains have been removed, a formal physical therapy evaluation will ensure that patients are performing ROM activities correctly and that their recovery is following a normal trajectory. This visit can be used to demonstrate how patients should advance their ROM activities, to educate patients in the long-term protective benefits of regular stretching, and to provide instruction in breathing techniques (e.g., breath stacking) (39). The latter will preserve intercostal muscle excursion. Patients should also be alerted to contact a health care provider if they have not recovered full, painless shoulder ROM 1 month prior to the start of radiation.

The major and minor pectoral muscles merit special attention as they are in proximity to breast surgeries, receive up to 60 Gy with conventional breast tangent beams (40), and may be affected by implant-based breast reconstruction. Pectoral

Table 44.4 ESSENTIAL ELEMENTS OF ALL COMPREHENSIVE REHABILITATION PROGRAMS FOLLOWING PRIMARY BREAST CANCER TREATMENT

Flexibility/Range of Motion Exercises	
Shoulder: Forward	flexion
	Scaption (plane of the scapula; ~20 degrees of cross-abduction)
	Abduction
	Extension at 0 degrees and 90 degrees of abduction
	Internal/external rotation
Thorax:	Abdominal muscles: rectus and obliques
	Pectoral muscles
	Intercostal muscles
Cervical spine	Lateral rotation
	Lateral bending
	Extension
Progressive Resistive/Strengthening Exercises	
Shoulder:	Scapular retractor muscles
Thorax:	Spinal extensor muscles
Cervical spine:	Spinal extensor muscles
Activities for Posture and Biomechanics	
Education	
Rationale for exercises (e.g., need for continued stretching activities)	
Precautions (e.g., lymphedema)	
Signs of complications (e.g., strain, infection, seroma)	
Tailored Home Program	
Instructions for tapering over time	
Indefinite maintenance activities as needed	
Emphasis on limited, "essential" exercises	

stretching should be a central therapeutic focus since tightness produces well-characterized, maladaptive changes in shoulder biomechanics (33). Several approaches to pectoral stretching are illustrated in Figures 44.1 through 44.3. The standing corner stretch in Figure 44.1A and 44.1B should be held for at least five deep breaths, with the patient leaning forward and allowing her body weight to gently carry her into the stretch. The abdominal muscles should be lightly engaged, tilting the pelvis forward to protect the lower back, as illustrated by the curved arrow. The positions in Figures 44.2A–D should be passively maintained for as long as 15 minutes on a firm surface. The progression from 44.2A to 44.2D illustrates increasing shoulder external rotation, which places greater traction on the pectoral muscles and intensifies the stretch. At no time should patients experience discomfort. The pectoral stretch can also be increased by placing a pillow, rolled towel, or bolster between the scapulae (Fig. 44.3), ensuring that the head is adequately supported with a pillow to avoid anterior cervical muscle strain.

Strengthening

Resistive exercises normalize focal strength deficits, ensure adequate strength for normal biomechanics, and prevent periscapular muscle strain. Strength deficits are rarely immediately apparent after surgery in the absence of long thoracic nerve injury. More commonly, evaluations for pain reveal weakness or myofascial dysfunction of the muscles that act on the scapula and upper arm. Strength deficits generally respond to incremental, isotonic resistive activities in all but the rare cases of significant axonal damage. Muscle spasm and pain must be addressed before initiating strengthening exercise. A "no pain no gain" approach simply aggravates the problem and may aversively condition the patient. Resistance can be offered by Thera-Bands (Hygenic Corp, Akron, Ohio), light weights, circuit training equipment, or even soup cans. Activities should target the scapular retractor (middle trapezius, rhomboids), scapular elevator (upper trapezius, levator scapulae), and thoracic spinal extensor muscles. The risk of inciting lymphedema mandates that resistive exercises be initiated at a low level and increased gradually with an emphasis on stamina rather than strength. Patients considered at

FIGURE 44.1. Wall stretches for pectoralis major and minor muscles should be performed with the abdominal muscles engaged to protect the low back as indicated by the arrow . Patients should allow their weight to gently carry them forward while focusing on breathing in a slow relaxed fashion. The stretch can be held for 5 to 10 breathes.

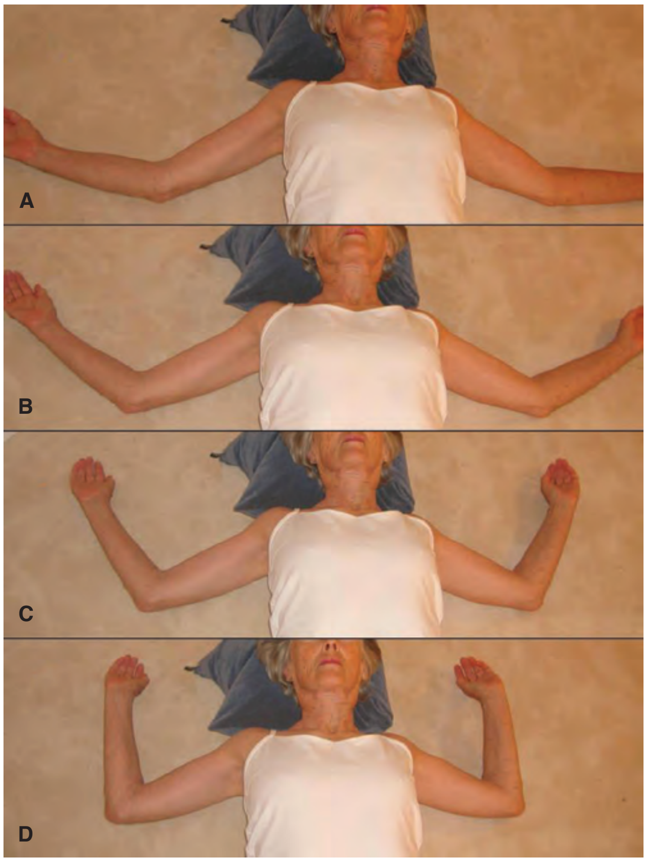

FIGURE 44.2. Sustained anterior chest wall stretch which becomes more aggressive as shoulder external rotation increases from **(A)** through **(D)**. The head should be supported to avoid strain of the anterior cervical muscles.

FIGURE 44.3. A rolled towel, pillow, or bolster can be placed between the shoulder blades to achieve greater pectoral extension. Patients should be encouraged to relax over the prop in a sustained, passive stretch.

risk of developing lymphedema should inspect their arms following sessions and consider use of a prophylactic garment (http://www.lymphnet.org/pdfDocs/nlnexercise.pdf). The choice to use a garment should be discussed and supervised by a health care professional familiar with lymphedema.

Posture

Effective postural therapy requires restoration of adequate strength and flexibility. Once this essential foundation has been laid, patients can progress to activities designed to enhance truncal alignment. In the discussion that follows, posture and alignment are used interchangeably. Postural work following breast cancer treatment strives to eliminate exaggerated thoracic kyphosis, scapular protraction, compensatory cervical lordosis, and asymmetry in the shoulder girdle. Postural work can be deceptively subtle and, although not inherently difficult, may be more challenging than ROM and strength-building activities. Most patients recognize "good" posture and can adopt it with little concentrated effort provided they have the requisite strength and flexibility. However, many patients do not maintain "good" posture once their concentration drifts, as it eventually must, to an alternate focus. When no longer deliberately maintaining "good" posture, patients lapse gradually into their default alignment.

A host of factors operating within muscles and at different levels of the peripheral and central nervous systems determine patients' default posture. Several important factors may be influenced by breast cancer treatment: muscle length–tension relationships, muscle spindle and Golgi tendon organ sensitivity, and afferent proprioceptive input. The central nervous system responds to afferent proprioceptive input with efferent output that determines muscle tone and patients' default alignment (41,42). When an individual deviates too far from her default posture, afferent input triggers subconscious, autorighting mechanisms that restore her default.

Postural therapies refine patients' default alignment to avoid secondary musculoskeletal problems, reduce stress on osseous and articular structures, and support normal biomechanics. Effective therapies spare patients future difficulties, including premature osteoarthritis, neural impingement, and rotator cuff dysfunction. Fortunately, the physiological determinants of posture respond predictably to therapies. Once flexibility and strength have been normalized, postural work begins by bringing patients passively into proper alignment. Therapists then work through active assistive techniques to teach patients selective recruitment and relaxation of discrete muscles in order to maintain proper alignment. Work is ideally performed in front of mirrors that provide visual feedback from several planes (e.g., frontal, oblique, etc.). In this way patients can begin to appreciate when they are properly aligned and self-correct when out of alignment. Therapy's ultimate goal is automatic self-correction independent of visual feedback. With due diligence, patients develop a more functional default alignment and sustain it through subconscious, autorighting mechanisms. It should be noted that many patients have poor posture when diagnosed with breast cancer, and it is not the medical profession's responsibility to eradicate poor posture. However, attention to treatment-related problems that increase patients' vulnerability to future morbidities is an integral part of comprehensive cancer care.

Biomechanics

Biomechanics can be thought of as dynamic posture, or the interrelationship of body parts as patients engage in integrated, multiplanar movements. Restoration of normal upper quadrant biomechanics represents the culmination of successful therapy. Treatments attempt to preserve the optimized static relationships achieved through postural therapies. Initially therapists provide active assistance and tactile cuing to optimize patients' performance of simple motions such as shoulder abduction. Once patients can perform these motions with proper biomechanics, they are encouraged to do so repeatedly with visual feedback from mirrors and verbal cuing. Eventually patients are taught to self-correct independent of feedback while performing increasingly complex activities in several planes.

Timing

Much research to date has examined the timing of therapies following breast cancer surgeries. Precipitous and overly aggressive mobilization is associated with seroma formation, however, delayed therapy places patients at theoretical risk of shoulder contracture (43). A robust evidence base supports the safety and efficacy of gentle postoperative shoulder, neck, and truncal mobilization provided that shoulder forward flexion and abduction are restricted to 90 degrees for the first postoperative week (15,44,45). Thereafter, stretching and strengthening activities can be advanced as tolerated in the absence of breast reconstruction with autologous tissues.

The literature provides far less guidance in the optimal type, intensity, and timing of therapy after the subacute postoperative period. Continuous physiotherapy for 3 months following surgery is beneficial (10) but difficult to justify in the current era of medical cost containment. A majority of patients remain free of long-term musculoskeletal problems after limited physical therapy visits following removal of their surgical drains (15,44,45). This low musculoskeletal complication rate may reflect the current trend toward less anatomically disruptive treatments. Patients with advanced age or lymphedema and those who undergo ALND; chest wall, or supraclavicular radiation treatments; or breast reconstruction are at up to 10 times greater risk of developing shoulder disability (2,4,10–13,31). Anecdotal experience supports more extended physical therapy for these patients, with the goals of detecting incipient problems, education in self-diagnosis and referral, and provision with long-term prophylactic ROM and strengthening programs. When feasible, coordination of physical therapy visits with radiation treatments allows patients to minimize travel and time away from life responsibilities.

POTENTIAL CONCERNS

Several clinical findings should alert physicians to the possibility that patients require additional attention and care. Lymphedema remains a concern when patients exercise, particularly if they have undergone ALND with or without axillary or supraclavicular irradiation. Patients who have undergone these treatments will generally benefit from a visit with a lymphedema therapist certified by the Lymphology Association of North America (LANA) to review precautions and formulate a safe yet effective rehabilitation program. (LANA-certified therapists can be located at http://www.clt-lana.org.)

Axillary web syndrome affects up to 72% of patients following breast cancer treatment (24). Affected patients develop palpable "cords" in their axillae (Fig. 44.4) that can extend distally as far as the wrist. These cords may or may not be painful. If painful, discomfort is triggered by shoulder abduction, which increases tension in the cords. Conjecture regarding the tissue composition of these cords persists despite a small case series that characterized resected cords as lymphatics or veins and fibrosed connective tissue (46). Longitudinal studies indicate that the cords resolve independent of treatment. However, their presence may be disturbing to patients and discourage them from performing shoulder ROM activities. Severely painful cords may warrant administration of as-needed anti-inflammatory or even opioid analgesics (20). If cords are painful or persist beyond 2 months after surgery, patients should be referred to a physical therapist familiar in treating breast cancer patients.

Added concern should always attend the rehabilitation of patients who have undergone breast reconstruction with autologous tissues. The range of harvesting and reconstruction techniques coupled with practitioner variability makes it difficult to accurately predict the locations and fragility of vascular anastomoses. Referral to a cancer rehabilitation physician specialist is advisable prior to initiating physical activity, particularly if reconstruction involved muscle tissue, as in transverse rectus abdominis or latissimus dorsi muscle flaps.

FIGURE 44.4. Axillary web syndrome or "cording."

INTEGRATED EXERCISE APPROACHES

An ever-expanding array of fitness approaches is available to breast cancer survivors at health clubs and, increasingly, cancer centers. Some approaches such as Feldenkrais movement therapy are long-established traditions utilized routinely by physical therapists (47). Other approaches have only become widely available within the past decade. To name but a few, patients may encounter Pilates, yoga, Alexander technique, Mensendieck exercise therapy, and tai chi. Each approach has unique emphases and most will benefit breast cancer survivors beyond enhancing general fitness and body awareness. For example, the Alexander technique focuses on craniocervical alignment, a critical dimension of postural therapy (47). Patients should be encouraged to explore different approaches with several caveats. First, most fitness instructors are unaware of lymphedema precautions, hence patients must function as their own self-advocates to protect against inadvertent lymphatic overload. Second, breast cancer patients' fitness regimens should include pectoral muscle stretching, strengthening of scapular retractors, and postural exercises, as discussed above. If an integrated exercise approach does not include these elements, patients will need to independently supplement with guidance from a health professional.

A number of exercise regimens have been tailored to breast cancer survivors and marketed through video classes, books, and weekend workshops. Table 44.5 lists several available resources. The developers of such approaches may or may not have formal clinical training and familiarity with the unique physical vulnerabilities associated with breast cancer treatment. No empiric data support the efficacy or safety of these tailored approaches. In the authors' opinion, the worth of such media derives from patients' enhanced comfort levels and enthusiasm.

Table 44.5 PATIENT-ORIENTED BREAST CANCER–SPECIFIC EXERCISE RESOURCES

Medium	Author (Reference)	Title	Publisher	Year
Book	Kaelin (53)	The Breast Cancer Survivor's Fitness Plan	McGraw-Hill	2007
Compact disc	Cowden and Poppenberg (59)	Strength and Courage: Exercises for Breast Cancer Survivors	University of Pittsburgh Medical Center	2007
Book	Stumm (54)	Recovering from Breast Surgery: Exercises to Strengthen Your Body and Relieve Pain	Hunter House Inc.	1995
Book	Lebed Davis et al. (55)	Thriving After Breast Cancer: Essential Healing Exercises for Body and Mind	Broadway Books	2002
Book	Halverstadt and Leonard (56)	Essential Exercises for Breast Cancer Survivors	Harvard Common Press	2000
Book	Essert (57)	Breast Cancer WaterWork: Management Through Aquatic Exercise and Rehab Techniques	ECS Printing	2004

If patients feel more confident with breast cancer–oriented fitness materials, then they are unquestionably worthwhile.

CONCLUSIONS

Musculoskeletal problems involving the shoulder and upper truncal quadrant are common following primary breast cancer treatment, associated with disability, and a source of reduced health-related quality of life. A majority of patients recover normal strength and ROM after transient postoperative deficits resolve, however, a significant proportion develop chronic problems. Modified radical mastectomy, ALND, breast reconstruction, and axillary or supraclavicular irradiation increase the likelihood of chronicity.

All breast cancer patients should receive formal instruction in gentle progressive shoulder and arm ROM following surgery. Forward flexion and abduction should be restricted to 90 degrees until the seventh postoperative day and increased as tolerated thereafter. Patients at increased risk of long-term musculoskeletal problems should receive additional physical therapy with the goal of prevention and education in long-term risk reduction and self-advocacy. Irrespective of risk, all exercise programs should include several essential elements, including anterior chest wall stretching, strengthening of scapular retractor muscles, as well as activities to foster optimal posture and biomechanics. Patients treated with radiation therapy should indefinitely continue a limited ROM program targeting the anterior chest wall and shoulder muscles.

Empiric evidence suggests that musculoskeletal problems can be prevented with routine rehabilitative interventions after primary breast cancer treatment. Simple stretching, strengthening, and postural activities have the capacity to improve breast cancer survivors' health-related quality of life and represent an integral part of comprehensive care.

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