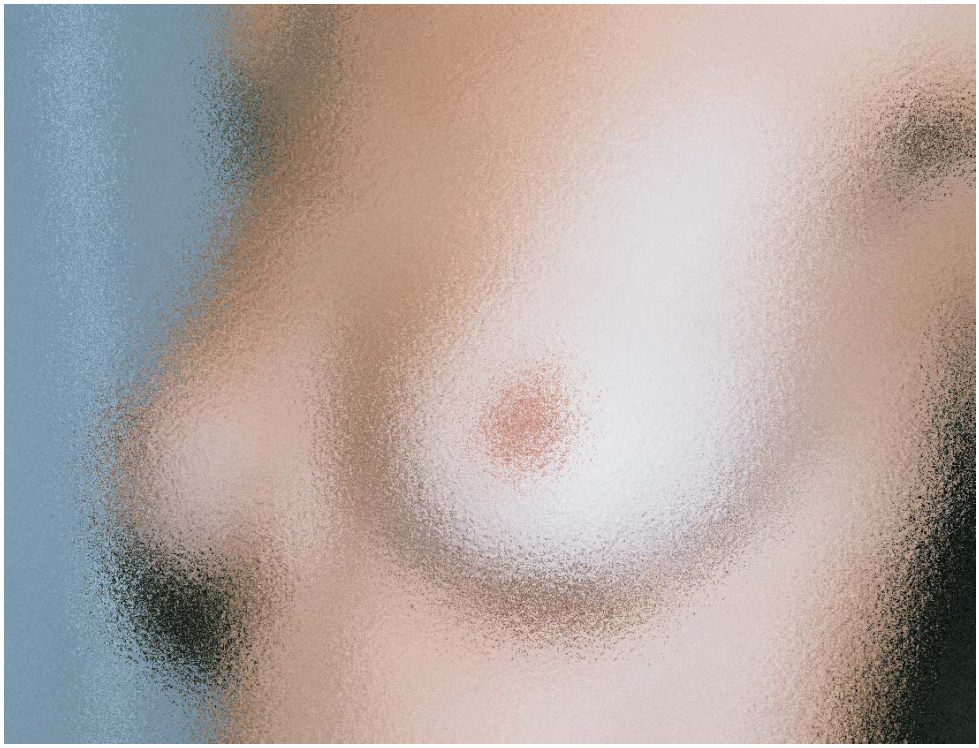
JYVÄSKYLÄ STUDIES IN SPORT, PHYSICAL EDUCATION AND HEALTH
108

Anne Kärki

Physiotherapy for the Functioning of Breast Cancer Patients

Studies of the Effectiveness of Physiotherapy Methods and Exercise, of the Content and Timing of Postoperative Education and of the Experienced Functioning and Disability



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ABSTRACT

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These studies were undertaken to create a broader understanding of the effectiveness of physiotherapy methods and exercise, and to evaluate the requirements, content and timing of physiotherapy services after breast cancer surgery.

The first study, critical review and meta-analysis, showed that with shoulder movements after breast cancer surgery the whole range of motion movements should be delayed for several days. The review indicates that methods of lymphedema therapy are various, but only some have scientific support for their effectiveness. The use of an elastic sleeve is supported by the studies. Lymph massage alone has not been studied, and the effect of exercise on the prevention and treatment of lymphedema is still unclear. Exercise therapy had some positive effects on the functioning of breast cancer patients. Aerobic exercise was safe, had a positive effect on quality of life, decreased fatigue and increased well-being.

In the second cross-sectional study, it was found that the post-operative education of breast cancer patients was limited and even conflicting. Some patients are educated to use their upper limb as before operation and some are warned to place no load on it. For almost half of the patients the hospital period was the only time they were informed of this matter. The third, follow-up, study showed that breast cancer patients experience numerous impairments after surgery, most of them remaining constant one year post-operatively. Numerous activity limitations and participation restrictions were also reported. In the fourth study, a randomized clinical trial, individually adjusted therapeutic exercise had various positive effects on the upper body and limb structures and functions, on the experienced impairments, activity limitations and participation restrictions.

Key words: shoulder exercise, exercise therapy, lymphedema therapy, aerobic exercise, post-operative education, strength training

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II Kärki Anne, Simonen Riitta, Mälkiä Esko, Selfe James 2004. Postoperative education concerning the use of the upper limb, and exercise and treatment of the upper limb: cross-sectional survey of 105 breast cancer patients. Supportive Care in Cancer 12, 347-354.

III Kärki Anne, Simonen Riitta, Mälkiä Esko Selfe James 2005. Impairments, activity limitations and participation restrictions 6 and 12 months after breast cancer operation. Journal of Rehabilitation Medicine 37, 180-188.

IV Kärki Anne, Simonen Riitta, Mälkiä Esko, Selfe James 2005. The effect of therapeutic exercise on the upper limb functioning and experienced disabilities of breast cancer patients: a one-year randomized controlled trial. Submitted for publication.

ABBREVIATIONS

1 RM	one repetition maximum
ACSM	American College of Sports Medicine
ADL	activity of daily living
BMI	body mass index
BRS	Behavioural Rating Scales
BSO	breast saving operation
CI	confidence interval
CMF	cyclophosphamide, methotrexate, 5-fluorouracil
d-index	effect size index
DLT	decongestive lymphatic therapy
ICC	Intraclass Correlation Coefficent
ICF	the International Classification of Functioning, Disability and Health
MET	Metabolic Equivalent
MLD	manual lymphatic drainage
MRM	modified radical mastectomy
QOL	quality of life
RBP	radiation-induced brachial plexopathy
ROM	range of motion
SDQ	Shoulder Disability Questionnaire
SF-MPQ	Short Form McGill Pain Questionnaire
SNB	sentinel node biopsy
VAS	visual analogue scale
WHO	World Health Organization

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1 INTRODUCTION

Breast cancer is the most common cancer among women in the world (Lacey et al. 2002). In Finland the mean annual number of new breast cancer cases in 2002 was 3774 (Finnish Cancer Registry 2004). The number of new cases has increased continuously in Finland and also in other developed countries. In a ten-year period (1991-2002) the increase in Finland was 10.2% in the mean annual number of new cases (Finnish Cancer Registry 2004). The prognosis of breast cancer has greatly improved during recent decades because of advances in early detection and treatment. For example, breast cancer has a 20-year relative survival rate of 65% in the USA (Brenner 2002) and a 5-year relative survival rate of 84% in Finland (Sankila 2002). Those five-year relative survival rates are dependent on breast cancer stages, being 93% for patients with localised disease, 69% with localised metastasis and 22% for distal metastasis (Teppo et al. 1999).

Breast cancer affects all age groups of women over 25 years of age in Finland, and risk increases with age. Most of the new cases are found at the 50-55 years of age. (Institute for Statistical and Epidemiological Cancer Research 2004) Four percent of Finnish women will develop breast cancer before retirement age, and every 10th women will have breast cancer over their whole lifetime (Pukkala et al. 1997). Some women with breast cancer are therefore in their early working life and some already older; this sets demands for the rehabilitation programmes planned and carried out for patients of various ages. In the primary treatment period of cancer the aim is a short hospital stay, which concerns particularly older patients. While the time in hospital is reduced compared to the 1990's, the whole postoperative rehabilitation, as well as postoperative treatment of breast cancer patients, is undergoing change.

Physiotherapy is part of rehabilitation during the hospital period, particularly in the immediate postoperative phase. Patients are instructed how to use the upper limb and how to protect it against factors that could cause acute infection and add the risk of lymphedema. Patients are assumed to be able to carry out the instructions thereafter. Some of the patients get more instructions in adaptation courses, some are referred to physiotherapy if postoperative complications occur. Unfortunately, follow-up protocols in Finland have not necessarily included assessment of upper body and limb

impairments, activity limitations and participation restrictions for the evaluation of the possible individual rehabilitation needs of the patient.

Physical activity seems to be useful in the rehabilitation process for cancer patient. However, it is still unclear what the most effective dose for each patient would be that would support functioning and prevent disability. Based on population studies it seems evident that high physical activity, that includes both total occupational and household activity, can cause postmenopausal risk reduction in breast cancer incidence (Friedenreich et al. 2001A, Friedenreich et al. 2001B), but the possible benefits of physical activity in second cancers are still open question (Brown et al. 2003). According to a recent epidemiological study in Finland (Rintala 2003), aerobic physical activity when used for diminishing the risk of breast cancer should be regular, occurring several times per week, lasting at least 30 minutes per exercise bout, and the intensity of the activity should be at least moderate.

Suggestions for breast cancer patients' exercise programmes and physical activity as well as recommendations for immediate post-surgical physiotherapy and thereafter for treatments of late impairments are conflicting and lacking evidence. Some of the exercise and physical activity suggestions for cancer patients are given by ACMS (American College of Sports Medicine). According to their recommendation exercise for strength should be done in 50% of one repetition maximum (1RM), and stretching should be carried out 5-7 days per week (Schwartz 2003). Brown et al. (2003), however, states in An American Cancer Society Guide that the suitable exercise level has not been studied or tested in cancer survivors.

A systematic review of randomised controlled breast cancer trials between 1991 and 2000 by Brockow et al. (2004) showed that functional concepts related to breast cancer patients' activities or life situations have been less frequently studied than the most commonly used structural, physiological and psychological concepts. Also items describing external conditions have been poorly addressed, for example, support by immediate family members, friends and health professionals.

In the first study of the present thesis, a critical analysis and meta-analysis of the existing knowledge of physiotherapy methods and exercise after breast cancer operation was carried out. The aim of the second study was to examine post-operative education concerning the use of the upper body and limb, the prevention and treatment of upper limb lymphedema, exercise of the upper body and limb. The third study examined the impairments of upper body and limb, activity limitations and participation restrictions for better understanding the needs of rehabilitation and physiotherapy. The International Classification of Functioning, Disability and Health (ICF) (World Health Organization 2001) was used as a frame. Finally, in the fourth study, intensive strength training was examined for ascertaining a safe and effective level of exercising the upper limb and body. Understanding breast cancer patients' needs and health demands is crucial for more effective planning of education and postoperative physiotherapy of breast cancer patients.

2 REVIEW OF THE LITERATURE

2.1 Primary treatment of breast cancer

The primary treatment of breast cancer is based on the clinical extent and pathological state of the tumor, the age of the patient, biological prognostic factors, other diseases of the patient, as well as the desires and psychological state of the patient (Tasmuth 1997). The treatment of breast cancer in Finland has been based on various treatment recommendations since 1992, the latest being published in 2002. Surgery of breast cancer should be breast conserving, when ever it is possible. Radiotherapy after surgery significantly decreases the local recurrence of breast cancer and is therefore suggested after breast conserving surgery. Also after radical breast surgery radiotherapy is recommended with certain prerequisites. Adjuvant therapy is carried out primarily by using an antracyclin cellblockers combination, especially with postmenopausal patients a CMF (cyclophosphamide, methotrexate, 5-fluorouracil) combination can also be used. (Suomen Rintasyöpäryhmä ry 2002.) In a certain hormone receptor positive tumor cases tamoxifen or anastrozole is suggested for five years (ATAC Trialists' Group 2005). The treatment of metastatic breast cancer is palliative, but with medication the quality of life can be increased, lengthening disease-free average lifespan (Suomen Rintasyöpäryhmä ry 2002).

Axillary surgery concerns level I (about 13 nodes), level II (five nodes) and level III (two nodes) (Bundred et al. 1994). Level I and II nodes are usually removed both in breast saving operation (BSO) and modified radical mastectomy (MRM). Sentinel node biopsy (SNB) has been gradually replacing the routine axillary surgery. In SNB the first draining lymph node, called the sentinel lymph node, is removed during surgery, and the pathology results determine the necessity of axillary surgery (Haid et al. 2002, Swenson et al. 2002, Rönkä et al. 2005).

2.2 Rehabilitation after breast cancer operation

Cancer patients need specific rehabilitation programmes as do other patients groups (Wikström & Holli, 1999). Even though the need for such programmes has been shown by numerous studies concerning the rehabilitation needs of cancer patients, these programmes do not exist in Finland. In Finland we do, however, have an effective follow-up protocol as agreed in the treatment recommendations (Suomen Rintasyöpäryhmä ry 2002). Instead of regular systematic follow-ups, follow-ups are based on treatment needs assessed by oncologists or the patient's own family doctor (Finnish Cancer Association/ Suomen Syöpäyhdistys 2004). In the treatment recommendations, the first follow-up should be implemented one to three months after primary treatment. It should also include clinical examination of upper limb functioning, and could therefore also involve other health professionals than the oncologist. In no part of the treatment recommendations further mention of wider assessment of rehabilitation needs and planning for individual rehabilitation could be identified. Rehabilitation is suggested to include psychological support, external breast prosthesis and wig, dental care, physiotherapy methods, physical activity and adaptation courses. Unfortunately, the treatment recommendations lack assessment of individual rehabilitation needs and planning of rehabilitation.

Before hospitalisation, when the operation is confirmed, the patient gets the name of a support person from a local cancer organisation, and she can contact this person whenever she wishes. Rehabilitation starts when the patient enters the hospital for the breast cancer operation and includes, for example in Finland, getting information about life after surgery, help to handle therapy-induced problems and getting psychosocial support. Physiotherapy and social support, as a part of rehabilitation, should start immediately on the patient's arrival day at the hospital. After primary treatment, participation in an adaptation course is based on the patient's needs and there are numerous official courses offered. The main aim of the adaptation courses is to enhance the psychosocial rehabilitation of the patient and to facilitate the coping skills of the patient and relatives. (Rautalahti 2000, Suomen Syöpäjärjestö 2001, Finnish Cancer Association 2004.) Adaptation courses are available for up to 2 years after surgery. At the same time local cancer organisations offer different group activities that may be targeted only for breast cancer patients or for patients with all types of cancer. (Holsti et al. 1992, Vertio 1994, Kautoniemi, Kärki 1995.)

Advances in the treatment of breast cancer have improved survival rates and now patients are living longer with the physical impairments caused by the disease or the treatments. These physical impairments might lead to functional limitations and restrictions, but we still lack knowledge of this stage. This knowledge would be great value in evaluating rehabilitation needs.

Along with the improved survival rates, the quality of life in patients who have been cured of their cancer has become an important issue. The long-term goal of rehabilitation is to return the person to work, domestic activities and

social interaction with as few physical deficits as possible. To achieve this, intervention should occur as soon as the likehood of disability is anticipated.

2.3 Timing and content of the post-operative education

In the recent review by Finney Rutten et al. (2004) it was stated that in order to ensure the quality of cancer care, professionals have to understand what patients need to know and when during the cancer journey. It is also relevant to know from whom the patients should receive the information. The review showed that during the diagnosis and treatment phase cancer patients were primarily interested in finding out their diagnosis and the stage of disease, exploring their treatment options and understanding the side effects of those options. After the operation patients needed information about the surgery, adjuvant therapy and radiotherapy they had and their side effects and the need for information about rehabilitation was also prominent. (Finney Rutten et al. 2004.)

Breast cancer patients have similar information needs as cancer patients overall (Loveys & Klaich 1991, Rees & Bath 2001). The studies of information given and received have shown that patients and health professionals have differing opinions of both the amount and content of the information (Suominen T 1992, Suominen & Laippala 1993, Suominen et al. 1994). The studies have shown that patients were not able to remember given information (Tierney et al. 1992), and that quite many patients experienced that they had not had enough information (Backman & Westman 2001). Experience of cancer is said to be so overwhelming that patients are unable to remember or fully understand the information given at the state of cancer diagnosis and operation (Laverey & Clarke 1996, Backman & Westman 2001). Lerman et al. (1993) showed that 84% of the patients in their study had difficulties communicating with their medical team. Although information and explanations were offered, the patients had difficulties in comprehension.

Support from family, friends and health care professionals has been shown to help breast cancer patients in successful adjustment to their illness and the empowerment process (Royak-Schaler 1991, Mok 2001). Multidisciplinary care-protocols may also create gaps in the continuity of information, when mutual understanding and co-operation between different professionals is insufficient (Van Wersch et al. 1997).

The need for rehabilitation information among breast cancer patients has also been shown by Boman et al. (1997), particularly concerning post-operative exercise, how much to lift and work with the operated arm side. Courneya & Friendenreich (1999) indicated in their survey that physicians might have an important influence on breast cancer patients' exercise behaviour during cancer treatment.

2.4 Post-treatment impairments of upper body and limb, activity limitations and participation restrictions

The key interest of rehabilitation should be patients' short recovery times and the best possible functioning after breast cancer surgery. Most of the studies in breast cancer rehabilitation have concerned impairments, although there has been a gradual shift of interest towards broader understanding of all components of health (Figure 1), introduced by the World Health Organization (2001). Based on the systematic review concerning 640 randomised controlled trials published during 1991-2000, Brockow et al. (2004) concluded that functional and environmental aspects were poorly addressed in breast cancer rehabilitation outcome measurements.

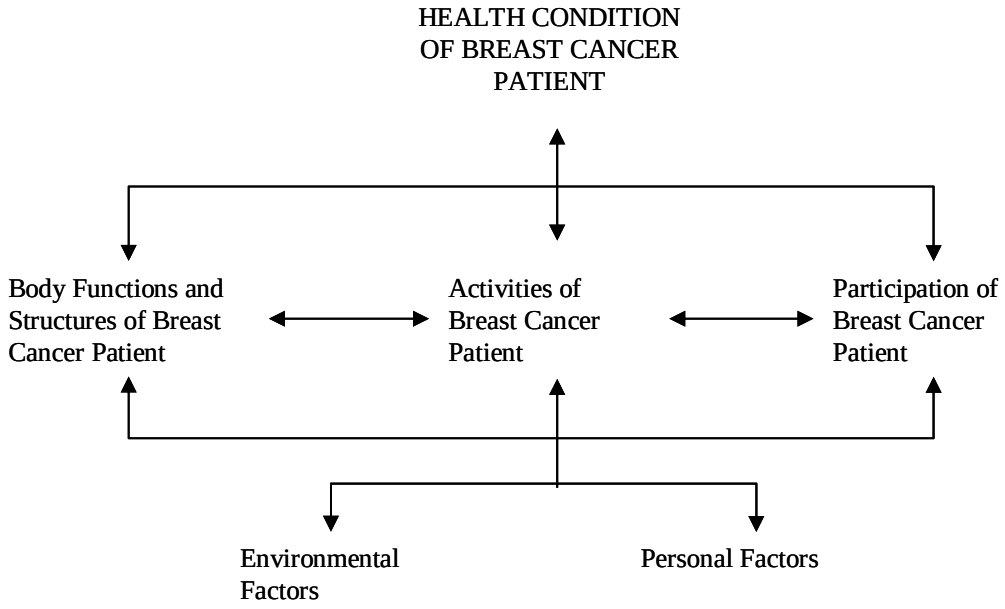

FIGURE 1 Functioning of the breast cancer patient in the frame of the components of the International Classification of Functioning, Disability and Health (ICF).

Upper limb edema, decreased shoulder mobility, neural tissue injuries causing sensory and motor dysfunction, and pain of the upper body and limb are common post-treatment impairments. Both radiotherapy and surgery have been shown to be associated with a range of long-term treatment-related morbidities (Gossenlink et al. 2003, Rietman et al. 2004).

Lymphedema of the upper limb is one of the most common impairments. The edema can develop as a result of the interruption of lymphatic flow. The possible reasons for interruption can be the surgery itself, radiotherapy and possible infection (Loudon & Petrek 2000). Extensive surgical dissection of the axillary nodes creates a twofold problem: loss of nodes to circulate lymph fluid and a decreased ability to fight infection. The operation can result in scarring,

which promotes adhesions and close down lymphatic channels. Radiation-induced fibrotic tissue becomes thickened and invasive, shutting down the channels. Infection is, however, the most significant and most frequent cause of edema. When the lymphatic system is incompetent, obstructed or surgically obliterated, proteins and their products accumulate in the tissue space. The tissue has abnormally large quantities of fluid in the intercellular space. If this process continues, collagen tissue tends to be deposited in this protein-rich fluid leading to fibrosis. These patients will be at risk of sarcoma (soft tissue cancer). The best means of avoiding this are the prevention of edema, the regular monitoring of constituted lymphedemas, and the hygienic and preventive behaviours of infections. (Adcock 1990, Holleb et al. 1991, Schunemann & Willich 1992, Dennis 1993, Peyron et al. 1993.)

The incidence of lymphedema can vary from 6% to 30% after breast cancer treatment (Loudon & Petrek 2000). There seems to be a higher risk for developing lymphedema with advanced disease at diagnosis, older age, greater body mass index (BMI) and longer follow-up (Kocak & Overgaard 2000). In addition, the risk has been shown to increase with radiotherapy (Isaksson & Feuk 2000, Johansen et al. 2000). Mastectomy (MRM) patients have more edema than patients with a breast saving operation (BSO) (Tasmuth 1997, Rowland et al. 2000, Deutsch & Flickinger 2001).

Most of the studies concerning post-operative incidence of **impaired shoulder movements** show an increase in range of motion during the follow-up (Tasmuth 1997, Isaksson & Feuk 2000, Duff et al. 2001). The incidence of impaired shoulder movements vary from 1.5% to as high as 50% (Tasmuth 1997, Kakuda et al. 1999, Isaksson & Feuk 2000, Kuehn et al. 2000, Tengrup et al. 2000, Deutsch & Flickinger 2001). Bentzen & Dische (2000) listed predisposing factors to radiotherapy-related impaired shoulder movements: older age, non-participation in physical exercise programmes, and subcutaneous fibrosis. Impaired shoulder movements are also more common after mastectomy than after a breast saving operation (Sudgen et al. 1998, Rowland et al. 2000, Gossenlink et al. 2003). Radiotherapy and chemotherapy may increase the risk for impaired shoulder movements (Rietman et al. 2004). In one longitudinal study done in Sweden decreased mobility was very common, and the internal rotation was most influenced by the breast cancer treatment at the 2-year follow-up (Johansson et al. 2001).

Breast cancer patients can experience **neuropathic changes** and many women have developed a **brachial plexus injury** after breast cancer treatment (Adcock 1990, Olsen et al. 1993). Radiation-induced brachial plexopathy (RBP) is also more frequent in patients receiving chemotherapy and in younger patients (Olsen et al. 1993). Nerve tissue is highly radioresistant, but vascular tissue is vulnerable. At the macroscopic level, constricting bands of fibrous tissue around the brachial plexus can be seen. Microscopically there is focal demyelination with fibrosis of the nerve sheaths and fibers, with obliteration and hyalinization of the small vessels. These radiation-induced changes are delayed (months to years). (Zeidman et al. 1993.) Entrapments of the nerves

can, however, also occur as a result of edema (Adcock 1990). Postsurgical patients experience short-term superficial sensory loss and radiating pain, though symptoms subside over time. Patients can have long-term changes because of plexopathy, experiencing paraesthesia, hypaesthesia, weakness, trophic changes and pain. Of these impairments, paraesthesia and hypaesthesia are most frequent and earliest in onset, followed by weakness, decreased muscle stretch reflexes and pain. The motor and sensory impairments of the arm and hand may be sufficient to render the limb functionless. (Adcock 1990, Olsen et al. 1993, Brennan 1995.)

Incidence of **muscle weakness** of the upper limb has varied from 18 to 23% after breast cancer treatment (Kakuda et al. 1999, Johansen et al. 2000, Kuehn et al. 2000). Thirteen percent of the patients have experienced weakness even two years after the operation (Isaksson & Feuk 2000). Progression of the weakness has also been seen and this can lead to loss of hand function. For example, grip strength reduction has been measured from 40% of breast cancer patients about three years after treatment (Rietman et al. 2004).

Long-lasting post surgery **pain** has not been a particular interest of the rehabilitation, until recently. In the review by Rietman et al. (2003), the prevalence of pain ranged from 12 to 51% among breast cancer patients. Even one third of the patients have experienced some pain in the arm as long as five years after operation (Tengrup et al.2000). The arm pain is more due to damage of the intercostobrachial nerve or/and brachial plexus (Tasmuth &Kalso 2003). Tasmuth et al. (1999) found that chronic pain correlated significantly with other post-treatment impairments such as edema, parasthesia, strange sensations, and phantom pain. Pain described with values more than 50 mm on the visual analogue scale influenced daily activities severely. Lower values (30-50 mm) had only a moderate effect. (Tengrup et al. 2000.) Most commonly the patients have described their pain as shooting (Stevens et al. 1995, Kwekkeboom 1996, Tasmuth 1997).

The incidence of numbness, the most common **sensory disturbance**, varies from 29% to 81% among breast cancer patients after the operation (Maunsell et al. 1993, Polinsky 1994, Baron et al. 2000, Isaksson & Feuk 2000, Rowland et al. 2000, Bosompra et al. 2002). The incidence of objectively measured numbness decreased very little in one year, from 85% to 81% in a MRM group and from 82% to 80% in a BSO group (Tasmuth 1997).

Phantom breast pain occurs in 15-30% of patients. Pain starts in the region of the nipple and spreads to the entire breast. Pain may be continuous or paroxysmal and can be associated with paraesthesia. (Cherny & Portenoy 1994) Studies of this pain and pain incidence have been published but there are no therapy interventions in this area (Kwekkeboom 1996).

Breast cancer patients following sentinel node biopsy (SNB) have fever impairments in body functioning and structure than patients with complete axillary dissection (Haid et al. 2002, Swenson et al. 2002, Rönkä et al. 2005). However, tenderness, soreness, tightness, and numbness still appear to be severe and distressing symptoms (Baron et al. 2002).

The possible impairments in breast cancer patients' functions and structures of the upper limb and body are well defined. Contrary to the impairments, little is known of about **activity limitations and participation restrictions**. In the systematic review by Rietman et al. (2003) only limited number of studies, published over the last 20 years, were found, which investigated late morbidity of the upper limb in relation to daily activities and quality of life. Rietman et al. (2004) showed in a longitudinal study, that pain had a strong relationship to perceived disability and health related quality of life almost three years after treatment. In their study pain, forward flexion, external rotation and age explained 73% of the variance in the Shoulder Disability Questionnaire. This study lacked baseline assessment and had a relatively small study sample, therefore limiting further conclusions. It is still also unclear how the operation type affects activity limitations and participation restrictions. Gosselink et al. (2003) reported that MRM patients experienced greater functional limitations, concerning the ADL (activity of daily living) of the upper limb than BSO patients.

Pain-related disability has been reported in a number of studies (Maunsell et al. 1993, Tasmuth et al. 1999, Haid et al. 2002). However, the level of functioning has not been assessed systematically in these studies. Patients with arm swelling can experience considerable activity limitations in home and work environments (Segestrom et al. 1992, Maunsell et al. 1993, Tobin et al. 1993, Woods et al. 1995, Tasmuth et al. 1999, Kwan et al. 2002). Swelling can also cause participation restrictions for breast cancer patients (Woods et al. 1995). Some studies have also shown that limited shoulder movements and numbness seem to increase self-assessed activity limitation (Segestrom et al. 1992, Polinsky 1994). Lash & Sillman (2000) concluded in their study that upper-body dysfunction can affect breast cancer patients sooner or later after operation. They suggested that upper-body function should be followed and appropriate intervention planned for at least 2 years (Lash & Sillman 2000). Use of SNB seems to have less negative interference with daily life than more extensive axillary treatment (Haid et al. 2002, Rönkä et al. 2005).

2.5 Efficacy of physiotherapy methods and exercise after breast cancer surgery

In the immediate post-surgical stage, patients are instructed on how to use the upper limb and how to avoid acute infection and edema or the risks of chronic lymphedema (Adcock 1990). The instructions on the use of the upper limb and the exercises of the arm do, however, have little scientific support because of the lack of research in this area. Some research has been done concerning physical activity with cancer patients, the effect of moderate exercise training in cancer patients and physical activity habits of breast cancer patients. Physical activity seems to be an important part of the rehabilitation process for cancer patients.

(Hicks 1990, Pfalzer 1995, Solli & Søresen 1995.) However, the problem with most patients appears to be insecurity about what the body can tolerate after treatment. Peters et al. (1994) showed that moderate exercise had an effect on the amount of natural killer (NK) cells, the amount increased after five weeks and also after six months submaximal training (60% of the maximum). NK-cells have an important role in the defence against tumor cells (Peters et al. 1994).

Stretching improves ROM and joint function, increases tendon flexibility and also enhances muscular performance (American College of Sports Medicine 1998). Breast cancer patients are tutored that it is particularly important for those patients who have had radiotherapy to commit to a life-long mobility training of the upper body and limb (Hick 1990, Pfalzer 1995). How much and how often training should be done has still to be determined.

A pre-experimental study (Kärki & Kautoniemi 1999) of the effects of intensive therapeutic exercise (upper limb ROM exercise, stretching, strength training) on upper limb function and on the experienced symptoms of the patients showed that the experimental group had positive results concerning range of motion, strength, functional movements of the shoulder and using the upper limb when jumping. One of the most important findings was that with intensive training the edema of the operated upper limb decreased rather than increased. In this study the muscle strength training intensity was individually adjusted, and participants trained initially at submaximal levels (50-60%) and then the load was increased up to 65-70% of maximum. Since the group sizes were small more research is needed to confirm these results. (Kärki & Kautoniemi 1999.)

Two case studies of breast cancer patients showed that no new cases of lymphedema were developed during (McKenzie & Kalda 2003) and five months after (Harris & Niesen-Vertommen 2000) a progressive exercise training.

A critical review by Megens & Harris (1998) analyzed the quality of studies concerning physical therapist management of lymphedema using the rules of evidence developed by Sackett (1989). The authors' recommended the use of compression garments, combined techniques, modified complex physical therapy and microwave therapy together with compression garments. They, however, stated that these recommendations were not supported by numerous and definitive studies. Brennan & Miller (1998) also pointed out in their review of available literature from the period 1982-1996 that the evidence supporting many of the forms of lymphedema treatment was insufficient and they suggested that a multidimensional approach should form the core program for controlling the swelling. The program should include garments, massage, exercise, and use of compression pressure pumps.

The possible effect of exercise on breast cancer patients' axillary lymphatics is a matter of interest for preventing lymphedema and treating lymphedema after breast cancer treatment. Adult lymphatics can regenerate by sprouting from pre-existing lymphatic vessels (Lymboussaki et al. 2000, Alitalo & Carmeliet 2002). This regeneration process may be facilitated by factors than

are known to be normal contributors of tissue healing e.g. sufficient nutrition by repetitive movements of the upper limb. Mechanical loading as a stimulus for adaptation is commonly accepted. Exercise related stress on tissues include tensile stress that results from stretch or increased resistance, pressure or compressive forces. (Baar et al. 1999.)

Pinto & Maruyama (1999) reviewed the literature on the role of exercise in the rehabilitation of breast cancer survivors and reported that study design and small sample sizes limited strong conclusions on the mood benefits of exercise. However, their review suggested that exercise can contribute to improved mood, reduced anxiety and depression. Exercise may prevent weight gain during cancer treatment and cause reduction in fatigue; it may also be useful in alleviating menopausal symptoms in breast cancer survivors who experience early menopause. Exercise may also prevent osteoporosis and reduce the risk of other chronic disease among survivors. The review indicated that the studies included were fairly heterogeneous in their focus of interest and they could only provide some evidence of benefits. The review showed that it is safe for breast cancer patients to exercise, but what type of exercise is the most effective for individuals with specific problems is far from clear.

Brown et al. (2003) stated in their original article that no studies have examined the effects of exercise on cancer recurrence or overall survival after cancer treatment. It seems evident that an increased exercise level is related to the primary prevention of some cancers, and physical activity can therefore be beneficial for cancer survivors in the prevention of a second cancer.

The increase in weight after diagnosis and treatment of breast cancer is an important predictor of breast cancer death in early stage disease (Enger et al. 2004). Some recommendations (Brown et al. 2003) suggest that patients, who were sedentary before diagnosis, should carry out low-intensity activities such as stretching and short, slow walks and gradually increase the intensity level. The level of activity has not been studied or tested in cancer survivors. Brown et al. (2001) point out that an extremely high level of exercise might increase risk for infection.

2.6 Current recommendations for physiotherapy, other therapies and physical activity

The current recommendation of the Finnish Breast Cancer Group (Suomen Rintasyöpäryhmä 2002) for physiotherapy, other therapies and physical activity are based on the studies of Le Vu et al. (1997), Schultz et al. (1998) and Pinto & Maruyama (1999). Immediate post-operative massage and shoulder range of motion exercises increased shoulder mobility (Le Vu et al. 1997) during the hospital stay (7 days), but no differences were seen in 8-24 months follow-ups between treatment and no-treatment groups. In the pre-experimental study of Schultz et al. (1998) the pre-post test design showed that physical activity

increased both the physical fitness and psychological welbeing of breast cancer patients. Pinto & Maruyama (1999) concluded in their review of the effects of physical activity that physical activity has positive effects both on physical and psychological health, but not what and how much should be recommended. The recommendations of the Finnish Breast Cancer Group are as follows:

1 Massage and exercise therapy immediately after the operation increase shoulder mobility (Le Vu et al. 1997)

2 Lymphatic therapy or lymph massage gives subjective relief in the case of lymphedema of the operated side (no references)

3 Notable lymphedema can be relieved by an elastic sleeve (no references)

4 Physical activity helps breast cancer patients both physically and mentally (Schultz et al. 1998, Pinto & Maruyama 1999)

None of the three studies concern therapeutic exercise or systematic strength training after breast cancer surgery, or reviews all the therapy modalities used for treatment of various impairments, activity limitations or participation restrictions.

Practice guidelines by The American Cancer Society on physical activity during and after cancer treatment recommend that cancer patients receiving radiation therapy or chemotherapy should alter their program or begin exercise at a low intensity, and progress slowly. Patients who have exercised before diagnosis should keep on maintaining their activity. If the disease or treatment requires long bed rest periods, physical therapy is recommended for these patients. Guidelines for living after recovery from treatment point out that one should adopt a physically active life style. The suggested exercise level is at least moderate activity for at least 30 minutes on five or more days of the week. On the other hand, 45 minutes or more of moderate to vigorous activity on five or more days per week may further enhance reduction in the risk for breast cancer. (American Family Physician 2004.)

The existing recommendations for therapeutic exercise in Finland and in USA are somewhat vague and therefore it is important to discover how the already existing evidence of the effective levels of activity is applicable to breast cancer patients. In the recommendations for healthy adults by the American College of Sports Medicine ACSM (1998) of Quantity and Quality of Exercise for Muscular Fitness and Flexibility it is suggested that resistance training should be progressive, individualized and provide a stimulus for major muscle groups: 1 set; 8-12 repetitions for 2-3 days per a week. For more frail persons of 50-60 years of age and above 10-15 repetitions would be more appropriate. In ACSM (2000) more recent guidelines, 2 days per week and 1 set; 8-15 repetitions is recommended for strength training. Stretching for ROM should be performed a minimum of 2-3 days per week (ACSM 1998, 2000). Muscle strength is best developed by using heavier weights (maximum or near maximum tension) with few repetitions and muscle endurance is best developed by using lighter

weights with a greater number of reps. In both strength and endurance 8-12 reps/set but for heavier weights 6-8 reps/set may better optimize strength and power, and for 50-60 year of age or more low-or moderate RM, 10-15 reps/set is recommended. (ACSM 1998.)

3 AIMS OF THE STUDY

The general aim of this thesis was, by using different research methods, to create a broader understanding of the effectiveness of physiotherapy methods and exercise, as well as evaluate the requirements, content and timing of physiotherapy services after breast cancer surgery. This series of studies also aimed to create a useful follow-up protocol for assessing the functioning of the upper limb and body (Figure 2). The specific aims of this thesis were to:

1. Evaluate the effects of different therapy methods on the upper limb edema of breast cancer patients, early vs. delayed onset of shoulder exercise after breast cancer operation, exercise therapy and aerobic exercise among breast cancer patients by a systematic review (I).

2. Describe the amount and content of the postoperative education of breast cancer patients concerning the use of upper limb, exercise (shoulder movements, strength training), edema prevention and treatment (II). This second study also describes patients' view on who were the advisors that gave these instructions. Additionally, this study also sought to analyse how the evidence-based protocol developed along the critical review and meta-analysis (I) was supported in real world settings in the Satakunta area in Finland.

3. Describe the impairments of upper body and limb functions and structures among breast cancer patients (III). In this third study the impact of impairments on activity limitations and participation restrictions experienced by breast cancer patients at work, in the home and in leisure activities was also examined 6 and 12 months after the operation. Secondary aims were to identify the effects of age, operation type and adjuvant treatments on the impairments, limitations and restrictions.

4. Examine the effects of individually adjusted therapeutic exercise on shoulder movements, upper limb muscle strength, upper limb volume

and circumference (IV). Another purpose of this fourth study was to investigate the effects of therapeutic exercise on experienced impairments of upper body and limb, and on experienced activity limitations and participation restrictions of breast cancer patients.

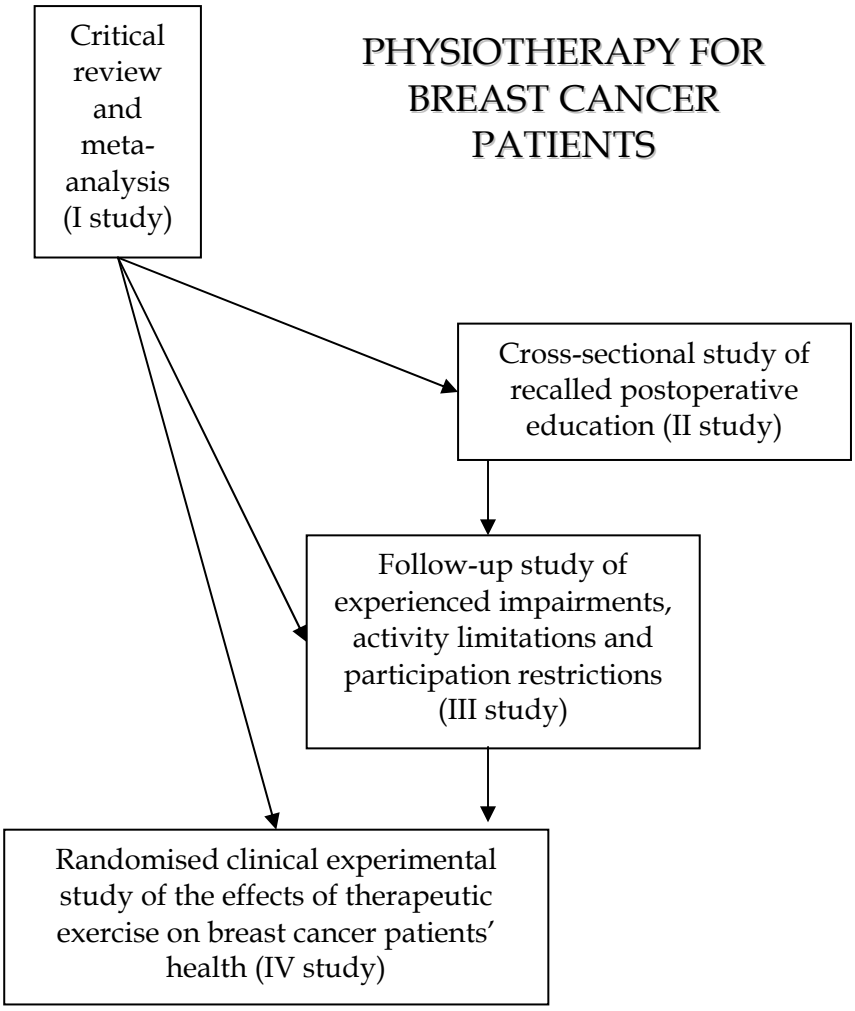

FIGURE 2 Flow diagram of the series of studies.

Hereafter the critical review and meta-analysis is presented completely, while the frame for the studies II-IV was developed using the results and conclusions of the first study (Figure 2).

4 CRITICAL REVIEW AND META-ANALYSIS OF PHYSIOTHERAPY METHODS AND EXERCISE AFTER A BREAST CANCER OPERATION (I)

4.1 Material and methods

In this study, two physiotherapists (MSc degree in health sciences) reviewed the studies published in English and Scandinavian languages. These studies were obtained by one of the reviewers through a computer-assisted search of the MEDLINE, EMBASE and ArbSpriSwe (Medical database in Scandinavia) covering the period 1980-1999. For the search, the used terms were breast cancer, breast neoplasm, physical therapy, physiotherapy, rehabilitation, exercise, lymphedema, late symptoms, therapy, quality of life, physical activity. Manual searches from relevant reference lists were also carried out. In order to be included in this review the studies had to meet the following criteria:

1. A prospective clinical trial.
2. A sample of breast cancer patients.
3. A study design either single subject experimental, pre-experimental (no control group), quasi-experimental or true experimental randomized.
4. A study had to concern post-operative therapy, therapy methods used with late symptoms, therapeutic exercise or training.

The methodological analysis was used to assess the quality of study design, conduction, and reporting. Table 1 presents the criteria that were developed and used for the analysis of quality. The scoring and criteria were based on generally used principles in other systematic reviews (Koes et al. 1991, de Kruif & van Wegen 1996, Hilden & Bo 1998, de Bie et al. 1998). The instrument used by Koes et al. (1991) and de Bie et al. (1998) was modified because of the different outcome measures relevant for breast cancer research and different areas; early vs. delayed shoulder movements after operation, lymphedema therapy, therapeutic exercise, exercise. The two reviewers assessed the quality of each study independently, and in a subsequent meeting the reviewers discussed disagreements until consensus was reached.

Meta-analysis was used after the methodological analysis, when the study reports presented the relevant data needed for the analysis. Furthermore, those study designs had to be either quasi-experimental or true-experimental, where randomization had been attempted. Only studies concerning early versus delayed shoulder exercise after surgery met these criteria.

TABLE 1 Criteria list for assessment of methodological quality of prospective clinical trials concerning therapy methods and exercise after breast cancer operation.

Criterion*	Weighting	
Study population		18
A. Homogeneity	3	
B. Relevant baseline characteristics	5	
C. Adequate randomisation procedure	2	
D. Loss of subjects and description of drop outs	5	
E. Number of subjects	3	
Intervention		20
F. Intervention adequately described	10	
G. Co-intervention avoided	5	
H. Healing effect/placebo controlled	5	
Measurement of effect		22
I. Outcome measures in	10	
Treatment of edema		
Early vs. delayed shoulder movements		
Exercise therapy		
Exercise		
J. Number of measures	6	
K. Attempted blinding	6	
Statistical validity		10
L. Statistical tests acceptable	5	
K. P-value or another descriptive value are marked	5	
		70

*Details of criterion are presented in the original article (I).

4.1.1 Statistical methods

Effect size index (d-index) by Cohen (1988) and *95% confidence intervals (CIs)* were used to evaluate the possible influence of early or delayed shoulder exercise on the drainage volume and aspiration volume (Guyatt et al. 1994, Munro et al. 1997). Effect sizes were counted from the means and standard deviations of the early and delayed groups.

Effect size can be small (.2-<.5), medium (.5-<.8) or large (≥.8). All therapy studies included in this report are real world studies and are influenced by

uncontrollable extraneous variables which can make the size of the effect small. (Cohen 1988.) A positive d-index indicates in this review that the delayed exercise of the shoulder caused less drainage and the aspiration volume was lower than with the early exercise group. If the d-index is negative it indicates that the group of delayed shoulder exercise had higher drainage or aspiration volume. In the results of meta-analysis the pooled effect sizes and corresponding 95% CIs were reported. The power tables by Cohen (1988) were used to analyze power for **t**-test on means of two independent samples when the group sizes were unequal.

4.2 Results

The critical review included 31 studies published from 1980-1999 (Table 2). Seven of the studies concerned immediate postoperative physiotherapy and compared early shoulder exercise to delayed exercise regimes. Four studies dealt with exercise such as walking, cycling or other aerobic activity after hospitalization. Four studies concerned exercise therapy or rehabilitation programs after surgery. More than half of the studies (n=16) studied the effects of different therapies on lymphedema among breast cancer patients.

Methodological analysis of the studies concerning lymphedema therapy showed that there were large methodological differences between the studies. The scores varied from 14 to 46 points from a maximum of 70 points (Table 2). None of the studies avoided co-interventions, and the healing effect of placebo was uncontrolled in 13 studies. Further pooling of the data was not possible, because of low methodological quality.

In the methodological analysis of studies concerning exercise therapy after surgery, three of the four studies received more than 40 points (Table 2). All these studies lacked proper randomization, and also the descriptions of the interventions were insufficient. The quality of the studies prevented further analysis and pooling of the data, as some of the results were not included in the reports, and some relevant statistics were lacking e.g. means, standard deviations.

Studies concerning aerobic exercise after breast cancer operations were carried out during chemotherapy or radiation therapy. All four studies (Table 2) received more than 40 points. Major flaws in these studies were seen in the randomization and blinding procedures. Further pooling of the data was not possible, because two studies had deficiencies in reporting the results and the study methods differed (pre-experimental, one-group and two-group designs).

TABLE 2 The studies included in the critical review and their scoring.

		Study Population (18 points)					Intervention (20 points)			Measurements (22 points)			Statistical Validity (10 points)		Total scores
		A	B	C	D	E	F	G	H	I	J	K	L	M	
	Study	3	5	2	5	3	10	5	5	10	6	6	5	5	70
1	Johansson et al 1999	3	5	0	5	3	6	1	2	6	5	0	5	5	46
2	Swedborg 1980	2	5	0	4	3	10	0	0	5	4	4	5	3	45
3	Bertelli et al 1992	3	4	2	4	3	9	0	0	3	4	0	5	5	42
4	Bertelli et al 1991	3	5	0	3	3	5	0	0	5	4	0	5	5	38
5	Balzarini et al 1993	2	3	1	1	2	8	0	0	5	5	0	4	5	36
6	Gan et al 1996	1	1	0	5	3	6	0	0	10	2	0	3	5	36
7	Piller et al 1998	3	2	0	3	2	6	0	2	10	6	0	2	0	36
8	Morgan et al 1992	3	3	0	2	2	8	0	0	3	4	0	4	5	34
9	Bunce et al 1994	2	4	0	3	2	4	0	0	7	4	0	4	3	33
10	Swedborg 1984	2	4	0	1	2	7	0	0	3	5	0	4	5	33
11	Swedborg et al 1993	3	4	0	0	2	7	0	3	3	2	0	4	5	33
12	Zanolla et al 1984	2	4	0	5	3	6	0	0	6	3	0	2	1	32
13	Kim-Sing et al 1987	2	4	0	5	2	9	0	0	3	2	0	0	0	27
14	Johansson et al 1994	3	4	0	0	2	4	0	0	7	2	0	0	4	26
15	Hornsby 1995	2	0	1	2	2	3	0	0	6	3	0	0	0	19
16	Kirshbaum 1996	0	3	0	5	1	2	0	0	2	1	0	0	0	14
17	Wingate et al 1989	2	4	1	5	3	4	3	3	7	3	4	5	5	49
18	Na et al 1999	3	5	0	5	2	6	1	0	8	4	0	5	5	44
19	Wingate 1985	2	4	0	5	2	3	0	4	7	4	0	5	5	41
20	Gaskin et al 1989	0	4	0	0	2	4	0	0	6	2	0	0	0	18
21	MacVicar et al 1989	1	3	0	3	2	10	4	5	9	2	0	4	5	48
22	Schwartz 1999	3	3	0	4	2	10	1	0	8	5	0	5	5	46
23	Mock et al 1994	3	3	2	3	1	6	2	3	10	4	0	3	5	45
24	Mock et al 1997	3	3	0	2	2	5	2	3	6	4	0	5	5	40
25	Jansen et al 1990	3	4	2	5	3	7	3	2	7	5	0	4	4	49
26	Chen et al 1999	3	5	1	4	3	4	3	3	6	6	0	3	5	46
27	Petrek et al 1990	3	5	2	5	3	8	5	0	4	3	0	5	2	45
28	Schultz et al 1997	1	5	1	5	3	5	2	3	6	3	0	5	4	43
29	Rodier et al 1987	3	5	2	5	3	2	5	0	4	2	0	4	5	40
30	van der Horst et al 1985	2	5	0	5	3	6	3	0	7	3	2	2	1	39
31	Dawson et al 1989	1	3	1	5	3	1	0	5	6	1	0	4	1	31

Studies concerning early versus delayed shoulder exercise scored from 31 to 49 points. Five of the seven studies could be used for further statistical analysis and pooling of the data (Table 2). All those five studies were true-experimental clinical trials. The two studies excluded lacked similar outcome measures or exact data. When analyzing the drainage volume after surgery, four of the five studies produced a positive effect size (d-index), favouring delayed exercise of the shoulder after surgery. In total, the number of patients in these five studies was 597; 303 in the early exercise group and 295 in the delayed exercise group. The pooled effect size was +0.46, 95% CI 0.42-0.50, favouring delayed onset of shoulder exercises.

4.3 Discussion

The critical review and meta-analysis aimed to create a greater understanding of the effectiveness of physiotherapy methods and exercise. This review indicated that there were major flaws in the studies concerning physiotherapy methods and exercise. We could only pool the data of some studies in the matter of early vs. delayed onset of shoulder exercise pool the data of some studies and conclude that this evidence favours delayed onset of shoulder exercise. Based on the analysis of the studies in the critical review, we were able to create a framework for the content of the postoperative education after breast cancer operation.

Since pooling the existing data, Bendz & Olsén (2002) have published a study comparing early vs. delayed shoulder exercises. In their study the delayed group received written instructions and no supervision and the early group received both instructions and supervision by a physiotherapist. The operated arm elevation was, however, limited to 90° in the early group, until both groups after 14 days received exercise instructions for the whole ROM. In the early group the mobility of the shoulder recovered significantly earlier, but all impairments were similar after 1 month, 6 months and 2 years postoperatively. This last study also supported the conclusion of meta-analysis of gradual onset of shoulder mobility exercises.

Based on the studies concerning lymphedema therapy in this systematic review, we can assume that there exists a wide range of methods that physiotherapists use for treating lymphedema after breast cancer operation. In this review the effectiveness of an elastic sleeve was shown, and that the use of the sleeve should be systematic and prolonged. We could not draw strong conclusions because of the treatment bias, which was seen particularly in the studies concerning lymphatic massage. Lymphatic massage was not studied alone, but in combination with other modalities.

Several studies of different forms of therapy used for the treatment of lymphedema have been published since this systematic review was carried out (Andersen et al. 2000, Bagder et al. 2000, Wozniewski et al. 2001, Box et al. 2002, Szuba et al. 2002, Sitzia et al. 2002, Williams et al. 2002, Carati et al. 2003, McKenzie & Kalda 2003, Mondry et al. 2004). However, in those studies

(Andersen et al. 2000, Wozniewski et al. 2001, Bagder et al. 2002, Box et al. 2002, Sitzia et al. 2002, Szuba et al. 2002, Williams et al. 2002, Mondry et al. 2004) where exercise was part of the protocol the treatment bias prevents further conclusions of the effects of exercise or other examined methods alone. Most of the studies aimed to point out the effectives of one method; manual lymphatic drainage (MLD) vs. simple lymphatic drainage, multilayer bandaging and elastic hosiery vs. elastic hosiery, decongestive lymphatic therapy (DLT) vs. DLT combined with intermittent pneumatic compression, MLD vs. standard therapy without MLD. None of the studies, however, could clearly point out that MLD was more effective. Another study by Andersen et al. (2000) showed that MLD did not have any adverse effects. The studies failed to show the effectiveness of manual drainage over other methods. In the study by Carati et al. (2003) low-level laser therapy caused a reduction in limb volume after two treatment cycles.

Lymphedema prevention, e.g. exercise and elevation, after breast cancer surgery has not been studied by randomised controlled trials. Therefore, only suggestions can be provided based on the studies where edema incidence has been followed during exercise therapy after breast cancer operations. Four studies of exercise therapy, where different forms of active, assisted and resisted exercise were used, showed no differences in circumference measurements between experimental and control groups (Gaskin et al. 1989, Wingate 1985, Wingate et al. 1989, McKenzie & Kalda 2003). Nothing can be concluded about the late outcome, since the follow-up times were short, varying from 1 to 3 months. Based on these findings the role of exercise in preventing lymphedema is still unclear. The effect of elevation has been studied when lymphedema is present and elevation used alone was ineffective (Swedborg et al. 1993). In the future, controlled studies of elevation in the prevention of upper limb lymphedema for breast cancer patients are needed. The healing of the lymphatic system after breast cancer operation and the effects of movements on the healing process are still open questions.

Postoperative arm massage within 24 hours after surgery has been recently studied for treating postoperative pain and discomfort (Forchuk et al. 2004). No differences were found between the control group and massage group after the third postoperative day with the used measurements. The study design had some major flaws; one patient in the intervention group never had massage, the questioning of actual pain was lacking, pain relief was questioned by asking the patient's ability to control her pain by massage. There was no exact data of shoulder movements, and the movements were reported to be same in both groups. One finding that should have been pointed out more carefully was that patients who got massage had significantly higher circumferential measurements in two distal measurement points in every follow-up measurement. This was explained by outliers that seemed to have an affect on these results. However, more careful study and analysis of the healing process should be carried out before the use of postoperative massage could be suggested.

The analysis of the effectiveness of exercise therapy and aerobic exercise based on the critical review is limited because few publications exist in this area. Studies concerning exercise therapy had the same problem with the treatment bias; each examined programme used several methods. In a more recent study of aerobic exercise effects by Courneya et al. (2003) increase in cardiovascular capacity was seen and exercisers also showed an increase in QOL-outcomes. Some studies have shown (Mock et al. 2001, Mock et al. 2004) that moderate walking exercise during chemotherapy or radiation therapy caused decrease in fatigue levels of breast cancer patients and could increase QOL (Mock et al. 2001). Segal et al. (2001) failed to show a benefit of three different protocols of aerobic exercise counselling; self-directed vs. supervised vs. control group supervised by phone. Turner et al. (2004) carried out a one-group 8–week experimental study with a moderate exercise program. The programme consisted of aerobic-based exercise, water-based exercise for two weeks, and exercises with free- and machine-weights for last weeks of the programme. This intervention had no significant effect on aerobic capacity, but it managed to significantly decrease lean body mass and fatigue. It also significantly increased mood and quality of life of the participants.

In the latest review concerning physical exercise interventions in cancer patients by Oldervoll et al. (2004) the number of randomized trials identified was 12, and two of these studies used resistance exercises among acute leaukaemia and prostate cancer patients. Only the study by Segal et al. (2003) has demonstrated that resistance training improved the quality of life and reduced treatment-related fatigue. Oldervoll et al. (2004) pointed out in their review that there is urgent need for further studies on the effects of resistance exercise.

Based on this systematic review and some new studies we can state that aerobic exercise is safe and effective during radiation and chemotherapy (MacVicar et al. 1989, Mock et al. 1994, Mock et al. 1997, Schwartz 1999, Mock et al. 2001). Psychological benefits were seen in three of the studies (Mock et al. 1994, Mock et al. 1997, Mock et al. 2001), and functional capacity increased with the breast cancer patients who were exercising in all five studies (MacVicar et al. 1989, Mock et al. 1994, Mock et al. 1997, Schwartz 1999, Mock et al. 2001). The intensity of exercise should not be too strenuous as that can cause increased fatigue. The estimation of individual training levels is essential for creating a safe and effective exercise programme. Already in a retrospective study by Courneya & Firendenreich (1997) it was shown that women who exercised at least once a week at a moderate to strenuous level during cancer treatment, reported higher quality of life and an overall satisfaction with life.

In TABLE 3 the clinical implications and the framework of study II are presented. The summary is based on the critical review and is also supported by more recent studies. Further existing recommendations by ACSM (1998), American Family Physician (2004), and the Finnish Breast Cancer Group (2002) support the summary.

TABLE 3 Summary for the content of the education for exercise and use of the upper limb after breast cancer surgery based on review and recommendations.

Content of the education after breast cancer surgery	**Shoulder movements**	**Upper limb edema prevention and treatment**	**Aerobic exercise**	**Exercise for upper limb strength**
Timing	When drains have been removed	Immediately after operation	After wound has healed	After wound has healed
Methods	From assisted to active and resisted movements, gradually increasing repetitions	Dynamic muscle work like movements of hand, elbow and shoulder In case of edema use of elastic sleeve and depending on severity of edema other methods can be considered	Every type of aerobic exercise e.g. Walking Running Swimming Cycling Rowing Skiing	Dynamic muscle work starting from submaximal level and gradually increasing resistance to maximal level
Precautions	No outside force for increasing range of motion as long as wound is healing, pain should be taken as a warning signal	Avoidance of prolonged static muscle work of the upper limb and upper trunk	Exercise prescription needs to be adapted to the patient's ability Both lack of exercise and too high intensity might increase fatigue	Avoidance of prolonged static muscle work of upper limb and upper trunk

5 POST-OPERATIVE EDUCATION (II), EXPERIENCED IMPAIRMENTS, LIMITATIONS AND RESTRICTIONS (III), EFFECTS OF THERAPEUTIC EXERCISE ON FUNCTIONING AND DISABILITIES (IV)

5.1 Patients and method of surveys (II-III) and experimental trial (IV)

The cross-sectional (II) and prospective (III) survey population consisted of 110 patients with breast cancer from Satakunta district, Finland. The mean annual number of new cases in 1996-1997 in this area was 149 (Finnish Cancer Registry 2002). Breast cancer operations were carried out in three hospitals, two of the hospitals were district hospitals and one was a central hospital.

Data of the cross-sectional and prospective survey were collected after surgery by questionnaires, and if no correspondence was received in two weeks a second questionnaire was sent. Questionnaires were sent to all patients who had undergone surgery for breast cancer during the previous year (1996-1997). Part of the first questionnaire concerned post-operative education (II) and was surveyed 6 months after surgery. The other part of the questionnaire concerned experienced impairments, limitations and restrictions (III) and was surveyed both 6 and 12 months after surgery. The criteria for exclusion from the studies II-III were subsequent local recurrence of breast cancer, acute psychiatric illness, other severe disease (e.g. hip fracture) and hospitalisation. Patients' medical records were used for more detailed information on surgery, length of hospitalisation, drainage time, postoperative treatment (radiotherapy, chemotherapy, hormonal therapy) and post-operative physiotherapy.

In the experimental trial (IV) randomisation of breast cancer patients to an experimental group and control group took place in the cohort study population (N=71) operated in the Satakunta area more than 6 months earlier (November 1996-March 1997). The criteria for exclusion from the study were

subsequent local recurrence of breast cancer, acute psychiatric illness, other severe disease and hospitalisation. A total of 49 patients met the inclusion criteria and of these, 43 patients gave their written consent to participate the study. Patients were randomly assigned by using stratified sampling to the groups. The stratifying characteristics were age (≤40, 41-50, 51-60, 61-70, >70), time from the operation (<1year, ≥1year), operation type (MRM, BSO), radiation therapy (yes, no), need for exercise (yes, no), home address (near, distant).

The experimental study was designed as a double-blind, controlled comparative experimental study. Using stratified randomisation, 22 patients were assigned to the experimental group and 21 patients to the control group. Initially 12 patients in both the experimental and control groups entered the study. Drop-out patients were either unable to arrange the required time for participation or did not want to join in the binding protocol of the study. One patient dropped out from the experimental group because of a previous rotator cuff operation and worsening of shoulder pain. One patient dropped out from the control group because of relapse of cancer. In both groups 11 patients finished the study.

5.1.1 Cross sectional survey (II)

There were both closed- and open-ended questions in the questionnaire. Answering took about 15-20 minutes. Basic data were collected by five questions concerning the type of surgery, axillary dissectomy, postoperative treatment, handedness and the side of the operation and number of aspirations.

The amount and content of the instructions concerning shoulder movements, edema prevention and treatment, strength training and use of the upper limb were surveyed with five closed- and five open-ended questions. In the closed-ended questions patients had to define if they had postoperatively received enough information, some information or none at all. Patients were also asked to explain the content of the information with their own words. One question clarified if these instructions had been given after the hospital period.

Furthermore, patients were asked to define in a ranked order (1.-3.) who were the professionals/persons who had given most instructions. The list of instructors was given in the questionnaire in random order and it included physiotherapy assistant, physiotherapist, operating surgeon, other medical doctor, oncologist, nurse or nursing assistant, radiographer, support person (Cancer Society), other.

5.1.2 Prospective survey (III)

In the first questionnaire 6 months after surgery basic data were collected with questions concerning type of surgery, axillary dissectomy, postoperative treatment, duration of hospital stay, drainage duration, handedness and the side of the operation, number of aspirations, social situation (in work, pensioned, on sick-leave), participation in an adaptation course for cancer patients.

The second questionnaire also updated the treatment received, the social situation and participation in the adaptation course during the 6 months following the 1st survey. In addition patients were questioned about weight and height, body mass index (BMI) being calculated based on these. Patients also reported the possible weight changes they had had.

Figure 3 presents the classification of some of above mentioned factors to the categories of environmental and personal factors in the frame of ICF.

5.1.2.1 Impairments of body functions and structures

Experienced impairments in functions and structures of the upper limb, axilla, shoulder joint, breast and neck area were surveyed. In the questionnaire patients were asked to mark the impairment of either one or several from the list. The list included the following items: shoulder movement restriction, upper limb edema, axilla edema, tightness of scar tissue in axilla, tightness of scar tissue in breast area, neck-shoulder pain, upper limb numbness, upper limb ache, upper limb weakness, pain in the operated breast area, other (patient could define these).

Pain was examined by the Short Form McGill Pain Questionnaire (SF-MPQ), which is easier and quicker to administer than the long form, and is also suitable for both chronic and acute pain (Melzack & Katz 1992, Sim & Waterfield 1997, Turk & Okifuij 1999). The SF-MPQ consists of 15 words from sensory and affective categories. Each descriptor is ranked by the patient on an intensity scale of 0=none, 1=mild, 2=moderate, 3=severe. The Finnish version of the MPQ (Ketovuori & Pöntinen 1981) was used.

The severity of impairments was surveyed by modified VAS for Breast Cancer Patients. The scale's alternatives were formed based on the impairment list. Nine items were selected (Figure 3). On 100-mm visual analogue scales (VAS), with anchor points 0 (no pain or no difficulty) and 100 (worst possible pain or limitation), the patient marked the level of experience of the item. The reliability of the VAS has been tested before and is reported to be high when repeatedly used with the same person (Sim & Waterfield 1997). A VAS score over 30 mm should be considered moderate pain/limitation and over 54 mm severe pain/limitation (McQuay & Moore 1999). VAS scales can be considered as tools for assessment of quality of life issues.

In Figure 3 the ICF codes of Body functions domain are included in the items surveyed. More detailed information of questioning is presented in the original article (III; Table IA).

5.1.2.2 Activity limitation and impairment of sleep function

In this study a Modified Behavioural Rating Scale for Breast Cancer Patients was used. It was developed based on ideas from the Oswestry Low Back Pain Disability Questionnaire. Behavioural Rating Scales (BRS) have been developed mainly for the assessment of pain intensity and the degree to which it interferes with concentration or everyday tasks (Jensen & Karoly 1992). In this modification for breast cancer patients only valid and reliable test items found in earlier

studies were included in the test (Jensen & Karoly 1991, Segestrom et al. 1992, Maunsell et al. 1993, Tobin et al. 1993, Woods et al. 1995, Sudgen et al. 1998, Kärki & Kautoniemi 1999, Tasmuth et al. 1999, Haid et al. 2002, Kwan et al. 2002, Lash & Sillman 2002). In Figure 3 the ICF codes of the Activities domain and the Body functions domain are shown along with the items surveyed.

Personal care has been reported in some studies as relating to the patient's ability to use the upper limb e.g. brushing the hair, closing the back zipper, reaching overhead, carrying 5 kg and making a bed (Sudgen et al. 1998, Kwan et al. 2002, Lash & Sillman 2002). In this study, the aim was to find out about the limitations on personal care (washing, dressing), using the items of most common activities in a woman's life. Five items (Figure 3) were selected: personal care, lifting with the upper limb of the operated side, carrying with the upper limb of the operated side, reaching above head level with the upper limb of the operated side and sleeping. The ranking of each item was 1-6, where 1 meant no limitation in this activity or impairments of sleep functions, and 6 meant that the person was not able to carry out the activity or could not sleep.

More detailed information of this part of the questioning is seen in the original article III (Table IB).

5.1.2.3 Participation restrictions

Closed- and open-ended questions were used to determine whether the respondent experienced restriction at work, in the home and in leisure activities caused by upper limb impairments. If experiencing restrictions the respondents were asked to define them. In addition, they were asked if they had had to give up or alter their leisure activities after the operation. In Figure 3 the ICF codes of the Participation domain are shown along the items surveyed.

5.1.2.4 Test-retest consistency of VAS and Behavioural Rating Scale for Breast Cancer Patients and experienced impairments

The consistency of results of the questionnaire (paired measurements) was assessed by a pilot study among breast cancer patients operated 6 months previously. The test-retest consistency of the questions was evaluated. The time between test and retest was one week. The Coefficient Alpha of questions concerning experienced activity limitation and impairment of sleep function was in the case of the Behavioural Rating Scale for Breast Cancer Patients .67 (96% CI = .37, .82), and in the case of VAS for Breast Cancer Patients .90 (96% CI = .83, .93). The Kappa value of experienced impairment over one week by the same subjects was .60. The results of test-retest consistency are acceptable for the further use of the questions (Munro et al. 1997).

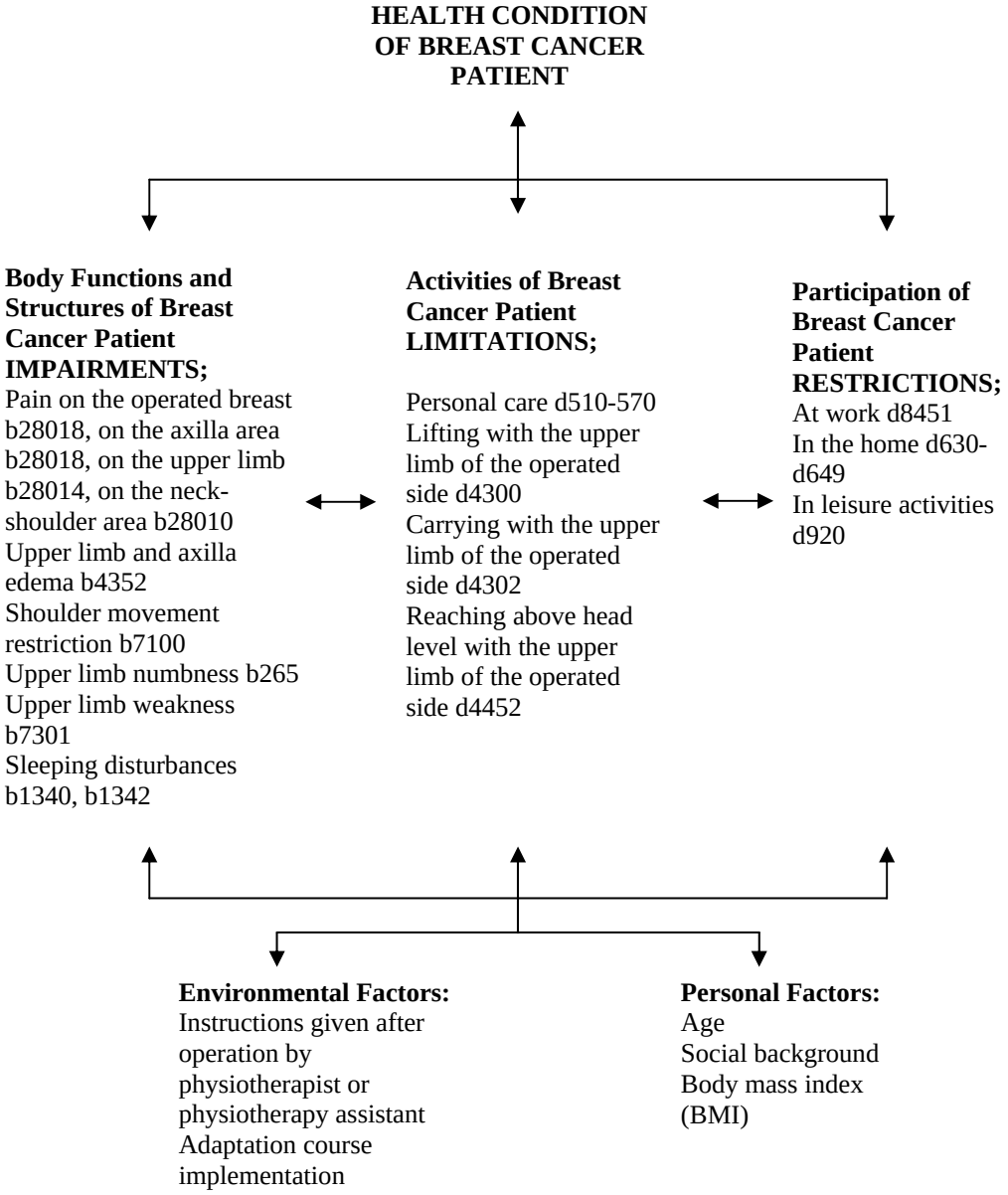

FIGURE 3 Functioning of breast cancer patients inquired in the survey (III).

5.1.3 Experimental trial (IV)

Measurements were repeated monthly during the intervention period, and follow-up measurements were carried out 3 months after the intervention had ended. Most common impairments were measured by the same tester, the tester was blinded.

Upper limb edema was assessed by both Volumetry and circumferential measurements from five levels (hand, wrist, 10 cm, 20 cm, 30 cm above processus styloideus of ulna) (Megens & Harris 1998, Kärki et al. 2001, Cornish et al. 2002, Courneya et al. 2003). All tape measurements were repeated twice

and started from the non-dominant side. Volumetric values were given in grams.

Upper limb weakness was assessed by using three different measurements. Grip strength was measured by Jamar dynamometer and upper limb strength by a dynamic lift test by the Invalid Foundation (Alaranta et al. 1990). Grip strength was measured in two trials and the best value was recorded. The lift test was carried out once. The testee aimed to get as many repetitions as possible, and reasons for stopping the test were pain, decreased shoulder range of motion and fatigue.

A one repetition maximum was assessed with free weights in a bench press-up (horizontal level), a scaption in internal rotation and a military press. Because of the breast cancer surgery and adjuvant treatment of the participants, we aimed to find the maximal level with 1-10 repetitions as suggested by Dionne et al. (2004), Braith et al. (1993), and Ploutz-Snyder & Giamis (2001). The aim was to avoid harm and too strenuous movements that could increase the severity of existing impairments or create new ones.

Restricted shoulder range of motions (ROM); flexion, abduction, internal and external rotation, were measured by MIE inclinometer (Mellin et al. 1994). ROM measurements were carried out twice and repeated once more if two measurements differed by five degrees.

All measurements were carried out one time as a retest-protocol, which accustomed patients to the measurements and the test-retest consistency could be assessed. The time interval between test and retest was one week (Knapp & Brown 1995). Motor learning could to some extent be controlled with this protocol (Rutherford & Jones 1986). All measurements showed high repeatability. More detailed ICC values are given in the original study (IV).

Questionnaires (Study III) were used to survey the experienced impairments in functions and structures of upper limb, axilla, shoulder joint, breast and neck area. The severity of impairments was surveyed by modified VAS, and activity limitations and impairment of sleep functions were measured by the modified Behavioural Rating Scale. In addition, participation restrictions in the home, at work and in leisure time were surveyed. The surveys were carried out at the beginning of intervention and 6 months later.

The therapeutic exercise programme was developed based on a pilot study by Kärki & Kautoniemi (1999). The aim of the programme was to decrease or prevent impairments of the upper body and limb of the operated side. The movements used were selected based on studies of the effective exercises for muscles of the upper limb (Moseley et al. 1992, Wickiewicz et al. 1993, Glass & Amstrong 1997). Rowing has been shown to activate the upper, middle and lower trapezius, as well as the rhomboideus and elbow flexors. The military press was used for the upper trapezius, serratus anterior and elbow extensors. The scaption activates the upper and lower trapezius, levator scapulae and serratus anterior. The bench press-up activates the pectoralis minor and major. Each participant was also given theraband for home exercises. For prevention and treatment of lymphedema repeated dynamic movements

were included in the programme, and these movements were encouraged to be carried out as a home programme.

Tutored sessions included mobility training for the upper body and upper limb. Also the possibility of treatment-induced neural tissue injuries was considered and some mobility exercises were included (Landers & Altenburger 2003). Stretching and range-of-motion exercises are mostly used to increase the mobility of joints and soft-tissues. It is said to be particularly important that those patients who had radiotherapy should have a life-long commitment to mobility training. (Adcock 1990, Hicks 1990)

A strength training protocol was chosen based on previous studies (Ostrowski et al. 1997, Kärki & Kautoniemi 1999), and the training was individually adjusted. Therapeutic exercise sessions were carried out twice a week for three months. The 60-minute sessions were tutored by a qualified physiotherapist. Each participant was asked to carry out three exercise sessions per week. The mean number of tutored exercise sessions that the experimental group participated in was 12, maximum attendance was 22 times and the minimum was 2.

More detailed prescription of the exercise program is seen in the original study (IV).

5.2 Statistical methods (II-IV)

Descriptive statistics were used to describe the demographic and medical data collected by questionnaires and from medical records. Relationships of operation types and studied variables were determined by Spearman with non-parametric variables and Pearson correlation with parametric variables. Analysis of variance (Anova) was used to test group differences: the length of hospital stay, the duration of drains and the age of patients. (Hicks 1995, Munro 1997.)

In the second study alpha coefficient was used for reliability analysis of the questions concerning the instructions of shoulder movements, instructions on edema prevention and treatment, instructions of strength training and the use of the upper limb. Also 95% Confidence Intervals (CIs) were calculated, and as Alpha value .70 was seen as a cut off point for good and modest reliability. (Knapp & Brown 1995, Munro 1997.) Spearman rho was used when comparing a dichotomous variable with a continuous variable e.g. age with received instructions. The Kruskal-Wallis Test was used to analyse the differences concerning the instructions given between the three hospitals. Differences between patients with MRM and patients with BSO in receiving instructions were studied with Levene's Test for Equality of Variances and two-tailed *t*-tests were then reported. When the *p*-value of Levene's Test was > .05 the hypothesis of no statistical differences was supported. Wilcoxon Signed Ranks Test for analysis of variance and the paired *t*-test were used for determining the instructions most given to the patients. Statistical significance was accepted if $p < .05$. (Munro 1997.) The qualitative data from the open-ended questions were

analysed by using narrative analysis, and qualitative data was used to clarify the results of quantitative data, broadening the information acquired to be more patient-centred.

In the third study correlation between other parametric variables and non-parametric variables were also calculated: age and VAS, impairments and SF-MPQ, adjuvant treatment and impairments, weight changes and impairments, weight changes and adjuvant therapies. The Wilcoxon Signed Ranks Test was used for counting of changes of impairments, and participation restrictions in the home, at work and in leisure activities. Differences between operation types were determined by using one-way ANOVA, the calculation concerned VAS value, age, hospitalisation time and drainage duration. A Paired Samples Test and 95%CIs were calculated for assessment of changes between VAS-values at 6 and 12 months post-operatively. Linear regression analysis was carried out by using forward solution and with a ratio of 50 subjects to one variable or subsets of variables. Subsets of variables can be used when there is high intercorrelation between the variables. In using regression analysis the aim was to determine the variable or subsets of variables that account for the greatest proportion of variance in the dependent variables, such as activity limitations and sleeping disturbances.

In the experimental study (IV) analysis of variance (ANOVA) was used to test group differences; the age, body mass index (BMI), time from the operation, length of the hospital stay, number of aspirations and drainage duration. The Wilcoxon Signed Ranks Test was used for analysis of changes in modified VAS and in modified Behavioural Rating Scales. This test was selected because the distributions did not meet parametric assumptions. Friedman's ANOVA for repeated measures was used for calculating the differences in shoulder range of motion (ROM), in strength values, in circumferential values and in the volume of the upper limb. Friedman's ANOVA was chosen because the distributions of the scores were not normal. The Mann-Whitney U-test was used for analysis of the differences between groups, U-test was chosen because of the non-normal distribution of the values. An analysis of covariance (ANCOVA) was calculated, the age was chosen as a covariate. Also Confidence Intervals (CI) of 95% were reported where appropriate.

5.3 Approval of studies (II–IV)

The Social and Health Ministry of Finland approved the protocols of studies II-IV in 1997. Patients were provided with written information about the study and were ensured confidentiality, anonymity and freedom to withdraw from the study without prejudicing any future medical care.

5.4 Results

This results section reviews the main results of the three studies (II-IV) carried out and reported after critical review and meta-analysis. More thorough information of each study is presented in the original articles (II-IV). Some unpublished results are also included.

5.4.1 Recalled postoperative education (II)

One hundred and six patients answered the survey of 110 patients operated six months previously, one was excluded. The demographic data of patients is shown in Table 4. A description of the physiotherapy was found in the records of 85 patients (81%).

The most commonly reported item by the respondents was instructions of shoulder movements. Instructions for upper limb strength training and edema prevention and treatment were less recalled than instructions for using the upper limb in daily activities. Patients own comments were sometimes conflicting: "Use the upper limb as before and you can even lift weights" and "You cannot drive a car or lift over 3 kg for 6 weeks." Operation type and length of hospital stay did not have any effect on the education recalled, but older patients had less education (r=-0.23, p< .05). Only 44 patients recalled receiving information on these items after discharge from hospital.

TABLE 4 Demographic data of patients in studies II, III and IV.

	Patients from three hospitals		Operation	Mean age	Adjuvant therapy	Hospital stay
Cross-sectional study II	Breast cancer patients (n=105) operated in one year		MRM 68.6% BSO 31.4%	59.0 (26;89)	78.1%	4.2 (SD= 1.58) days
Prospective study III	Breast cancer patients operated in one year (n=96)		MRM 66.7% BSO 33.3%	58.1 (26;86)	79.2%	4.0 (SD= 1.2) days
Randomized controlled experimental study IV	Breast cancer patients (n=22)	Experi-mental group (n=11)	MRM 90.9% BSO 9.1%	60.5 (48;76)	81.8%	4.0 (SD= 1.28) days
		Control group (n=11)	MRM 72.7% BSO 27.3%	53.8 (44;63)	72.7%	4.1 (SD= 1.4) days

Over half of the respondents (n=60) named the physiotherapist or physiotherapy assistant as the person who gave the most instruction concerning the items. A medical doctor was ranked in first place by 19% of respondents.

5.4.2 Impairments, activity limitation and participation restrictions (III)

The first questionnaire was sent to 110 patients and a second questionnaire was sent out 12 months after the operation to those included in the first survey (n=105), and 96 (91.4%) patients responded.

The demographic data of patients in this follow-up survey (III) is shown in Table 4. The mean BMI was 27.7 (SD=8.61) at 1-year follow-up. A self-reported increase in weight had taken place in 42.2% of MRM patients and in 28.1% of patients with BSO. Weight had decreased in 15.6% of the MRM patients and in 9.4% of patients with BSO. No significant correlation was found between weight changes and different adjuvant therapies (χ^2=9.59, p > .05).

The most common *impairments of the upper body and limb* that the patients experienced 6 months after operation were breast scar tightness and axilla scar tightness (45.8%), axilla edema (39.6%) and neck-shoulder pain (38.5%). Twelve months after surgery the most common impairments were axilla scar tightness (36.5%), limb numbness (32.3%) and neck-shoulder pain (40.6%). At 12-month follow-up, the breast scar tightness (p = .008) and axilla edema (p = .023) decreased, and limb ache increased (p = .005).

MRM patients experienced significantly more breast scar tightness (p = .039) at 12-month follow-up than BSO patients. BSO patients experienced other symptoms more (p <.05) at 12-month follow-up and more axilla scar tightness (p = .006) at 6-month follow-up than MRM patients. In the MRM group patients reported less axilla edema (p = .016) and more limb ache (p = .013) at 12-month follow-up. In the BSO group both axilla scar tightness (p = .002) and breast scar tightness (p = .001) decreased during the follow-up.

There were no significant differences between patients with different postoperative adjuvant treatments in the incidence of experienced impairments. Patients with higher BMI more often reported upper limb weakness at 12-month follow-up (r=.22, p = .033) than the leaner subjects.

Pain descriptions based on SF-MPQ showed that the most common pain descriptions at 6-month follow-up were sharp (18.8%), shooting (22.9%) and tender (45.8%). Mastectomy patients described their pain as fearful more often than the BSO group (p = .034). At 12-month follow-up the most common descriptions were still sharp (14.6%), shooting (20.8%), and tender (38.6%). In the MRM group the frequency of three pain descriptions decreased significantly; aching (p = .015), fearful (p = .034) and tender (p = .034). The range and frequency of pain descriptions of SF-MPQ in both groups at 6-month and 12-month follow-ups are shown in Table 5.

Patients experiencing axilla scar tightness at 6-month follow-up described their pain mostly as tender (r= .37, p = .002). Tender was also the most common pain description among patients with breast scar tightness (r= .38, p = .001). At 12-month follow-up, tender was the most common pain description among

patients with axilla scar tightness (r= .27, p = .009), limb numbness (r= .17, ns. p = .11) and neck-shoulder pain (r= .27, p = .009).

The most limiting impairments assessed by *VAS* were axilla edema (21 mm) and limb numbness (22 mm) 6 months after operation, and at 12-month follow-up axilla edema (20mm). The worst pain that was experienced was neck-shoulder pain at 6-month follow-up (27 mm) and at 12-month follow-up (28 mm). Five of the nine items of VAS decreased and four increased during the follow-up, only one decreased significantly, limitation caused by numbness (p = .04). At 6-month follow-up BSO patients experienced significantly more severe axilla pain (p = .003) and breast pain (p = .022) than MRM patients. Lower BMI was associated with more axilla pain and higher BMI with more neck-shoulder pain and more limited shoulder ROM.

Activity limitations and impairment of sleep functions; activities such as carrying and reaching out above head level caused worsening of impairments to 53.1% and lifting to 61.5% of the respondents and at 6-month follow-up. At 6-month follow-up impairments were interfering with the sleep of 38.5% of the respondents. The number of patients complaining about the limitations in daily activities or sleep disturbances decreased slightly during the follow-up (ns.). Personal care was less limited during the follow-up (10.4%, 8.3%). Younger patients had more difficulties in sleeping (p = .027) than older patients, who complained more of worsening of impairments when lifting (p = .032).

Participation restrictions at home were constant and experienced by 32.3% of the respondents during the follow-up. At 6-month and 12-month follow-ups restrictions at work were experienced by 16.7% and 15.6% of the respondent, respectively. More restrictions were experienced during leisure activities. These restrictions decreased significantly (p = .02) during the follow-up from 25.0% to 16.7%.

At the 12-month follow-up, none of the respondents (n=31) experiencing restrictions at home had given up home tasks totally. One of the respondents (n=11) experiencing restrictions at work had given up some work tasks. Four of the respondents experiencing restrictions (n=16) during their leisure activities had given up all their activities, others (n=3) had given up some and four had reduced activities. Many of the respondents had experienced their impairments getting worse at work (n=11), at home (n=12), and during leisure activities (n=5).

Regression analysis (Table 6) shows that many upper limb and body impairments together were determinants of activity limitations and sleep impairment.

TABLE 5 Pain descriptions based on SF-MPQ of breast cancer patients.

		MRM (n=64)		BSO (n=32)	
Pain descriptions	**Categories for pain**	**6 months after surgery % (n)**	**12 months after surgery % (n)**	**6 months after surgery % (n)**	**12 months after surgery % (n)**
1. THROBBING	Mild	1.6 (1)	- (-)	- (-)	3.1 (1)
	Moderate	- (-)	1.6 (1)	- (-)	- (-)
	Severe	- (-)	- (-)	3.1 (1)	3.1 (1)
2. SHOOTING	Mild	18.8 (12)	10.9 (7)	6.3 (2)	6.3 (2)
	Moderate	6.3 (4)	10.9 (7)	9.4 (3)	9.4 (3)
	Severe	1.6 (1)	- (-)	- (-)	3.1 (1)
3. STABBING	Mild	3.1 (2)	4.7 (3)	- (-)	6.3 (2)
	Moderate	4.7 (3)	- (-)	6.3 (2)	- (-)
	Severe	- (-)	- (-)	- (-)	6.3 (2)
4. SHARP	Mild	10.9 (7)	9.4 (6)	6.3 (2)	9.4 (3)
	Moderate	- (-)	3.1 (2)	21.9 (7)	6.3 (2)
	Severe	1.6 (1)	- (-)	3.1 (1)	3.1 (1)
5. CRAMPING	Mild	- (-)	1.6 (1)	3.1 (1)	- (-)
	Moderate	- (-)	- (-)	- (-)	3.1 (1)
	Severe	- (-)	- (-)	- (-)	- (-)
6. GNAWING	Mild	3.1 (2)	4.7 (3)	- (-)	- (-)
	Moderate	1.6 (1)	- (-)	3.1 (1)	- (-)
	Severe	- (-)	- (-)	- (-)	6.3 (2)
7. HOT-BURNING	Mild	- (-)	- (-)	3.1 (1)	6.3 (2)
	Moderate	- (-)	3.1 (2)	- (-)	- (-)
	Severe	-(-)	- (-)	3.1 (1)	6.3 (2)
8. ACHING	Mild	10.9 (7)	4.7 (3)	6.3 (2)	3.1 (1)
	Moderate	4.7 (3)	- (-)	3.1 (1)	3.1 (1)
	Severe	1.6 (1)	- (-)	- (-)	- (-)
9. HEAVY	Mild	1.6 (1)	6.3 (4)	- (-)	- (-)
	Moderate	4.7 (3)	- (-)	- (-)	3.1 (1)
	Severe	- (-)	- (-)	- (-)	- (-)
10.TENDER	Mild	28.1 (18)	25.0 (16)	21.9 (7)	31.3 (10)
	Moderate	12.5 (8)	6.3 (4)	31.3 (10)	15.6 (5)
	Severe	1.6 (1)	1.6 (1)	- (-)	3.1 (1)
11.SPLITTING	Mild	3.1 (2)	6.3 (4)	3.1 (1)	6.3 (2)
	Moderate	4.7 (3)	6.3 (4)	9.4 (3)	- (-)
	Severe	3.1 (2)	- (-)	- (-)	3.1 (1)
12.TIRING-EXHAUSTING	Mild	3.1 (2)	3.1 (2)	- (-)	6.3 (2)
	Moderate	1.6 (1)	3.1 (2)	6.3 (2)	- (-)
	Severe	- (-)	- (-)	- (-)	3.1 (1)
13.SICKENING	Mild	- (-)	3.1 (2)	- (-)	- (-)
	Moderate	- (-)	- (-)	- (-)	3.1 (1)
	Severe	- (-)	- (-)	- (-)	- (-)
14.FEARFUL	Mild	7.8 (5)	1.6 (1)	6.3 (2)	9.4 (3)
	Moderate	4.7 (3)	3.1 (2)	12.5 (4)	3.1 (1)
	Severe	3.1 (2)	1.6 (1)	- (-)	3.1 (1)
15.PUNISHING-CRUEL	Mild	4.7 (3)	- (-)	3.1 (1)	6.3 (2)
	Moderate	1.6 (1)	3.1 (2)	6.3 (2)	- (-)
	Severe	1.6 (1)	3.1 (2)	- (-)	3.1 (1)

TABLE 6 Results of linear regression analysis of subsets of variables explaining the activity limitations and sleep impairment at 6 and 12 months follow-ups.

ACTIVITIES AND SLEEP FUNCTION	IMPAIRMENTS, OTHER FACTORS EXPLAINING LIMITATIONS AND SLEEP IMPAIRMENT	β	R	R^2	F
At 6-month follow-up					
Personal care	Breast pain	.393†	.393	.155	10.602†
Lifting with the upper limb	Axilla pain	.353†			
	Upper limb weakness	.334†			
	Upper limb edema	.254*			
	Axilla pain, upper limb weakness and edema		.689	.465	17.184‡
Carrying with the upper limb	Breast pain	.461‡			
	Shoulder movement restriction	.273*			
	Breast pain and shoulder movement restriction		.561	.315	13.103‡
Reaching above head level	Upper limb weakness	.387†			
	Upper limb ache	.288*			
	Upper limb ache and weakness		.538	.289	11.789‡
Sleeping	Breast pain	.374†			
	Neck-shoulder pain	.312†			
	Shoulder movement restriction	.275†			
	Age	-.274†			
	Breast and neck-shoulder pain, shoulder movement restriction, age		.746	.556	16.919‡
At 12-month follow-up					
Personal care	Neck-shoulder pain	.372†			
	Age	.331†			
	Neck-shoulder pain and age		.499	.249	8.278†
Lifting	Upper limb weakness	.371*			
	Upper limb ache	.319*			
	Upper limb weakness and ache		.621	.383	15.667‡
Carrying with the upper limb	Upper limb ache	.301*			
	Upper limb edema	.393†			
	Age	.249*			
	Upper limb ache and edema, age		.675	.455	13.364‡
Reaching out above the head level	Shoulder movement restriction	592‡	.592	.350	27.506‡
Sleeping	Upper limb weakness	.485‡			
	Shoulder movement restriction	.339†			
	Upper limb weakness and shoulder movement restriction		.677	.459	21.200‡

*p< .05, †p< .01, ‡p< .001

5.4.3 Therapeutic exercise effects on body functions and structures of the operated side, on activity and participation of breast cancer patients (IV)

The experimental and control group were similar in all but one characteristic; the mean age of the experimental group was higher (p = .048).

In both groups ROM deficits were seen at the baseline, and the values were slightly less in the experimental group. The ROM results showed that internal rotation increased significantly in both groups during intervention. At the follow-up the experimental group had a significant increase in abduction (p= .040).

The experimental group had some increase in grip strength and a significant increase in the lift test of the operated side (p = .014) and the non-operated side (p= .35). In the pectoral press-up the experimental group achieved higher values than the control group. Age-adjusted pectoral press results were significantly better than those of the control group at the end of the intervention and at the follow-up. The military press and scaption age-adjusted results showed significant increase in both groups, values being higher in the experimental group. The experimental group achieved higher strength levels after age-adjustment than the control group. However, the differences were statistically significant only in a small number of cases.

Volumetric measurements of the operated upper limb showed no obvious changes. The experimental group achieved a 24 mg decrease and the control group had a 16mg increase between the baseline and the last measurement. In the circumferential measurements the experimental group had a decrease in all, but one measurement level and the decreases were significant in two levels (at 10 cm, and 30 cm; p >.01, p = .05).

The number of experienced impairments decreased and activity limitations improved in both groups. The most improvement was seen in the experimental group in tasks such as carrying (p=.046) and reaching. The experimental group experienced less arm related restrictions in the home than the control group at the end of the study.

5.5 Discussion

With this series of three studies we aimed to evaluate the requirements, content and timing of physiotherapy services after breast cancer surgery. With the help of the critical review and meta-analysis we were able to create a frame for breast cancer patients' physiotherapy (Table 3) and point out the major limitations that were observed in the studies of physiotherapy methods, postoperative physiotherapy, therapeutic exercise and aerobic exercise.

The cross-sectional survey showed that the patients' education had some major defects and should be modified to meet the requirements of effective postoperative physiotherapy and patient education.

In the prospective study different aspects of functioning and disability were surveyed. The questionnaire modified for breast cancer patients was a useful tool for scanning the upper body and limb impairments, the amount of limitation caused by impairments, activity limitations and participation restrictions. As seen in this study the experienced disabilities were quite constant during 6- and 12-month follow-ups. One impairment alone did not explain the experienced activity limitations, but several impairments had a joint effect on some limitations.

In the randomized controlled experimental study the most common impairments of body functions and structures were examined. In this study the survey from the third study was also used for experienced disabilities. Therapeutic exercise intervention caused positive changes in all variables measured, and in addition intensive strength training caused no increase in the volume of the operated side upper limb. Therapeutic exercise program including warm-up, cool-down, mobility training, dynamic repeated movements for upper limbs and strength training was a safe and relatively effective programme for breast cancer patients 6 months after the operation.

5.5.1 Postoperative education

There exists some evidence based on critical reviews, meta-analyses and practical knowledge about the amount and the content of instructions for shoulder movements, for prevention and treatment of upper limb edema, instructions for strength training and for use of the upper limb after breast cancer surgery (Table 3). However, in this study only a limited number of these items listed above were found in the patient records or were recalled by the patients after breast cancer operation. The recalled content of the education consisted mainly of the movements of the upper limb and less of the instructions on the use of the upper limb. The patients least recalled other important items, such as edema prevention and treatment and strength training.

Some inconsistency was seen in patients' comments about the instructions. Some patients were instructed to use the upper limb in a normal way and some to limit the amount of heavy work, such as lifting. In a study by van Wersch et al. (1997), health professionals were not always aware of what others were doing to or telling patients. This could also be one possible explanation for the inconsistency in the patients' comments and patients' records concerning the content of the instructions. In addition this study showed that less than half of the patients reported that they had received education after discharge.

This study is in line with other studies and suggests that the time reserved for postoperative education concerning the use, exercise and treatment of the upper limb is insufficient (Lerman et al. 1993, Backman & Westman 2001, Jones et al. 2004). In addition a short hospital stay, as seen in this study and in a study by Backman & Westman (2001), is a challenge for the health professionals because all necessary information concerning the future treatment and the rehabilitation process should be covered. However, based on this study and on the most recent review by Finney Rutten et al. (2004) of cancer patients'

information needs, the education content and the methods of the hospital period should be reconsidered. The review showed that during the diagnosis and treatment phase cancer patients are primarily interested in finding out their diagnosis, treatment options and the side-effects with those options. The need for rehabilitation information is prominent during the post-treatment phase (Finney Rutten et al. 2004).

In the medical records 81% of the patients had been tutored by physiotherapists or physiotherapy assistants, yet only less than 60% ranked them in the first place as a main instructor. Several other studies (Royak-Schaler 1991, Lerman et al. 1993, Lavery & Clarke 1996, Backman & Westman 2001), also indicate that the information given by professionals is not always received by patients. The importance of multiprofessional team work is seen in this study, where the medical doctors had an important role as advisors.

5.5.2 Upper limb and body impairments, limitations and restrictions after breast cancer treatment

Axilla edema decreased (40%-27%), but upper limb edema stayed realitively constant (25%-26%) during one year period. The incidence of upper limb edema in this study was similar to a population-based Australian study (McCredie et al. 2001). Compared to an earlier study carried out in Finland, this study had a lower incidence of upper limb edema (Tasmuth et al. 1999). The incidence of shoulder movement restriction was 23 % and the incidence of numbness was 32% at one-year follow-up. Upper limb weakness was less experienced, 18%, at one-year follow-up.

The pain values in VAS in this study were less than 30 mm, and should not affect daily activities according to an earlier study by Tengrup et al. (2000) affect daily activities. We, however, found that most of the activities were affected by pain symptoms. Other impairments were experienced as the most limiting impairment; upper limb edema at 12-month follow-up and numbness at 6-month follow-up. Limitation caused by numbness decreased after the first survey and we can assume that patients adjusted to the numbness. Patients with a higher BMI in this study had more neck-shoulder pain and shoulder movement restrictions limited their activities more.

Radiotherapy was not an explanatory factor in experienced shoulder movement restriction or experienced upper limb weakness in the MRM or BSO group. This finding is contradictory to the results shown by Blomqvist et al. (2004). In their study, radiotherapy with MRM patients was responsible for most of the reduction of ROM and the strength of the shoulder joint. Experienced activity limitations were also more common among irradiated patients, but the difference was not, however, significant.

The SF-MPQ has been validated in a variety of therapeutic interventions and a high degree of consistency between the full and short version of the MPQ has been found (Melzack & Katz 1992). Breast cancer patients in this study described their pain as mostly sharp, shooting and tender both at 6- and 12-month follow-ups. Tasmuth (1997) reported in her study, carried out in Finland,

that the most common term was shooting. In this study we found the term tender being most commonly used as also reported in the study by Carpenter et al.(1998). The most common pain descriptions in this study represented the sensory dimension of pain (Melzack & Katz 1992). Tender has been included in the mild intensity level in the sensory miscellaneous subclass. Shooting has been classified in the distressing intensity level in the sensory spatial subclass, and sharp to the distressing level in the sensory incisive pressure subclass. (Melzack & Katz 1992.) Fearful was a more common pain description in the MRM group than in the BSO group indicating the affective dimension of pain in the distressing level of the fear subclass (Melzack & Katz 1992).

This study showed that activity limitations in lifting, carrying and reaching were experienced by many of the respondents. The experienced impairments interfered with sleep function among one third of the patients. Only a limited number of respondents, however, experienced limitations in personal care. The regression analysis suggests that most of the impairments experienced by patients also limited activities and sleep function. The effect of impairment on the limitation was not, however, always stable during the follow-up. This could be explained by adaptation to the impairments, by an on-going healing process or by the worsening of some impairments.

Participation restrictions in the home were constant and greater than at work and in leisure activities, but at home patients had not given up any tasks. Patients had given up leisure activities, which could mean the narrowing of social participation. Reduced work ability was described by some patients, which could lead to earlier retirement or an increase in taking of sick-leave.

In III study we used the ICF framework, which was a useful tool for understanding the process of disablement of breast cancer patients. Experienced impairments did not necessarily lead to activity limitations or similar participation restrictions at work, in the home or in leisure activities.

5.5.3 Effects of therapeutic exercise

The effects of therapeutic exercise were seen in most body functions and structures examined; shoulder movement deficits improved, upper limb strength increased, circumferences of the upper limb decreased and experienced pain decreased. Also some activity limitations and participation restrictions improved.

The increases in ROM measurements in both groups were small with, only the experimental group achieving a significant increase in abduction at the end of the study. As the ROM values at the baseline were near the normal values of this age-group, major changes could have not been expected. The increase in abduction could be explained by the use of exercises such as scaption, push-up, press-up and rowing. These exercises activate scapular motion, and proper stability of the shoulder joint is achieved by correct activity of scapular muscles (Moseley et al. 1992). Also mobility training could explain the end range increase in abduction. The changes in upper limb strength were more obvious in both groups. After age-adjustment the increase in strength values was more in the experimental group than in the control group in every strength

measurement. However, the differences between the groups were statistically significant only in the pectoral press. In addition, the experimental group had a significant increase in the lift test of both upper limbs.

Volumetric and circumferential measurements showed no increase in the mean values of either group. Rather, a positive trend was seen in the experimental group in most of the circumferential levels of the upper limb during and after therapeutic exercise. Similar positive results have been shown in one previous therapeutic exercise study by Kärki & Kautoniemi (1999), shorter intervention studies have not shown any significant effect (Wingate 1985, Wingate et al. 1989, Na et al. 1999, McKenzie & Kalda 2003).

The level of activity limitations decreased in the experimental group more than in the control group. Therapeutic exercise seemed to have an especially positive effect on the use of the upper limb in carrying and reaching. Also arm related participation restrictions in the home decreased more in the experimental group than in the control group.

5.5.4 Limitations (II-IV)

There are some critical issues concerning the cross-sectional study (II), as the survey was done 6 months after operation and the time gap could have affected the accuracy of the respondents' answers. Another point is that this retrospective survey only gave a view of the education recalled by the patients. More detailed information could have been collected by diaries or interviews. Wider knowledge of given and education recalled could have been achieved by a combination of data collection both during the hospital period, by observational methods, and after by survey or other suitable methods. However, we could assume that patients should be able to remember and follow the instructions they received from health-care professionals. Moreover, it seemed to be the only time they were educated in this matter for over half of the respondents.

In the study III a survey method was used for data collection of the experienced impairments, activity limitations and participation restrictions. Even though self-reports have been shown to have good correlation to measured ones (Turk & Okifuij 1999), perhaps more exact data could have been achieved by different, but more time consuming measurements. In addition, the sizes of the adjuvant treatment subgroups were too small for further analysis. This can also partly explain why the side-effects of radiotherapy (Gosselink et al. 2003, Blomqvist et al. 2004, Rietman et al. 2004) were not seen in this study. The follow-up time was one year, and it can be considered that it is too short to discover the persistence of the impairments or occurrence of new impairments as a late outcome of breast cancer treatments.

The use of the ICF framework in study IIII showed that for a more thorough understanding of functioning and disability the participation domain should be assessed by using various measures of both performance and capacity.

Major limitations in study IV concern the sizes of both the experimental and control group; they should have been larger. Achieving larger groups from

the same area, which would have been in the same healing phase, was not, however, possible in this study. The next step could be to repeat this experimental study protocol several times and pool the data in a meta-analysis. Another possibility would be to implement a joint research project with other districts in Finland or even in other countries.

In addition, little could be concluded regarding the effects of dynamic repeated movements for the prevention and treatment of lymphedema. For that purpose a separate study without therapy or exercise bias should be carried out. The strength training carried out in this study did not cause any side-effects and, therefore, an even higher training level could be implemented in future studies. We should also have monitored the home-exercises more carefully, for assessment of self-training intensity. In future studies the analysis of MET (Metabolic Equivalent) of each participant could be a useful tool for this purpose and for overall measurement of physical activity during intervention studies. Jones et al. (2004) already reported in their randomized controlled trial the self-reported exercise behaviour of breast cancer patients in MET.

6 CONCLUSIONS AND CLINICAL IMPLICATIONS

The main conclusions of the series of studies can be summarised as follows:

1. There are only a limited number of clinical studies (1980-1999) of high methodological quality in the field of physiotherapy and exercise after breast cancer surgery. Therefore, pooling the studies and meta-analysis was only possible in one research field. The effect size calculation in this field indicated that early shoulder movements compared to delayed movements have no justification. This implication is still justified after reviewing the newest studies in this field.

- Physiotherapists use various methods when treating lymphedema after breast cancer treatment. From various methods only studies concerning the use of an elastic sleeve manage to show its effectiveness. These results support the clinical implications for the systematic and prolonged use of an elastic sleeve, either alone or combined with pneumatic compression. Based on the studies of lymphedema therapy in this critical review we conclude that there is a clear need for studies with no treatment bias and with higher methodological quality for establishing evidence of the efficacy of widely used methods such as lymph massage, laser therapy, microwave, mechanical pressure, and exercise. Since the review, several studies of lymphedema therapy have been published, but only low-level laser therapy has been shown to be effective over other methods. The studies of different lymph massage methods suffer constantly from treatment bias. Exercise as prevention or treatment of lymphedema have not been separately studied, and based on the critical review and some other studies, we suggest that dynamic movements or exercise does not increase or cause lymphedema.
- The few published exercise therapy studies demonstrated methodological shortcomings. Some of the studies with control or comparison groups succeeded in showing some advantage when using exercise therapy. After critical review only one study concerning immediate postoperative arm massage for pain has been published. This study had similar methodological shortcomings and the effects of massage on the healing process in the immediate postoperative phase were not considered.
- Aerobic exercise studies published in 1980-1999 have been able to show that physical activity is beneficial for breast cancer patients. The psychological benefits were the most widely studied. Based on the studies of critical review

> we cannot make any recommendations regarding exercise frequency or intensity for breast cancer patients undergoing radiotherapy or chemotherapy. We can, however, state based on the review and the studies published after it, that it is safe for patients to exercise, but the intensity of exercise should not be too strenuous as that can cause increased fatigue. The estimation of individual training levels is essential for creating a safe and effective exercise program. Most of the studies have managed to show an increase in QOL, decrease in fatigue and an increase in overall well-being.

2. There is an obvious need for a systematic education protocol for breast cancer patients agreed by different health care professionals. In this protocol, the responsibility of each professional should be defined and an informal content of education described. While the hospitalization time is short, a day or some days, the follow-up protocol should be developed not only for screening the recurrence of the cancer, but also for offering systematic education concerning exercise and treatment and use of the upper limb. In this way we could also reduce the possible treatment costs, costs of sick leave and early retirement.

3. Breast cancer patients experience several impairments 6 and 12 months after primary treatment of cancer. Some impairments persist, some are relieved and some new even appear one year after breast cancer surgery. Activity limitations such as lifting, carrying and reaching were experienced by many patients, and sleep was also impaired by impaiments. Some impairments persist, but some adjustment was seen in the self-assessed activity limitation caused by numbness, which decreased in the one year follow-up. The impairment effect on activity and on participation domains was not so straightforward. Without severe impairment there were activity limitations and with impairment some did not experience activity limitations and participation restrictions. Experienced impairments did not lead to similar restrictions at work, in the home and in leisure activities. Women rather gave up their leisure activities than home or work tasks.

There is an urgent need for developing systematic rehabilitation protocols for breast cancer patients to support their functioning and to prevent permanent, limiting disabilities that affect their health condition. The protocols should also be different with different operations and postoperative treatment, because the recovery pattern and postoperative impairments are discrete. Use of ICF framework is a useful tool for understanding the functioning of breast cancer patients, and based on ICF, a wider rehabilitation concept and plan for each patient should also include more information concerning social and environmental aspects.

4. Therapeutic exercise is effective for the treatment of most post-treatment impairments of the upper limb and body. The exercise relieves upper limb related activity limitations and participation restriction to some extent. We can also state that it is safe for breast cancer patients six months after breast cancer operation to exercise at an intensive level. For these patients with disabilities the optimal length of therapeutic exercise intervention should be at least three

months, carried out twice a week and aiming to the optimal exercise level for strength (70-80%). An individual home exercise regime should be implemented and carried out independently for maintenance of functioning. The exercise therapy programme and home exercise regime should be carefully monitored and tailored by the rehabilitation needs of each patient. A systematic follow-up protocol with essential measurements alone can also enhance recovery and facilitate the use of the upper body and limb of the operated side.

YHTEENVETO

Rintasyöpäleikattujen toimintakyky ja siihen vaikuttaminen fysioterapiassa ja harjoittelussa

Rintasyövän sairastaneiden naisten määrä lisääntyy koko ajan, Suomessa vuonna 2002 sairastui 3774 naista. Suomessa, kuten muissakin länsimaissa, hoidot ovat tehokkaita ja 5-vuoden kuluttua rintasyöpään sairastuneista on elossa 84%. Rintasyöpä koskettaa niin nuorempia kuin vanhempiakin naisia, niin työssä kuin eläkkeellä olevia. Lääketieteellisen hoidon kehittyminen ei ole vastaavasti johtanut rintasyöpäleikattujen kuntoutuksen kehittymiseen samassa määrin. Rintasyöpäpotilaiden seurantajärjestelmä on kehitetty ennen kaikkea uusien syöpätapauksien seulontajärjestelmäksi ja leikkauksen jälkeen tapahtuvan syövän muun lääketieteellisen hoidon suunnittelemiseksi ja seuraamiseksi. Potilaiden ohjauksen ja hoidon sekä kuntoutuksen haasteeksi on muodostunut lyhyt sairaalassaoloaika. Lyhentyneet hoitoajat vaativat uudelleen arvioimaan sekä ohjausta leikkauksen yhteydessä että seurantajärjestelmän kattavuutta.

Rintasyöpään sairastuneilla todetaan edelleen useita myöhäisoireita, joiden aiheuttamaa haittaa suorituksissa ja osallistumisessa kotona, työssä ja harrastuksissa tulee pystyä vähentämään ja poistamaan riittävän tehokkaasti jo syöpähoitojen aikana. Tämän tutkimuksen perusteella ehdotamme, että myöhäisoireiden esiintymistä selvitetään, sekä haittoja ja rajoituksia arvioida seurannan aikana systemaattisesti. Tällainen arviointi johtaa riittävän laajaan yksilölliseen kuntoutustarpeen määrittelyyn ja kuntoutussuunnitelmaan sekä kuntoutustoimenpiteiden toteutukseen. Kuntoutuksessa fysioterapiapalvelut muodostavat yhden alueen käytettävistä kuntoutusmuodoista. Fysioterapiassa toteutettavien terapiamenetelmien ja harjoittelun tulee perustua näyttöön menetelmien ja harjoittelun vaikuttavuudesta ja turvallisesta toteutuksesta rintasyöpäleikatuilla. Nykyiset suositukset fysioterapiassa käytettävistä menetelmistä ja harjoittelusta perustuvat Suomessa ja muuallakin muutamiin tutkimuksiin, tai tutkimusnäyttö voi niistä puuttuu kokonaan.

Tämän väitöskirjan osatutkimusten avulla pyrittiin selvittämään rintasyöpäleikattujen toimintakykyä ja fysioterapiassa käytettävien menetelmien vaikuttavuutta. Ensimmäinen tutkimus oli kriittinen kirjallisuuskatsaus ja meta-analyysi vuosina 1980-1999 julkaistuista tutkimuksista (n=31) koskien rintasyöpäpotilaiden lymfaturvotukseen käytettyjen menetelmien vaikuttavuutta (n=16), rintasyöpäleikkauksen jälkeen sairaalavaiheessa toteutuvaa yläraajan liiketerapiaa (n=7), terapeuttista harjoittelua sairaalavaiheen jälkeen (n=4) ja aerobista harjoittelua (n=4). Toisessa tutkimuksessa selvitettiin kuuden kuukauden kuluttua leikkauksesta vuoden aikana Satakunnan alueella rintasyöpäleikattujen (n=105) sairaalavaiheen ohjausta koskien yläraajan käyttöä, harjoittamista, turvotuksen ehkäisyä sekä hoitoa. Kolmannessa tutkimuksessa seurattiin 6 ja 12 kuukautta leikkauksesta rintasyöpäpotilaiden (n=96) kokemia yläraajan ja ylävartalon oireita, suoritusten ja osallistumisen rajoittumista kotona, työssä ja harrastuksissa. Neljännessä tutkimuksessa selvitettiin koe-

(n=11) ja kontrolliryhmäasetelmalla (n=11) terapeuttisen harjoittelun vaikutuksia yläraajan liikkuvuuteen, voimaan, turvotukseen ja arvioitiin myös oireiden, suoritusten ja osallistumisen muutoksia harjoittelun seurauksena.

Kriittisen kirjallisuuskatsauksen ja meta-analyysin tuloksena voitiin todeta, että tutkimuksista vain muutama oli laadukas, ja meta-analyysi eli tulosten yhdistäminen tilastollisesti oli mahdollista vain yhdellä osa-alueella. Tämän osa-alueen meta-analyysi osoitti, että leikkauksen jälkeen heti aloitetut yläraajan liikkuvuusharjoitteet eivät ole perusteltuja, koska ne lisäävät haavaerityksen määrää enemmän kuin 5-7 vuorokautta leikkauksesta aloitetut harjoitteet. Meta-analyysillä voitiin myös osoittaa, ettei liikeharjoitteiden aloittaminen myöhemmin lisännyt leikatun puolen olkanivelen liikerajoituksia. Rintasyöpäleikattujen lymfaturvotusta pyritään fysioterapiassa hoitamaan erilaisilla menetelmillä. Tässä kriittisessä kirjallisuuskatsauksessa, ei voitu selvästi todeta kuin yhden menetelmän osalta selvä näyttö. Yläraajan elastisen tukihihan käytöstä oli selvää positiivista näyttöä, ja tutkimusten perusteella voidaan suositella systemaattista ja pitkäaikaista elastisen tukihihan käyttöä, joko yksinään tai yhdistettynä mekaaniseen kompressiohoitoon. Lymfahieronnan vaikutusta itsenäisenä hoitona ei ole tutkittu, vaan hieronta on toteutettu osana erilaisia hoitoyhdistelmiä, jolloin hieronnan vaikuttavuudesta ei voida yksin osoittaa näyttöä. Yläraajan harjoitteiden käyttöä niin lymfaturvotuksen ehkäisyssä kuin hoidossa ei ole erikseen tutkittu. Lisäksi voidaan todeta, etteivät yläraajan dynaamiset liikkeet tai yläraajan lihasharjoittelu lisää turvotusta.

Leikkauksen jälkeen toteutetusta yläraajan terapeuttisesta harjoittelusta ei voida kriittisen kirjallisuuskatsauksen perusteella antaa suosituksia tutkimusten heikon laadun vuoksi. Aerobinen harjoittelu rintasyöpäleikatuille on kirjallisuuskatsauksen ja sen jälkeen julkaistujen uusimpien tutkimusten perusteella niin fyysiseen kuin psyykkiseen hyvinvointiin positiivisesti vaikuttavaa. Näiden tutkimusten perusteella ei kuitenkaan voida vielä antaa tarkkoja suosituksia rintasyöpäleikkauksen jälkeen toteutettujen hoitojen aikana tapahtuvan aerobisen harjoittelun tehosta tai useudesta. Voimme kuitenkin todeta, että aerobinen harjoittelu on turvallista, kunhan se ei ole liian kuormittavaa eikä näin lisää hoitojen aiheuttamaa väsymystä. Harjoittelutason yksilöllinen arviointi on aina tarpeen turvallisen ja tehokkaan harjoittelun takaamiseksi.

Kyselytutkimuksen tulokset rintasyöpäleikattujen sairaalavaiheen ohjauksesta koskien yläraajan käyttöä, harjoittamista, turvotuksen ehkäisyä sekä hoitoa osoittivat, että potilaiden muistama ohjaus käsitti pääasiassa ohjeita yläraajan liikkuvuuden harjoittamisesta ja yläraajan käytöstä. Potilaat olivat omasta mielestään saaneet vähiten ohjausta yläraajan turvotuksen ehkäisystä ja hoidosta sekä yläraajaan voiman harjoittamisesta. Ohjauksen sisällössä näkyi ristiriitaa, osaa potilaista oli varoitettu kuormittamasta yläraajaa esim. varoitettu nostamisesta, kantamisesta, raskaan työn tekemisestä ja osalle oli ohjattu yläraajan normaali käyttö. Ohjauksen ristiriita voi myös johtua potilaita ohjanneiden erilaisista käsityksistä ohjattavasta asiasta. Sairaalavaiheen jälkeen ohjausta em. asioista oli saanut alle puolet vastanneista.

Seurantatutkimus potilaiden yläraajan ja ylävartalon oireista, suoritusten ja osallistumisen rajoittumisesta kotona, työssä ja harrastuksissa osoitti koettujen oireiden määrän pysyneen 6 ja 12 kuukauden seurannassa hyvin samanlaisena. Kipuoireiden aiheuttama haitta ei kipujanalla mitattuna ollut voimakas, mutta suoritusten, kuten nostamisen, kantamisen, kurkottamisen, koettiin rajoittuvan kivun takia. Tunnottomuuden aiheuttama haitta väheni seuranta-aikana, joten voidaan olettaa, että kyseiseen oireeseen totuttiin. Tässä tutkimuksessa ylipainolla oli merkitystä, näillä potilailla oli enemmän niska-hartiakipuja ja yläraajan liikerajoitukset haittasivat heidän suorituksiaan enemmän. Kyselyyn vastanneista kolmannes koki oireiden häiritsevän nukkumista. Osallistuminen kotitöihin oli rajoittuneempaa kuin osallistuminen työhön tai harrastuksiin, kuitenkaan kukaan vastaajista ei ollut luopunut kotitöistä. Sen sijaan osa vastaajista oli luopunut kokonaan jostain vapaa-ajan harrastuksesta ja koki työkykynsä alentuneen.

Kokeellisessa satunnaistetussa tutkimuksessa harjoittelun vaikutus nähtiin useimmassa tutkituista muuttujista, etenkin olkanivelen liikkuvuus parani, yläraajan lihasvoima parani joissakin mitatuissa lihasryhmissä enemmän kuin kontrolliryhmällä, yläraajan ympärysmitta pieneni ja koettu kipu väheni. Myös jotkut suoritusten ja osallistumisen rajoitteet vähenivät. Erityisesti kantaminen ja kurkottelu leikatun puolen yläraajalla helpottuivat ja kotitöiden tekeminen aiheutti vähemmän oireiden pahenemista.

Tämän väitöskirjan osatutkimusten perusteella voidaan ehdottaa rintasyöpäleikattujen leikkauksen jälkeisen yläraajan liikkuvuuden harjoittamisen aloittamista myöhemmin, 5-7 päivää leikkauksesta. Leikkauksen jälkeinen ohjaus tulisi uudelleen suunnitella moniammatillisessa työryhmässä, ja toteuttaa osana rintasyöpäleikattujen seurantaohjelmaa. Ohjaus tulisi suunnitella ja tulevaisuudessa päivittää tutkitun tiedon perusteella systemaattisesti. Rintasyöpäleikattujen oireet ja rajoituksen niin suorituksissa kuin osallistumisessa ovat moninaiset ja edellyttävät yksilöllisen kuntoutustarpeen arviointia seurantaohjelmassa. Vain riittävän varhainen puuttuminen toimintahäiriöihin tai niiden syntyyn voi edesauttaa rintasyöpäleikattujen toimintakykyisyyttä ja selviytymistä kotona, työssä ja harrastuksissa. Terapeuttista harjoittelua, joka sisältää myös yläraajan voiman harjoittamista voidaan suositella osaksi rintasyöpäleikattujen harjoittelua.

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