Gentle Strength Training in Rehabilitation of Breast Cancer Patients Compared to Conventional Therapy

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Abstract. *Movement therapy during the rehabilitation of breast cancer has become more important over the last years. Patients and Methods: In a randomized controlled study the feasibility of gentle strenght training was compared to conventional gymnastic exercises during rehabilitation of breast cancer patients. The aim oft this study was to identify alternative sports intervention in the treatment of breast cancer patients. The intervention group (IG) was lifting standardized weights weekly (50 % of h1RM), while the control group (CG) received conventional gymnastic exercises. A bicycle ergometry adjusted to the WHO system was performed with all participants at study entry (T0), after three (T1) and six months (T2). The quality of life was measured by standardized report forms (EORTC QLQ C30 Version 3 and BR23). Results: Both methods showed a slight improvement in submaximal endurance performance, a significant improvement in the subjective feeling of effort (IG: 75 W: <0.01, CG: 75 W <0.01), in psychosocial and psychological parameters like quality of life (IG: <0.01, CG <0.01) and in fatigue (IG: <0,01, CG: <0.01). Conclusion: This study shows positive effects for gentle strength lifting in the rehabilitation of breast cancer patients and turned out to be a probate alternative to gymnastic exercises.*

As a result of adjuvant chemo- or radiotherapy a large proportion of women with breast cancer suffer from extraordinary physical, mental and spiritual exhaustion (fatigue) (1). Several studies have shown that in addition to drug therapy, physical training has a positive effect on disease- and treatment-associated symptoms such as fatigue, nausea and reduced muscular and cardiovascular performance (1-7). In the past the target of sports and exercise therapy in rehabilitation after breast cancer, was only seen to be focusing in improving quality of life and fatigue. Meanwhile studies have shown a decrease in relapse rate due to increased physical activity (8).

The first sport intervention studies in patients with cancer focused on the effects and influence of endurance training (9, 10). Although more and more studies on strength training in oncology, during recent years, have shown that targeted strength training in the different therapy phases offers an option for the treatment of cachexia, the experience is limited to only a few studies (11-13). This phenomenon is also seen in rehabilitation, where almost exclusively, gymnastics as a sport and endurance training are found, whereas strength training intervention is under-represented.

The present study uses gentle strength training as a sports intervention in the rehabilitation of patients with breast cancer to evaluate the impact on the psyche (*e.g.* quality of life and depression) and the changes in submaximal endurance conductivity.

Patients and Methods

For this prospective, randomized study, female patients with breast cancer were recruited at the Breast Oncology Unit at the Kiel University Hospital (OB/GYN, UKSH, Kiel, Germany). The study was reviewed positively by the examination board.

Out of 60 patients screened, 38 patients were enrolled in the study and were randomized in a gentle strength training group as an intervention group (IG) and in a conventional gymnastics exercise group as a control group (CG). Inclusion and exclusion criteria are shown in Tables I and II. The study was supervised by breast oncologists and researchers of the Institute of Sports Science at Kiel University. The patients were recruited in the

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Table I. *Inclusion criteria for study participation.*

Inclusion criteria
Breast cancer patients after lumpectomy or mastectomy
Stage I-III
Completed chemotherapy
Completed radiotherapy
Age: 18-70 years
BMI: 18-30

Table II. *Contraindications or study participation.*

Contraindication
Acute infectious disease
Severe cardiac disease (New York Heart Association functional class III myocardial infarction <3 months)
Severe pulmonary insufficiency
Renal insufficiency (glomerular filtration rate <30%)
Serious neurological disorders
Less than 10,000 platelets
Hemoglobin 8g/dl
Limited walking distance, no walking or no stability

hospital at the end of their treatment. Randomization was alternately (1:1) carried out into the intervention and control groups. All patients were in the postoperative, post-chemotherapy and post-radiotherapy phase. An overview of the sample description (age, height, weight, primary diagnosis, therapy method) are shown in Table III. Due to secondary diseases (osteoarthritis) or time difficulties caused by professional activities during the randomized study, five out of 38 patients left the study: four withdrew from the IG and one from the CG. The data of 33 patients were used for the analysis, out of which 15 patients were in the IG and 18 in the CG.

Endurance tests as step stress tests were carried out by all patients before (T0) the first sports and movement unit, again after three months (T1) and then after six months (T2). A determination of body height and body weight was used to record the body mass index (BMI). To determine the initial stress level a hypothetical maximum force test was performed with all members of the IG (h1RM) (14). With the help of a quantitative survey at the time points mentioned above with the questionnaires EORTC QLQ C30 and the BR23 module, somatic complaints, feelings, fears and concerns, as well as the health status and quality of life status, were recorded and evaluated (3, 15). The two groups were compared with each other at the end of the study. The flow chart in Figure 1 shows a trial profile during the study.

The IG completed one training set of 20 repetitions with a hypothetical 50% of the maximum weight, using 11 workout machines. The training took place on the following devices: squat, chest press, leg curl, rowing, leg extension, upper arm curl, upper arm extensors, shoulder press, abdominal bench and lats pull down. The CG exclusively completed gymnastic exercises. For half a year both groups received their training programme once per week for one hour for each workout.

Table III. *Anamnestic and anthropometric parameters of the intervention of the control group.*

Anamnestic and anthropometric parameter	Intervention group	Control group
Number	15	18
Age (years) (mean±d)	58±8.41	55±10.59
Height (cm) (mean±d)	171±6.32	167±6.32
Weight (kg) (mean±d)	82±15.15	72±15.52
Time from diagnosis (in months (mean±d)	8.66±5.61	10.2±4.98
Chemotherapy and radiotherapy (n)	8	13

Recording quality of life. The European Organization for Research and Treatment of Cancer (EORTC) has developed several questionnaires to reveal the quality of life of patients with cancer in a multidimensional approach. The questionnaire EORTC QLQ C30, version 3 BR23, especially developed for patient with breast cancer as a basis for the recording of changes at the psychological level, was used for the study (5, 18). The results section focuses on the items of the questionnaire, quality of life and fatigue.

The training. During the study, the IG was trained with the training method, gentle strength training as strength endurance training. The control group carried out a weekly conventional gymnastic exercise unit such as chair or floor exercises with various sports equipment. During the gentle strength training workout, the individual training series was not carried out until the last repetition as in conventional strength training, meaning the complete short-term fatigue of the muscle, but was significantly stopped before. The criterion for completion of each series was the subjective feeling of stress which is still disregarded in strength training (19). For the subjective assessment of the impact of perceived exertion the scale of stress rating according to Borg was used (16).

The American College of Sports Medicine recommends a training load of 50% of one repetition maximum (1RM) (20). Therefore, on the basis of h1RM measurement, a training plan for every participant was developed, where at the very beginning of the gentle strength training programme the intensity of h1RM was set at 50%, with 20 repetitions during one training set per device. Any further increase in intensity was based on the Borg scale.

Measurement of endurance. The endurance test was used to verify endurance and was performed at all study time points. The test was preceded by a medical and a sports therapeutic examination. Only after all contraindications (Table II) for a step stress test were excluded, was the test performed.

Due to the temporal proximity to medical therapy a bicycle ergometer was used for the examination, according to the WHO scheme (15) (Figure 2), performed with a submaximal load and an upper pulse limit of 220 minus age as a termination criterion of the test and a maximum loading of 100 W. At the end of each exercise level, the heart rate, blood pressure and the subjective perceived exertion, based on a numerical scale according to Borg, were recorded (16).

The test was terminated when the upper heart rate limit was reached, a systolic blood pressure of 200 mmHg was exceeded (17), the number of rotations could not be maintained, or the patient

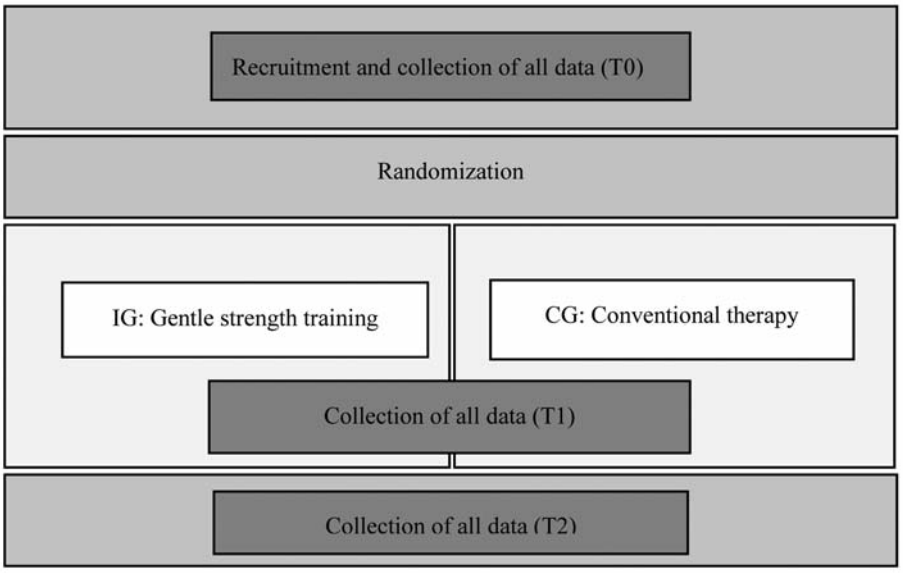

Figure 1. *Trial profile during the study.*

expressed discomfort or complained that the burden was too much. *Strength test*. The h1RM (hypothetical maximum weight for one repeat) is a dynamic maximum force test. The test is performed according to the repetition method, where the sports therapist chooses the weight, so that the patient cannot carry out more than 20 repeats (14). The testing took place on all devices, comprising the content of the training of the IG.

Statistics. For data analysis descriptive data such as mean and standard deviation were used. The α-level of significance was set at ≤0.05. The comparisons between the two groups were performed using an independent *t*-test and the changes within the group using analysis of variance.

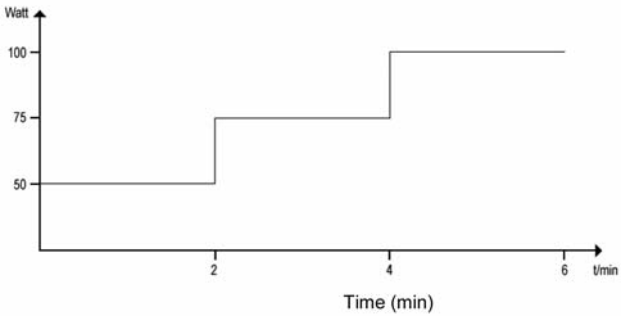

Figure 2. *Bicycle ergometer training according to the WHO scheme.*

Results

A non-significant improvement in submaximal endurance exercise capacity was seen in the IG. At the start at T0, the Watt capacity of every participant per kilogram of body weight in the IG was 1.18. This increased at T2 to 1.21 W/kg/body weight (>0.05). In the CG, this value decreased from 1.47 W/kg/body weight at T0 to 1.38 W/kg/body weight at T2 (>0.05).

A significant change in BMI over the course of the study was not detected (p>0.05). Weight reduction was measured in both groups. In the IG, the BMI at T0 was 28.04 kg/m^2 and at T2 it was 27.01 kg/m^2; in the CG, at T0 it was 25.81 kg/m^2, compared to 25.10 kg/m^2 at T2.

The results of the subjective assessment of the impact of perceived exertion showed a significant improvement in both groups. While the improvement in the IG was highly significant at all three load levels during the course (T0/T1/T2) (50 W: <0.01, 75 W: <0.01, 100 W: <0.01), the improvement in the CG was only highly significant at 50 W (<0.01) and at 75 W (<0.01) (Table IV).

The quality of life (Table V) at T0 was not equal in both groups; It was estimated to be poorer in the IG. At T2, the quality of life in both groups was estimated to be equal. In a comparison (two-factorial analysis of variance) of quality of life scores at the three different time points, significant improvements in both groups were seen (IG: <0.01, CG: <0.01). A comparison of values between the groups showed no significant difference. Furthermore a highly significant improvement in fatigue symptoms occured in both groups (IG: <0.01, CG: <0.01) (Table VII). There were no significant differences between the two groups at T0 (=0.774) and T2 (=0.630) by the *t*-test.

Table IV. *Subjective effort in the intervention and control group in training to Borg scale (16). Data are means±SD.*

	T0		T1		T2		*p*-Value	
	IG	CG	IG	CG	IG	CG	IG	CG
50 Watt	11.8±1.667	12.1±1.664	10.6±2.33	9.94±2.0	9.46±2.41	8.42±2.35	<0.01	<0.01
75 Watt	14±2.11	14.52±1.84	12.26±3.5	12.36±1.40	11.85±2.57	11.68±2.27	<0.01	<0.01
100 Watt	16±1.2	15.866±4.24	15.41±2.49	14.53±3.5	14.28±3.78	14.05±2.98	<0.01	n.s.

Discussion

A scientific evaluation of strength training in the rehabilitation of patients with breast cancer and comparisons of methods of training interventions have not yet been sufficiently performed. This investigation, conducted with 33 patients, confirms previous data (1, 3, 5, 7, 12, 18, 21, 22) that physical activity has a positive impact on the quality of life and fatigue. The intervention comparison shows that a conventional gymnastic exercise programme as well as a gentle strength training programme lead to a significantly improved quality of life and reduced fatigue symptoms. De Backer *et al*. had similar results in a study of patients with different cancer entities after the impact of an 18-week strength training programme (22). Pure strength training in the rehabilitation of breast cancer patients was led by Ohira *et al*. (12). The training programme resulted in a significant increase in muscle strength, which correlated with improvements in physical function scales of the EORTC questionnaire (12). Our own results are thus consistent with results from other studies.

In both groups, a weight reduction was seen. Chlebowski *et al*. and Goodwin *et al*. describe a causal relationship between obesity and the risk of developing breast cancer (23, 24). According to the evaluation criteria of the World Cancer Research Fund (WCRF), there is convincing evidence through different studies that a high BMI is associated with a worse prognosis for women with breast cancer (25). This factor plays an important role in risk reduction and should be controlled in other studies (23, 24).

The treatment methods, gentle strength training and conventional gymnastic exercise, should not be regarded as competitors, but as an extension of the therapeutic opportunities. In their study Courneya *et al*. found that patients with breast cancer may have preferences for a particular training method and that this preference influences the effectiveness of the training programme. Patients who preferred strength training had better improved quality of life if they had participated in strength training compared with usual care or aerobic exercise training (21).

Results from this study suggest that a conventional gymnastic exercise programme as well as a gentle strength training programme represent effective methods, leading to an improvement in quality of life and reduce symptoms of fatigue and subjective feeling of perceived exertion. Gentle strength training can be viewed as an effective means for sport therapeutic rehabilitation aftercare for patients with breast cancer and is a probate alternative to gymnastic exercises.

Table V. *Quality of life score at the three measuring points in the intervention group (IG) and control group (CG). Data are means±SD.*

Group	T0	T1	T2	*p*-Value
IG	59±16.62	67±19.92	76±12.93	<0.01
CG	67±17.23	75±17.95	77±15.27	<0.01

Table VI. *Fatigue at the three measuring points in the intervention group (IG) and control group (CG). Data are means±SD.*

Group	T0	T1	T2	*p*-Value
IG	49±23.7	31±20.22	26±23	<0.01
CG	47±17.79	23±14.2	34±26	<0.01

Conflicts of Interest

No potential conflicts of interest were disclosed.

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