EFFECT Study Training Manual for Exercise Specialists

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 825677

CONTENT

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1 INTRODUCTION AND CONTACT DETAILS

The EFFECT study: Effects of structured and individualized exercise in patients with metastatic breast cancer on fatigue and quality of life

Metastases are the leading cause of breast cancer-associated deaths, responsible for more than 600.000 premature deaths around the world each year. One in eight women will develop breast cancer and up to 40% of the women diagnosed with early breast cancer will develop metastatic breast cancer (1). Important drivers that determine how patients with metastatic breast cancer experience their HRQoL include levels of fatigue, pain, insomnia, depression and nausea. Of these side effects, fatigue (experienced by nearly up to 90% of individuals receiving cancer therapy)(2,3), exerts a deleterious impact on HRQoL and has a large negative impact on daily activities.
As the overall percentage of women that survive 5 years following stage IV diagnosis, now reaching 30% with 10% surviving 10 years, is gradually increasing due to the fast development of new agents, larger number of women will potentially be confronted with diminished HRQoL and its sequelae.

It is now well established that exercise has a positive effect on cancer- and treatment-related side effects. Exercise has been shown to have a positive effect on quality of life, fatigue and psychological distress, as well as on physical fitness and functional ability, which is important for activities of daily living and coping with everyday life. A systematic review of pharmaceutical and non-pharmaceutical interventions showed that exercise is the most promising intervention for reducing fatigue in cancer patients treated with curative intent (4). However, to date no clear evidence has been delivered in patients with metastatic breast cancer. Only very few, mainly small studies with short interventions have been performed.

As exercise interventions have been predominantly studied in earlier stages of breast cancer, researchers within this project identified the need for this type of research in patients with metastatic breast cancer. The condition of patients with advanced (metastatic) disease differs considerably from that of early-stage disease in terms of HRQoL and functional capacity.

Therefore, we aimed to investigate the effects of a structured and individualized exercise program on physical fatigue and/or the overall HRQoL-related symptom burden in patients with metastatic breast cancer. The most important result of the EFFECT study is that participants in the exercise group were less fatigued and reported a better quality of life than participants in the control group. In addition, positive results of the training program were observed for physical fitness and other symptoms such as pain and shortness of breath. Furthermore, participants only missed a few training sessions on average, which suggests that the training program was manageable for them.

This EFFECT study training manual for physiotherapists/certified exercise specialist provides insight as to what was provided to exercise specialists involved in the EFFECT study and how the training was structured as part of the EFFECT study.

If you have any questions, do not hesitate to contact the study team.

With kind regards,
The EFFECT study team

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Contact details EFFECT study team:

If you have any questions, please reach out to our coordinating center in UMC Utrecht in The Netherlands or to the country-specific centers listed below.

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2 PROTOCOL EXERCISE PROGRAM

Exercise program

The exercise program started with a 6-month period, where patients participated in a supervised multimodal exercise program twice a week (60 minutes per session) and additional unsupervised exercises (30 minutes per day on all remaining days of the week supported by the Fitbit and PREFERABLE app). After completing the initial 6-month period, one supervised session was replaced by one unsupervised session (60 minutes) until month nine.

A. Intake

Prior to commencing the exercise program, each participant had an one-on-one session with the exercise specialist in order to individualize the standard exercise prescription to meet their specific needs. During this session, the exercise specialist discussed the patient's medical and physical activity history. Furthermore, they discussed the following topics:

- Attendance during the exercise sessions
- The exercise protocol
- How to become active on a daily basis ((in the study this was supported by a Fitbit and exercise App)

B. Exercise session

All exercise sessions consisted of balance, strength and endurance exercises. All sessions ended with a 5-min cool down. Ideally, the strength training was performed before the endurance training.

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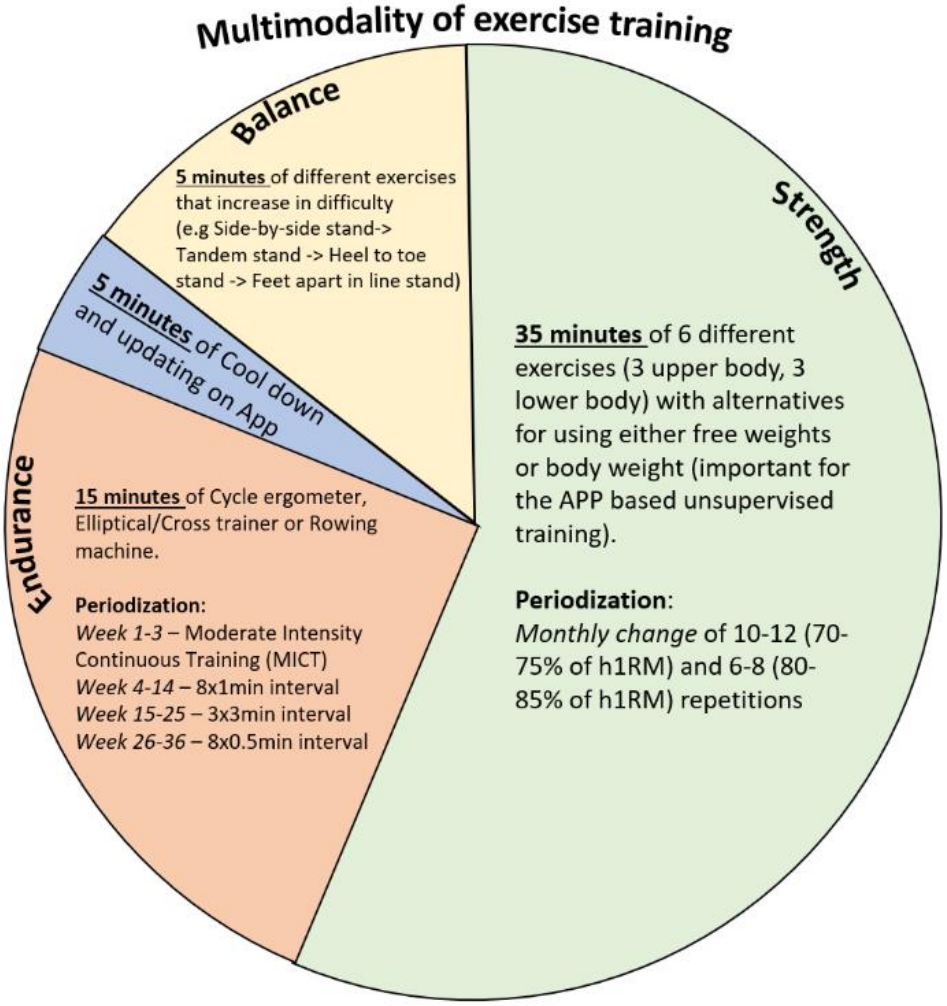

Balance exercises (5 minutes, Appendix I)

The exercise sessions started with 5-minutes of balance and core training. Exercise options are provided in the table below or can be found in appendix I. Progression depended on the subjective evaluation of both the trainer and patient. If necessary, the trainer provided assistance to ensure the patient didn't fall over. Risk of falling was always minimized.

Balance and Core Training *(for adaptation due to bone met., either omit exercises acc. to Table. 1 or use a "start low go slow" approach)*				
Duration (min)		**Exercises**	**Intensity**	**Target Body Region**
overall	**single**			
5		***Initial exercises (progressing from left to right)****		
		Step 1 / Step 2 / Step 3 / Step 4		
		Side-by-side stand / Tandem stand / Heel to toe stand / Feet apart in line stand		
		Normal walk / Sideways walk / Heel to toe walk / Grape vine		
		More challenging exercises (progressing from left to right)*		
		Step 1 / Step 2 / Step 3 / Step 4		
		1 leg stand / 1 leg stand eyes closed / 1 leg stand with upper arm exercise / 1 leg stand with upper arm exercise and trunk rotation		
		Normal Backwards walk / Backwards walk on line / Heel to toe backwards walk / Heel to toe walk with turn around		
		Dual tasking stand / Dual tasking with squat / Dual tasking forwards walk / Dual tasking sideways walk		

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		Gluteal bridge	Gluteal bridge + alternating heel raise	Gluteal bridge + alternating bent leg raise	Gluteal bridge + alternating stretched leg raise		
		All fours + alternating arm raise	All fours + alternating arm + leg raise	All fours + alternating arm + leg raise (arm/leg stretched)	All fours + alternating arm + leg raise (arm/leg stretched) + approach arm/leg		

** See appendix I for more exercises*

Resistance training (35 minutes, Appendix I)

The resistance training consisted of 6 exercises targeting the lower (3) and upper (3) body. The exercises were delivered using the following modalities: machine-based, free-weights or body-weight. The order of the exercises was modified to add variety to the program. The repetitions were performed in a controlled and non-explosive manner. The participants completed the exercises according to the agonist-antagonist principle, where possible.
The trainer provided corrective feedback throughout the session in regards to repetition speed, repetition counts, posture etc.
Each exercise was performed three times and the intensity was periodized with a monthly change of 6-8 reps with 80-85% of h1RM and 10-12 reps with 70-75% of h1RM. The intensity of the resistance training was extrapolated from 12 repetition maximum (RM) tests (i.e. the maximal weight that can be lifted 12 times, which is equivalent to ~70% of 1RM) as well as the use of the modified Borg RPE scale.
The 12-RM tests were performed under the supervision of the exercise specialist for the 6 main exercises during the first or second training session, as well as after 3 and 6 months. If one of the 6 exercises was not performed for some reason, it was substituted by another exercises or the variation of the main exercise with free weights. Please see Appendix II for more information on 12-RM testing.
During the 9-months intervention period, the weights were continuously adjusted (increased or decreased) according to a progressive training protocol and in line with the periodization (pending on the participant´s present health status) so that the predefined maximum number of repetitions was met as close as possible.

Resistance training in patients with bone metastases
In general, depending on the characteristics of the patient and the experience of the therapist, there were two options when training patients with bone metastases:
1): exercises that loaded regions with bone metastases were omitted according to Table 1.

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2): a "start low, go slow" approach was used. Patients with bone metastases started with lighter weights and more repetitions and gradually increased weight over time, up to 10-12 repetitions at approximately 12 RM (estimated, not tested). Higher intensities (6-8 repetitions with 80-85% of h1RM) were avoided if deemed inappropriate by the supervising exercise specialist. If new bone pain occurred during exercise or if there was an increase in pain/pain medication use since the last exercise session, the weight was reduced.

The 12-RM testing was not performed in patients with bone metastases.

Resistance Training

(for adaption due to bone met., either omit exercises acc. to Table. 1 or use a "start low go slow" approach and omit progression to 6-8 reps at 80-85% h1RM)

Duration (min)		**Exercises**			**Intensity**							**Target Body Region**
overall	**single**											
		Variation 1 (machine-based)	**Variation 2 (free weights)**	**Variation 3 (body weight)**	Week 1-4	Week 5-8	Week 9-12	Week 13-16	Week 17-20	…	Week 33-36	
					1 min rest between sets							
35	6	**Leg press**	Squad (with weights) **or** Lunge	Squad **or** Lunge **or** Sit-to-Stand (without weights)	**10**-12 reps, 70-75% h1RM, 3 sets	6-8 reps, 80-85% h1RM, 3 sets	**10**-12 reps, 70-75% h1RM, 3 sets	6-8 reps, 80-85% h1RM, 3 sets	**10**-12 reps, 70-75% h1RM, 3 sets	…	**10**-12 reps, 70-75% h1RM, 3 sets	lower body
	6	**Leg curl**	Prone leg curl with ankle weights	Step ups **or** lunge Supine bridge	**10**-12 reps, 3 sets	6-8 reps, 3 sets	**10**-12 reps, 3 sets	6-8 reps, 3 sets	**10**-12 reps, 3 sets	…	**10**-12 reps, 3 sets	lower body

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6	**Leg extension**	Leg extension with ankle weights	Step ups **or** lunge Supine bridge	**10**-12 reps, 3 sets	6-8 reps, 3 sets	**10**-12 reps, 3 sets	6-8 reps, 3 sets	**10**-12 reps, 3 sets	…	**10**-12 reps, 3 sets	lower body
6	**Chest press**	Dumbbell bench press on bench/floor **or** Forward pushing of medicine ball (lying position)	Low level push ups	**10**-12 reps, 3 sets	6-8 reps, 3 sets	**10**-12 reps, 3 sets	6-8 reps, 3 sets	**10**-12 reps, 3 sets	…	**10**-12 reps, 3 sets	upper body
6	**Seated row machine**	Dumbbell rowing (1 vs 2 arms) **or** T-Bar, if available **or** Thera-Band (pull from front to the back	Seated row with resistance bands tied around post/pole/door (could also be performed standing)	**10**-12 reps, 3 sets	6-8 reps, 3 sets	**10**-12 reps, 3 sets	6-8 reps, 3 sets	**10**-12 reps, 3 sets	…	**10**-12 reps, 3 sets	upper body
6	**Lat pulldown**	Thera-Band (overhead fixing and pull down) **or** pull-overs with dumbbells	Pull ups with resistance band(s)	**10**-12 reps, 3 sets	6-8 reps, 3 sets	**10**-12 reps, 3 sets	6-8 reps, 3 sets	**10**-12 reps, 3 sets	…	**10**-12 reps, 3 sets	upper body
FURTHER OPTIONAL EXERCISES											
6	Calf raises	Calf raises with dumbbells	Calf raises without any modification **or** at stairs	**10**-12 reps, 3 sets	6-8 reps, 3 sets	**10**-12 reps, 3 sets	6-8 reps, 3 sets	**10**-12 reps, 3 sets	…	**10**-12 reps, 3 sets	lower body
6	Shoulder press	Overhead lifting of dumbbells (sitting or standing)	Frontal/lateral raise	**10**-12 reps, 3 sets	6-8 reps, 3 sets	**10**-12 reps, 3 sets	6-8 reps, 3 sets	**10**-12 reps, 3 sets	…	**10**-12 reps, 3 sets	upper body

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	6	Butterfly	Thera-Band (pull from back to the front)	Low level push ups	**1**0-12 reps, 3 sets	6-8 reps, 3 sets	**1**0-12 reps, 3 sets	6-8 reps, 3 sets	**1**0-12 reps, 3 sets	…	**1**0-12 reps, 3 sets	upper body
	6	Back extensor	Deadlift with no or low weight	Chair back extension	**1**0-12 reps, 3 sets	6-8 reps, 3 sets	**1**0-12 reps, 3 sets	6-8 reps, 3 sets	**1**0-12 reps, 3 sets	…	**1**0-12 reps, 3 sets	upper body
	6	Ab Core (abdominal) machine	Lifting of one leg with bent knee while standing (with weight cuffs); improvement: lifting with straightened leg	Lifting of straightened leg while standing (without weight cuffs) **or** Plank	**1**0-12 reps, 3 sets	6-8 reps, 3 sets	**1**0-12 reps, 3 sets	6-8 reps, 3 sets	**1**0-12 reps, 3 sets	…	**1**0-12 reps, 3 sets	upper body
	6	Triceps extensions	Triceps extensions with dumbbells	Triceps dips on bench	**1**0-12 reps, 3 sets	6-8 reps, 3 sets	**1**0-12 reps, 3 sets	6-8 reps, 3 sets	**1**0-12 reps, 3 sets	…	**1**0-12 reps, 3 sets	upper body
	6	Biceps curls	Biceps curls with dumbbells	Bicep curl with resistance bands	**1**0-12 reps, 3 sets	6-8 reps, 3 sets	**1**0-12 reps, 3 sets	6-8 reps, 3 sets	**1**0-12 reps, 3 sets	…	**1**0-12 reps, 3 sets	upper body

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Endurance exercises (15 minutes, Appendix I)

At least one training session per week was encouraged to be completed on a cycle ergometer. The other training session could have been performed on alternative equipment such as a rowing machine, treadmill or elliptical/cross trainer. The intensity specification applied to the cycle ergometer. The intensity on the rowing machine or elliptic/cross trainer was monitored by RPE. The endurance training consisted of continuous endurance training (MICT, "moderate-intensity continuous training) and three different interval training protocols (HIIT, "high intensity interval training"). The MICT started with a 1-minute warm-up with an optional cool-down period. All interval sessions started with a warm-up of 3 minutes at 30 W and concluded with a cool down of up to 3 minutes. Exercise specialists were made aware that following HIIT, there is a transient increased risk of falls for ~10 minutes.
The intensity of the endurance exercise was calculated using the results of the Steep Ramp Test. The Steep Ramp Test was performed during the baseline and follow-up visits (3 and 6 months) at the study center. The Steep Ramp Test enabled us to calculate the estimated W_{peak} which was subsequently used to provide a guide for the intensity of the endurance training. Within this document you will see the training intensities for both the continuous endurance training and interval training used in the EFFECT Study. The intensity of the training was monitored every session using the Borg RPE and a guide of when to increase/decrease the load was provided: decrease the load by 10% if the RPE was higher than 15 and increase the load by10% if the RPE was lower than 13.

Endurance training in patients with bone metastases
Depending on the characteristics of the patient and the experience of the therapist, there were two options:
1): exercises that loaded regions with bone metastases were omitted according to Table 1 (Note: Due to the high forces acting on the body (especially shoulder joints, thoracic and lumbar spine, pelvis, hip and knee joints), the rowing machine and the elliptical/cross trainer were counted as weight bearing machines).
2): "start low, go slow" approach was used. Patients with bone metastases started with low intensity and increased intensity gradually over time. If new bone pain occurred during exercise or if there was an increase in pain/pain medication use since the last exercise session, the intensity was reduced.

Endurance testing in patients with bone metastases
In case of bone metastases, do not load the affected region (see Table 1).

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Endurance Training

(for adaptation due to bone met., either omit exercises acc. to Table. 1 or use a "start low go slow" approach)*
The MICT started with a 1-minute warm-up, cool-down was optional. All interval sessions started with a warm-up of 3 minutes at 30 W and up to 3 minutes of sufficient recuperation cool-down.

Duration (min)		**Exercises**	**Intensity** (Using the Training information form) Monitoring by RPE: RPE > 15: The load can be decreased with 10% RPE < 13: The load can be increased with 10%				**Target Body Region**
overall	**single**		Week 1-3	Week 4-14	Week 15-25	Week 26-36	
15		Cycle ergometer	15 min MICT (Start: 50% W_{peak} Goal: 60% W_{peak})	Interval (8x1 min with 1 min rest between intervals)	Interval (3x3 min with 2 min rest between intervals)	Interval (8x30sec with 1 min rest between intervals)	Lower Body
		Elliptical/Cross trainer	15 min MICT (Start: 50% W_{peak} Goal: 60% W_{peak})	Interval (8x1 min with 1 min rest between intervals)	Interval (3x3 min with 2 min rest between intervals)	Interval (8x 30sec with 1 min rest between intervals)	Lower Body/ Whole Body
		Rowing machine	15 min MICT (Start: 50% W_{peak}	Interval	Interval	Interval	Whole Body

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			Goal: 60% W_{peak})		(8x1 min with 1 min rest between intervals)		(3x3 min with 2 min rest between intervals)		(8x 30sec with 1 min rest between intervals)	
		Treadmill	15 min MICT (Start: 50% W_{peak} Goal: 60% W_{peak})		Interval (8x1 min with 1 min rest between intervals)		Interval (3x3 min with 2 min rest between intervals)		Interval (8x 30sec with 1 min rest between intervals)	Whole Body/ Lower Body

Cool down			
Duration (min)		**Exercises**	**Target Body Region**
overall	**single**		
5		STRETCHING	Whole body

*Due to the high forces acting on the body (especially shoulder joints, thoracic and lumbar spine, pelvis, hip and knee joints), the rowing machine and the elliptical/cross trainer also counted as weight bearing machines.

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Table 1. Adaption of exercise program according to metastases.

Metastases Site	Resistance Exercise			Aerobic Exercise		Flexibility
	Upper	Trunk	Lower	WB	NWB	Static
Pelvis	√	√	√**		√	√
Axial Skeleton (lumbar)	√		√		√	√***
Axial Skeleton (thoracic/ribs)	√*		√	√	√	√***
Proximal Humerus		√*	√	√	√	√*
Proximal Femur	√	√	√**		√	√
All regions	√*		√**		√	√***

√ = Target exercise region, * = exclusion of shoulder flexion/extension /abduction/adduction & inclusion of elbow flexion/extension, ** = exclusion of hip extension/flexion & inclusion of knee extension/flexion, *** = exclusion of spine/flexion/extension/rotation,
WB = weight bearing (e.g. walking), NWB = non-weight bearing (e.g. cycling)

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Session	
PRE-TRAINING ASSESSMENT	**Last session**
Since your last session, did any injuries, problems, or symptoms occur during or after physical exertion or exercise…	
… that required treatment, hospitalization, or talking to a doctor or other health professional?	□ no □ yes*
… that caused any other persistent worsening of your health or well-being (e.g. muscle strains, new occurrence of persistent pain or swelling)?	□ no □ yes*
… that led to an increased intake of medication or prescription of new medication due to bone pain?	□ no □ yes*

	Balance Training		**Resistance Training (10-12 reps, 70-75% h1RM) | 35min**						**Endurance Training (MICT) | 15min**					
Date	**Resting HR**	**Balance / Core**	**Exercises**	**Repetitions**			**Weight in kg**	**RPE**	**Adjusted due to complications**	**Cardio device**	**Watts and Time/Interval**	**RPE**	**Ø HR**	**Adjusted due to complications**	**Ø RPE**
				Set 1	**Set 2**	**Set 3**									
Mask? □ yes □ no		□ yes □ no If yes, please describe the exercises at the Comments. If no, please describe at the Comments.	1. 2. 3. 4. 5. 6.						□ no □ yes Adjustments	Cycling □ Elliptical/cross □ Rowing □ Treadmill □	(Adjusted) Target value: _____ (Watt) Actual value:____ (Watt) (_____ (km/h)) Time:_____ min			□ no □ yes Adjustments	

POST-TRAINING ASSESSMENT	**Current session**
Did the training cause or aggravate any pain?	□ no □ mild □ moderate □ substantial increase in pain*
If **moderate/substantial**, please describe:	
Did any other symptoms/problems occur or worsen during the session?	□ no □ yes*
If **yes**, please describe:	
Did any problems/symptoms occur during the session that required restrictions/alterations or early termination of the training?	□ no □ yes*

3 What to consider when training patients with advanced breast cancer

1. Contraindications (NO EXERCISE!) for cancer patients

The following contraindications need to be considered in addition to general contraindications for exercise:

- Within 24 h after chemotherapy (cardiotoxic agents, especially first administrations) → no exercise. Light activities, such as walking, are allowed.
- Thrombopenia with platelet count <20.000 /µl or acute bleedings or bleeding tendency (e.g. petechiae) → no exercise.
- Acute thrombosis or embolism → no exercise (return to training depends on organization of the thrombus; usually possible after four weeks for arm or leg vein thrombosis, provided a normal course of disease and anticoagulation). However, it is advised to seek explicit clearance from a physician.
- Severe nausea, vomiting, pain or dizziness → no exercise.
- Wound healing after surgery not completed → no intense whole body exercise, no local exercise.
- Bone metastases → Prior to start exercising, this should be evaluated by the treating doctor. Bone metastases/osteolyses with unknown or high fracture risk → no load/stress on regions with bone metastases OR no exercise. (see below and Table 1).
- Fever
- Severe infections (e.g. erysipelas)

2. Dealing with special issues (CAUTION!) in patients with advanced breast cancer

The following issues are common in patients with advanced breast cancer (please contact the study team for any further questions):

1. **Bone metastases/Osteolyses**

- For more information, please visit this website: https://cancerexercise.med.ubc.ca/bmehub/
- Bone metastases may be associated with elevated fracture risk → Ask for an evaluation of fracture risk from the treating doctor
- Bone metastases/osteloyses with unknown or high fracture risk → Consult the treating doctor and an exercise professionals specialized in treating persons with bone metastases.
- Bone metastases with low fracture risk → use Table 1 to adapt training; start with low weights and progress slowly up to a maximum of about 12 RM (estimated, not tested)

if possible; avoid shocks, shear stress, torsion, spine rotation, inclination, reclination, lateral inclination for the affected region, reduce weight in case of exercise-induced bone pain.

2. Brain metastases

- Ask for seizures, balance problems and motoric deficits
- Seizures → No exercises with high injury risk when seizures occur (e.g. no barbell workout)
- Balance problems or motoric deficits → Special caution to prevent falls and injuries (e.g. no coordinative demanding exercise with risk of falls like treadmill walking)

2. Breathing problems

- New breathing problems → Medical assessment required
- Known breathing problems → Start slow, go slow (as far as possible without severe dyspnea)

3. Circulatory problems/dizziness

- Avoid dizziness in patients with circulatory problems → Change the order of exercises so that upper and lower body exercises are not alternating; change positions slowly
- Ensure patients have something to hold onto for balance exercises (e.g. wall); Avoid balance exercises and/or treadmill if deemed unsafe

4. Fatigue

- Exercise is the best single intervention against fatigue; positive effects occur immediately
- Consider scheduling exercise sessions during times of least fatigue
- On bad days, reduce volume and intensity of exercise
- Any activity is better than none; encourage patients to be active (e.g. short walks, light gymnastics)

5. Leukopenia/increased susceptibility for infections

- The immune system might be weakened during chemotherapy
- Moderate intensity exercise strengthens the immune system, high to maximal intensity exercise weakens the immune system for a short while → avoid high-to-maximal intensity exercise
- Risk of infection is lowest during outdoor exercise and highest in swimming pools
- Avoid exercise together with sick persons and offer disinfection for hands and equipment

6. Lymphedema

- Light to moderate arm or leg lymphedema → Prefer dynamic exercise, activation of muscle pump (resistance training) and exercise with elevated extremity; avoid static exercise and exercise that turned out to worsen lymphedema in previous exercise sessions

- Severe, painful lymphedema → no exercise for this extremity; lymphedema treatment is required
- Compression garments → If worn in daily life, they also need to be worn during exercise; if not necessary in daily life, they are also not necessary during exercise

7. Low physical fitness level

- Patients with advanced cancer may have a low physical fitness, but they may benefit a lot from exercise
- Apply the study training protocol if possible; otherwise reduce volume and/or intensity of exercise following the recommendations in the exercise protocol.
- In rare cases, training might not be beneficial → please discuss with treating doctor

8. Osteopenia/Osteoporosis

- Be aware of higher risk of osteoporosis in older women and women receiving anticancer hormone treatment
- Osteopenia (prevention of osteoporosis) → Between two possible exercises choose the one with higher impact on the bones (e.g. walking instead of cycling)
- Osteoporosis is associated with elevated fracture risk → Avoid high loads on the bones (no shocks, no shear stress, no torsion, no end-rotation with weight)

9. Pain

- Avoid pain during exercise; choose exercises that can be performed without pain
- New pain, pain of unknown cause or pain of increasing intensity → Medical assessment required

10. Peripheral neuropathy (chemotherapy-induced, CIPN)

- Sensorimotor/balance/falls prevention exercises are of special importance to reduce risk of falls; exercise in general is supposed to improve symptoms
- Risk of falls might be elevated → Special caution to prevent falls and injuries (e.g. no coordinative demanding exercise with falls risk like treadmill running in patients with severe CIPN)

11. Port catheter

- Avoid direct pressure on the port (e.g. no training machines with shoulder pads on the port, no ball games, no fighting sports); avoid skin abrasion (no backpacks)
- Range of movement might be limited especially shortly after port implementation

12. Surgeries/scars

- Wound healing needs to be completed before starting exercise (at least exercise of the affected region, intense whole body exercise and exercise in the water)
- Avoid pain during exercise; choose exercises that can be performed without pain; start slow
- Big scars (e.g. after laparotomy) might take a long time to heal and never become as stable as the tissue was before → Avoid high impact on scars (e.g. after laparotomy avoid high intra-abdominal pressure). This is no absolute contra-indication for core strengthening exercises.

13. Weight loss/underweight/cachexia

- Weight loss is associated with poor prognosis and needs to be avoided → If weight loss during exercising exceeds 5% of starting weight within 1 months or 10% in total, please refer to the treating doctor
- New rapid weight loss → Medical assessment required

4 References

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APPENDIX I

Exercise Instructions for supervised training sessions

BALANCE EXERCISES

Package 1

Basic exercise:

One leg stand

- Instruct the patient to start with their feet together and knees slightly bent.
- Instruct the patient to raise one leg off the ground.
- It is important to activate the core muscles.
- To minimize the risk of fall, position yourself or an object (e.g. a chair) nearby the patient for support, if required.

Progressing exercises:

One leg stand with upper arm raise

- Instruct the patient to raise one arm and try to maintain balance whilst balancing on 1 leg.
- It is important to activate the core muscles.
- To minimize the risk of fall, position yourself or an object (e.g. a chair) nearby the patient for support, if required.

One leg stand with eyes closed

- Instruct the patient to close their eyes and to try to balance on 1 leg.
- It is important to activate the core muscles.
- To minimize the risk of fall, position yourself next to the patient for support, if required.

One leg stand with upper arm raise and eyes closed

- Instruct the patient to raise one arm whilst maintaining balance on 1 leg and having their eyes closed.
- It is important to activate the core muscles.
- To minimize the risk of fall, position yourself next to the patient for support, if required.

One leg stand with transfer of an object from one hand to the other

- Instruct the patient to raise one leg off the ground.
- The patient transfers an object from one hand to the other while trying to keep the balance.
- If the patient is doing well, instruct him/her to close the eyes while transferring the object.
- To minimize the risk of fall, position yourself next to the patient for support, if required.

Package 2

Side-by-side stand

- Instruct the patient to stand up straight with their feet side-by-side.
- It is important to keep the knees slightly bent and gently contract the core muscles.
- To minimize the risk of fall, position yourself or an object (e.g. a chair) nearby the patient for support, if required.

Semi-tandem stand

- Instruct the patient to stand up straight with the heel of one foot placed next to the big toe of the other foot.
- It is important to keep the knees slightly bent and gently contract the core muscles. To minimize the risk of fall, position yourself or an object (e.g. a chair) nearby the patient for support, if required.

Tandem stand

- Instruct the patient to place the heel of one foot so it is touching the top of the big toe of the other foot.
- It is important to keep the knees slightly bent and gently contract the core muscles.
- To minimize the risk of fall, position yourself or an object (e.g. a chair) nearby the patient for support, if required.

Feet apart in line stand

- Instruct the patient to place one foot in front of the other, approx. 1 foot apart.

- It is important to keep the knees slightly bent and gently contract the core muscles.
- To minimize the risk of fall, position yourself or an object (e.g. a chair) nearby the patient for support, if required.

Feet apart in line stand with circling arm moves

- Instruct the patient to place one foot in front of the other, approx. 1 foot apart.
- The patient makes slow circling moves with both arms simultaneously and in the same direction.
- Instruct the patient to move the arms faster, if possible.
- To minimize the risk of fall, position yourself or an object (e.g. a chair) nearby the patient for support, if required.

Package 3

i

Forwards walk

- Instruct the patient to maintain good posture with their back straight, head in line with the spine and looking forward.
- If the patient has balance problems, walk next to them and offer your arm for support if necessary.

Forwards walk in line

- Instruct the patient to maintain good posture with back straight, head in line with the spine and looking forward.
- Instruct the patient to imagine that they are walking on an imaginary line.
- If the patient has balance problems, walk next to them and offer your arm for support if necessary.

Heel to toe forwards walk

- Instruct the patient to maintain good posture with back straight, head in line with the spine and looking forward.

- Instruct the patient to place the heel of one foot so it is touching the big toe (front side) of the other foot whilst walking slowly.
- If the patient has balance problems, walk next to them and offer your arm for support if necessary.

Forwards walk in line with hands together

- Instruct the patient to place the heel of one foot so it is touching the big toe (front side) of the other foot whilst walking slowly.
- With arms being straight, the patient brings his/her hands together both behind and in front of the body (alternating with each step).
- If the patient has balance problems, walk next to them and offer your arm for support if necessary.

ii.

Backwards walk

- Instruct the patient to maintain good posture with back straight, head in line with the spine and looking forward.
- It is important that the patient walks backwards slowly and very carefully.
- If the patient has balance problems, walk next to them and offer your arm for support.

Backwards walk in line

- Instruct the patient to maintain good posture with back straight, head in line with the spine and looking forward.
- Instruct the patient to imagine that they are walking backwards on an imaginary line.
- Instruct the patient to walk slowly and carefully.
- If the patient has balance problems, walk next to them and offer your arm for support.

Toe to heel backwards walk

- Instruct the patient to maintain good posture with back straight, head in line with the spine and looking forward.

- Instruct the patient to place one foot behind the other with the big toe of one foot touching the heel of the other foot whilst walking slowly and very carefully.
- If the patient has balance problems, walk next to them and offer your arm for support.

Backwards walk in line with hands together

- Instruct the patient to place one foot behind the other with the big toe of one foot touching the heel of the other foot whilst walking slowly and very carefully.
- With arms being straight, the patient brings his/her hands together both behind and in front of the body (alternating with each step).
- If the patient has balance problems, walk next to them and offer your arm for support if necessary.

Package 4

4 point kneel with alternating arm and leg raise

- Contraindicated in case of cervical spine and high thoracic spine metastases.
- Instruct the patient to go on all fours (4 point kneel position), with knees hip-width apart, hands under shoulders and a straight back.
- It is important to activate core muscles and to keep the head in a neutral position.
- Instruct the patient to slowly extend one arm forward in line with body.
- The patient should alternate the arm they raise.
- It is important to maintain normal breathing throughout the exercise.

4 point kneel with simultaneous arm and contralateral leg raise (bent)

- Contraindicated in case of cervical spine and high thoracic spine metastases.
- Instruct the patient to go on all fours (kneel position), with knees hip-width apart, hands under shoulders and a straight back.
- It is important to activate core muscles and to keep the head in a neutral position.

- Instruct the patient to extend one arm forward and then the opposite leg backwards. Keep the arms/legs slightly bent.
- The patient should alternate the arms/legs they raise.
- It is important to maintain normal breathing throughout the exercise.

4 point kneel with simultaneous arm and contralateral leg raise (straight)

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- Contraindicated in case of cervical spine and high thoracic spine metastases.
- Instruct the patient to go on all fours (kneel position), with knees hip-width apart, hands under shoulders and a straight back.
- It is important to activate core muscles and to keep the head in a neutral position.
- Instruct the patient to extend and straighten one arm forward and the opposite leg backward.
- The patient should alternate the arms/legs they raise.
- It is important to maintain normal breathing throughout the exercise.

4 point kneel with elbow and contralateral knee touch

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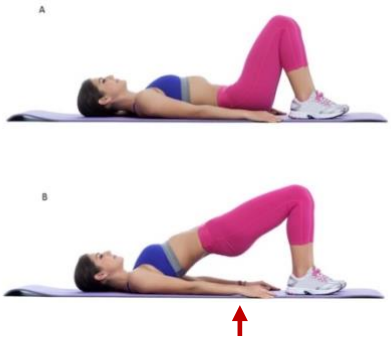
- Contraindicated in case of cervical spine and high thoracic spine metastases.
- Instruct the patient to go on all fours (kneel position), with knees hip-width apart, hands under shoulders and a straight back.
- It is important to activate core muscles and to keep the head in a neutral position.
- Instruct the patient to extend and straighten one arm forward and the opposite leg backward.
- After a short pause bring the extended arm/leg together so the elbow and knee meet underneath the body.
- The patient should alternate the arms/legs they raise.
- It is important to maintain normal breathing throughout the exercise.

Package 5

Gluteal bridge

- Contraindicated in case of cervical spine and high thoracic spine metastases.
- Instruct the patient to lay down with their back flat on the mat and their feet planted on the floor hip-width apart with their heels just in front of their buttocks.
- Instruct the patient to activate their abdominal muscles, squeeze their buttock muscles and raise their hips up to create a straight line from knees to shoulders.
- It is important to maintain normal breathing throughout the exercise.
- To make the exercise harder the patient can lift their arms off the mat.



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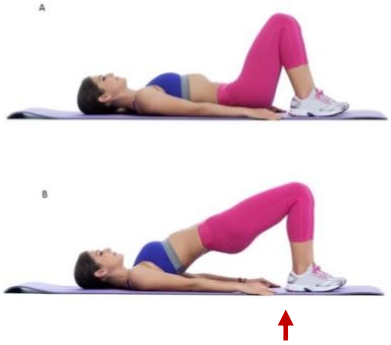
Gluteal bridge with alternating heel raise

- Contraindicated in case of cervical spine and high thoracic spine metastases.
- Instruct the patient to raise hips off the ground.
- Instruct the patient to slightly raise one heel but keep the forefoot on floor and the back straight/ hips lifted (straight line from knees to shoulders). The patient should alternate the heel they lift.
- It is important to maintain normal breathing throughout the exercise.
- To make the exercise harder the patient can lift their arms off the mat.



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Gluteal bridge with alternating bent leg raise

- Contraindicated in case of cervical spine and high thoracic spine metastases.
- Instruct the patient to raise hips off the ground.
- Instruct the patient to slightly lift one foot and hold. The patient should alternate the foot they lift.
- It is important to keep the knees bent and back straight/ hips lifted (straight line from knees to shoulders).
- It is important to maintain normal breathing throughout the exercise.
- To make the exercise harder the patient can lift their arms off the mat.

Gluteal bridge with alternating straight leg raise

- Contraindicated in case of cervical spine and high thoracic spine metastases.
- Instruct the patient to raise hips off the ground.
- Instruct the patient to raise one foot off the mat and gradually straighten the leg. The patient should alternate the leg they lift and straighten.
- It is important to keep back straight/ hips lifted (straight line from knees to shoulders).
- It is important to maintain normal breathing throughout the exercise.
- To make the exercise harder the patient can lift their arms off the mat.

Gluteal bridge with alternating straight leg + arm raise

- Contraindicated in case of cervical spine and high thoracic spine metastases.
- Instruct the patient to raise hips off the ground.
- Instruct the patient to raise one foot off the mat and gradually straighten the leg while also lifting the contralateral arm. The patient should alternate the leg and arm they lift and straighten.
- It is important to keep back straight/ hips lifted (straight line from knees to shoulders).
- It is important to maintain normal breathing throughout the exercise.

RESISTANCE EXERCISES

MACHINE BASED

Leg press

- Instruct the patient to place their heels and forefoot flat and hip-width apart on the footplate and maintain that position throughout the whole exercise.
- Instruct the patient to hold onto the handles for support.
- Instruct the patient to exhale as they extend their legs whilst keeping their head and back flat against the seat pad. It is important to 1) extend the legs with slow control rather than with an explosive movement and 2) to not lock the knees at extension.
- Further it is important that the knees remain in line with the feet throughout the entire movement.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return the footplate to the starting position by slowly bending the knees.

Leg curl

- **Lying Position:** Instruct the patient to lie face down on machine.
- **Sitting Position:** Instruct the patient to sit upright with a straight back on the backrest and head in a neutral position.
- Position the foot roller pad so that it rests around 1-2 inches under the calves and just above the heels. Make sure that the pad is not too high up on the calves as this can place pressure on the Achilles tendon and reduce the range of motion.
- Instruct the patient to hold onto the handles for support.
- Instruct the patient to exhale as they flex their knees and pull their ankles as close to their buttocks as possible. It is important to keep the hips firmly on the bench during the movement.
- Instruct the patient to pause at the position of highest effort for a short time.

- The patient inhales as they return their legs to the starting position in a smooth, slow, controlled movement.

Leg extension

- Instruct the patient to sit with the back resting straight against the backrest.
- The roller pad needs to be adjusted so that it rests comfortably above the ankle.
- Instruct the patient to grasp the handles with a full grip with thumbs circled around the handle.
- Instruct the patient to exhale as they straighten their legs. It is important to not lock the knees and to keep the back against the backrest without arching the back.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return their legs to the starting position in a smooth, slow, controlled movement.

Chest press

- Instruct the patient to sit comfortably with feet placed flat on the floor (approx. shoulder-width apart) and their back resting straight against the backrest.
- Position the seat height so that the starting position of the hands are at breast height.
- Instruct the patient to grasp the handles with a full grip, thumbs circled around the handle, and to maintain a neutral wrist position during the movement with wrists in line with the forearms.
- Instruct the patient to exhale as they push the handles forward until they are straight but without locking the elbows. The head should be kept steady and upright.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return their arms to the starting position in a smooth, slow, controlled movement.

Seated row machine

- Instruct the patient to sit upright with the abdomen and lower chest touching the pad. The feet are placed flat on the floor.
- Instruct the patient to grasp the handles with a full grip (palms facing towards each other) with thumbs circled around the handles. It is important to maintain a neutral wrist position during the movement with wrists in line with the forearms.
- Instruct the patient to exhale as they pull the handles back until their elbows are in-line with their body and briefly pause. Keep the chest on the pad for the entire exercise.
- It is important to keep the back straight and to squeeze the shoulder blades together during the movement.
- The patient inhales as they return the handles forward under tension to full extension in a smooth, slow, controlled movement.

Lat pulldown

- Instruct the patient to grasp the handles slightly wider than shoulder-width apart and place feet flat on the floor.
- The patient exhales as they pull the bar down until it reaches the height of their chin. It is important to maintain a neutral wrist position during the movement with wrists in line with the forearms.
- It is ok if the upper body slightly shifts backwards during the pull-down but instruct the patient to keep the back straight at all times.
- Instruct the patient to briefly pause once the bar is in-line with their chin. Instruct the patient to squeeze the shoulder blades together during the pull-down.
- The patient inhales as they return their arms to the starting position in a smooth, slow, controlled movement.

Calf raises

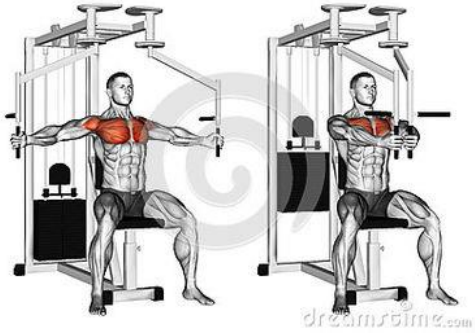
- Instruct the patient to sit up straight with their forefeet on the edge of the foot platform and the knee pad firmly positioned on their thighs.
- Instruct the patient to lift their heels up as far as they can whilst keeping their body straight.
- Instruct the patient to exhale as they raise their heels up whilst keeping their forefeet on the platform.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return their heels slightly below the foot platform level.

Shoulder press

- Instruct the patient to grasp the handles with a full grip (palms facing towards each other) with thumbs circled around the handle. The feet are placed flat on the floor and the back resting straight against the backrest.
- Ensure that the setting of the seat height allows the starting position of the hands to be slightly above shoulder height.
- Instruct the patient to exhale as they slowly push the handles up above their head until their arms are extended but without locking the elbows. The head should be kept steady and upright.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return their arms to the starting position in a smooth, slow, controlled movement.

Butterfly / Chest fly

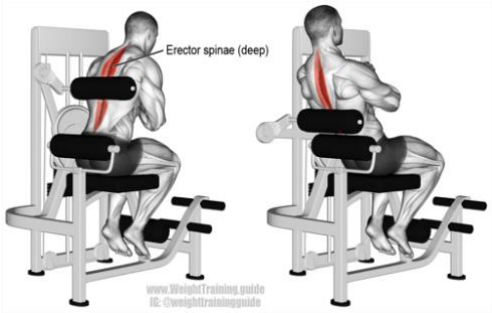
- Instruct the patient to sit upright with the back resting straight against the backrest and the feet placed flat on the floor. The seat should be positioned so that the handles are just under shoulder height.
- Instruct the patient to grasp the handles with a full grip (palms facing forward).
- Instruct the patient to exhale as they bring their arms together in front of their chest. It is important to keep



a slight bend in the elbows and the head should be kept steady and upright.
- Instruct the patient to bring their hands together and pause briefly.
- The patient inhales as they return their arms to the starting position in a smooth, slow, controlled movement.

Back extensor

- Instruct the patient to sit so that their feet are on (or behind) the foot rest whilst the bottom of their shoulder blades touch the backrest.
- The patient exhales as they lean back until there is an angle of 110-130° in the hip joint. At this position the patient pauses for a short time.
- It is important to keep the back straight and arms folded across the chest throughout the movement.
- The patient inhales as they return to the starting position in a smooth, slow, controlled movement.

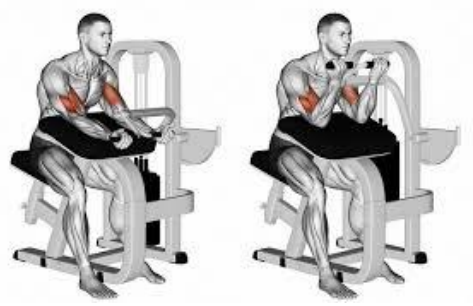


Triceps extensions

- Instruct the patient to grasp the handles with a full grip (palms facing forward) without thumbs circled around the handle. The feet are placed flat on the floor.
- Instruct the patient to exhale as they extend their arms until their arms are straight but without locking the elbows.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return their arms to the starting position in a smooth, slow, controlled movement.

Biceps curls

- Instruct the patient to grasp the handles with a full grip (palms facing backward) with thumbs circled around the handle. The feet are placed flat on the floor.
- Instruct the patient to exhale as they move their hands as close as possible to their shoulders.
- Instruct the patient to pause at the position of highest effort for a short time.



- The patient inhales as they return their arms to the starting position in a smooth, slow, controlled movement.

Ab Core (abdominal) machine

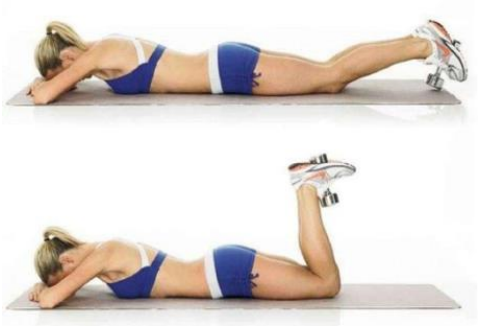
- Instruct the patient to adjust the machine settings so that 1) the roller pad rests comfortably above the ankle and 2) the handles can easily be grasped by both hands.
- Instruct the patient to exhale as they simultaneously pull their knees to the abdomen and bring their torso forwards.
- The head should be kept steady and upright throughout the movement.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return to the starting position in a smooth, slow, controlled movement.

RESISTANCE EXERCISES

FREE WEIGHTS

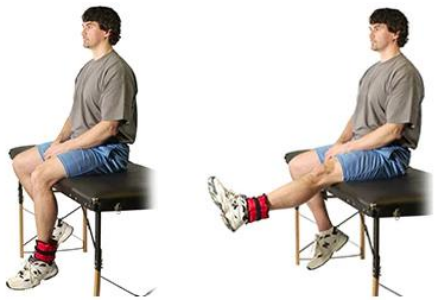
Leg curl with ankle weights

- Instruct the patient to attach ankle weights to both ankles and to lie face down on the floor/mat.
- Instruct the patient to exhale as they flex knees and pull their ankles as close to the buttocks as possible without lifting their thighs from the mat.
- It is important to engage abdominal muscles to avoid arching the back.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return their legs to the starting position in a smooth, slow, controlled movement.



Leg extension with ankle weights

- Instruct the patient to attach the ankle weights around both ankles and then sit with a straight back.
- Instruct the patient to exhale as they straighten the leg. The patient should alternate the leg they lift.
- It is important to maintain a straight back.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return their legs to the starting position in a smooth, slow, controlled movement.



Incline Dumbbell bench press (on bench)

- Set the backrest to 45° and instruct the patient to lie on the bench with a dumbbell in each hand (palms facing forward). Feet are placed flat on the floor.
- Instruct the patient to position the dumbbells at shoulder level. It is important to maintain a neutral wrist position during the movement with wrists in line with the forearms.
- Instruct the patient to exhale as they push the weights upward, taking care not to lock the elbows.

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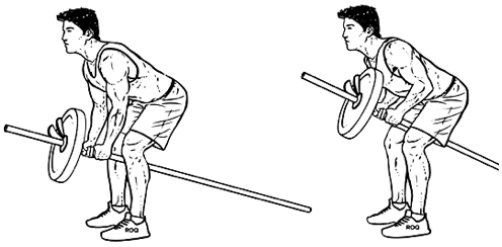
The weights should almost meet over the top of the chest.
- The head and shoulder blades should not rise off the bench.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return their arms to the starting position in a smooth, slow, controlled movement.

Dumbbell rowing (one arm)

- Instruct the patient to place one knee (approx. 90°) and one hand on a bench with the trunk horizontal to the bench. The other leg should be straight with the foot placed flat on the floor.
- The “free hand” holds onto a dumbbell.
- Instruct the patient to inhale as they lower the dumbbell towards the floor until there is a full extension at the elbow.
- It is important to maintain a proper posture in the shoulders, hips, and lower back whilst avoiding rounding or arching of the back.
- Instruct the patient to exhale when lifting the dumbbell up toward the upper body. At the end of the movement, the dumbbell should be at the level of the chest and the elbow should be pointing up toward the ceiling.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return their arm to the starting position in a smooth, slow, controlled movement.

T-Bar

- Instruct the patient to maintain a solid stance with legs approx. shoulder-width apart.
- Instruct the patient to stand above the bar and grasp the bar with both hands (thumbs circled around the handle). Optionally, position a “Double D row handle” around the bar next to the collar.
- Instruct the patient to keep a straight back and slightly bent knees throughout the exercise.
- Instruct the patient to exhale as they pull the weight to the chest. It is important to retract the shoulder



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blades and to flex the elbows until the arms are in line with the upper body.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return the arms to the starting position in a smooth, slow, controlled movement.

Pull-overs with dumbbells

- Instruct the patient to lie down on their back on a bench with their head and upper body supported and their feet flat on the floor.
- Instruct the patient to hold a dumbbell in both hands above their chest (palms facing towards each other), with their arms extended.
- Instruct the patient to activate their abdominal muscles.
- The patient inhales as they take both dumbbells slowly down behind the head without locking the elbows or arching the backs.
- The patient exhales as they return the arms to the starting position in a smooth, slow, controlled movement.

Calf raises / Standing toe raises with dumbbells

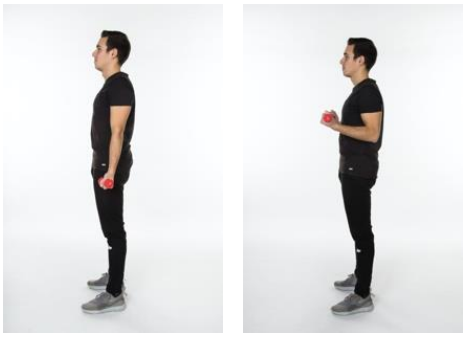
- Instruct the patient to start off standing up straight with toes on a flat object or steps/stairs (palms facing to the hips).
- Instruct the patient to exhale as they raise up on the forefoot so that the heels are lifted off the steps/stairs. It is important to engage abdominal muscles to keep a stable posture. The head should be kept in a neutral position.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return the heels to the starting position in a smooth, slow, controlled movement.
- To make the exercise harder, hold onto dumbbells.

Overhead lifting of dumbbells

- Instruct the patient to sit upright with their back straight (perhaps touching the backrest) and their feet flat on the floor.
- Instruct the patient to hold a dumbbell in each hand slightly above shoulder level (palms facing forward), with elbows next to the body and pointing towards to the floor.
- Instruct the patient to exhale as they push the weights above their head until their arms are extended but without locking the elbows. The head should be kept in a neutral position.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return the arms to the starting position in a smooth, slow, controlled movement.

Biceps curls with dumbbells

- Instruct the patient to maintain a solid stance with legs approx. shoulder-width apart and a dumbbell in each hand (palms facing to the hips).
- Instruct the patient to exhale as they lift one dumbbell toward their shoulder, rotating the forearm as it moves up so that the palm is facing towards the body.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return the arms to the starting position in a smooth, slow, controlled movement.



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Triceps extensions with dumbbells (one arm)

- Instruct the patient to place one knee and one hand (angle upper arm-to-body approx. 90°) on a bench with the trunk horizontal to the bench. The other leg should be slightly bent with the foot placed flat on the floor.
- The “free hand” holds onto a dumbbell.
- Instruct the patient to keep the upper arm of the “weight hand” parallel to the upper body and the back horizontal throughout the whole movement.
- Instruct the patient to exhale as they straighten their arm until it is fully extended.

- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return their arm to the starting position in a smooth, slow, controlled movement.

Frontal raise

- Instruct the patient to maintain a solid stance with feet approx. shoulder-width apart and a dumbbell in each hand (palms facing to the thighs).
- Instruct the patient to exhale as they raise both arms simultaneously in front of their body to shoulder level. It is important to keep a straight back (avoiding arching of the back).
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return their arms to the starting position in a smooth, slow, controlled movement.

Lateral raise

- Instruct the patient to maintain a solid stance with feet approx. shoulder-width apart and a dumbbell in each hand (palms facing to the hips).
- Instruct the patient to exhale as they raise both arms simultaneously to the side of their body until shoulder level with arms almost completely straight ("T" shape). It is important to keep a straight back (avoiding arching of the back).
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return their arms to the starting position in a smooth, slow, controlled movement.

Deadlift with no or light weight

- Instruct the patient to maintain a solid stance with feet approx. shoulder-width apart and toes under the bar. The feet should point straight ahead or slightly angle out.
- The patient inhales as they squat down, bending their legs just slightly with more focus on forward displacement of the straight upper body.

- Instruct the patient to grasp the bar just outside the line of the knees (palms facing the body).
- Instruct the patient to exhale as they lift the bar towards their hips by straightening their legs and bringing their hips forward. The bar should travel close to the shins and the arms and back should be kept straight throughout the movement.

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RESISTANCE EXERCISES

BODYWEIGHT

Squat

- Instruct the patient to maintain a solid stance with legs approx. shoulder-width apart.
- The patient inhales as they slowly bend their knees, lowering their buttocks towards the ground. It is important to keep the back straight and to stop the movement when the patient reaches a 90° angle in the knee joint.
- Throughout the whole movement the feet should remain flat on the floor with knees remaining behind the toes and in line with the feet.
- Instruct the patient to pause at the position of highest effort for a short time.
- Instruct the patient to exhale as they return their body to the starting position in a smooth, slow, controlled movement.

Lunge

- Instruct the patient to stand upright and step forward with one foot. The toes of both feet should be facing forward, and the knees should be in line with the feet.
- The patient inhales as they lower their back knee straight down towards the floor.
- During the downward movement it is important that the thigh of the back leg remains in a vertical position and is lowered until the knee is a few centimeters from the ground.
- Make sure that the body weight is evenly distributed between both legs and the upper body stays upright.
- If there are balance issues, support the patient with your hand or an object, e.g. a chair.
- Instruct the patient to exhale as they return the legs to the starting position in a smooth, slow, controlled movement.

Step up

- Instruct the patient place one foot forward onto a step/flat object.
- Instruct the patient to exhale as they step up and bring their back leg upwards until their hip-to-knee angle is at approx. 90°.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return to the starting position in a smooth, slow, controlled movement.
- Alternate the legs.

Low level push ups

- Instruct the patient to kneel on a mat with their feet either on the floor or in the air. Their hands are placed on the floor or on a bench.
- Instruct the patient to inhale while lowering their upper body towards the floor or bench
    - If the patient has their hands on the floor (picture 1) it is important to place the hands directly under the shoulders and to keep the body straight when lowering it down.
    - If the patient has their hands on a bench (picture 2) it is important to keep the body straight when lowering it towards the object.
- Ensure that the patient's elbows point backwards throughout the whole movement
- Instruct the patient to exhale as they return their body to the starting position in a smooth, slow, controlled movement.

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Seated row with resistance bands

- Instruct the patient to sit upright on a mat with their knees slightly bent and heels touching the ground.
- Instruct the patient to hold the end of a resistance band in each hand (palms facing towards each other) and to maintain a neutral wrist position during the movement with wrists in line with the forearms.
- Instruct the patient to exhale as they pull the resistance band towards their body, keeping the elbows close to the body, the back straight and without leaning back.
- Instruct the patient to squeeze their shoulder blades together during the movement and pull the bands until their elbows are in line with their body.
- Instruct the patient to pause at the position of highest effort for a short time.

- The patient inhales as they return their arms to the starting position in a smooth, slow, controlled movement.

Calf raises / Standing toe raise

- Instruct the patient to maintain a solid stance with legs approx. shoulder-width apart and to hold onto a stable object (e.g. the backrest of a chair or a pole).
- Instruct the patient to exhale as they raise up on the forefoot so that their heels are lifted off the ground.
- Instruct the patient not to rock forwards or backwards during the movement.
- Instruct the patient to pause at the position of highest effort for a short time.
- The patient inhales as they return their feet to the starting position in a smooth, slow, controlled movement.

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Chair back extension

- Instruct the patient to place their thighs on the pad and position their lower legs beneath the roller pad. The arms are kept folded across the chest.
- The patient inhales as they slowly bend at the hip until the upper body is at 90° to the lower body without arching the low back.
- Instruct the patient to exhale as they extend to the starting position. It is important to extend a bit more upward so that the back is slightly in hyperextension.
- Instruct the patient to pause at the position of highest effort for a short time.

Plank

- Instruct the patient to go into a push-up position with forearms and toes on the floor, placing the elbows directly below the shoulders. The head should be kept in a neutral position whilst looking at the floor.
- Instruct the patient to engage the abdominal muscles and keep a straight line from head to feet (if necessary, the patient can perform the exercise whilst kneeling to make it easier).
- It is important to ensure that the shoulders are not hunched during the exercise.
- It is important to maintain normal breathing throughout the exercise.

Biceps curl with resistance bands

- Instruct the patient to maintain a solid stance with feet approx. shoulder-width apart while holding the end of a resistance band in each hand (palms facing to the hips).
- Instruct the patient to exhale as they raise both hands simultaneously towards shoulders while keeping the elbows close to the waist.
- It is important that the patient rotates the forearms as they move upwards so that the palms start off facing inward and then rotate to facing the body.
- The patient inhales as they return their arms to the starting position in a smooth, slow, controlled movement.

APPENDIX II

Standard Operating Procedure for 12-RM testing

The 12 repetition maximum (12RM) is the maximum weight that 12 repetitions of a defined exercise/movement sequence can be performed with correct technique. Afterwards, the so-called hypothetical 1RM (h1RM) can be calculated. The h1RM is used in strength training to prescribe training intensities.

1. Before starting the test, explain the patient that a test is being performed to determine the maximum force and briefly describe the test procedure so that the patient knows what to expect.
2. Instruct the patient how to perform the exercise correctly.
3. Begin a warm up consisting of 6 repetitions at low intensities or no weight with 2 minutes rest afterwards.
4. To determine the patient´s hypothetical maximum strength, a load is chosen which can be lifted clearly a maximum of 12 times (12RM test trials). The tester chooses the weight based on experience and after assessing the participant's current level of performance. For follow-up measurements, the results of the last 12RM test performed and the patient's training documentation must be viewed beforehand (as comparative values). With that approach, the maximum weight and number of repetitions will be used to estimate the h1RM.
5. If the participant has performed too many/too few repetitions, after a break of at least 2 minutes, the weight will be decreased/increased and a new trial will be performed. It is important that the tester tries to choose the ideal weight in order to achieve the maximum weight with as few trials as possible.
6. Maximum of 4 trials to determine 12RM. To avoid unnecessary fatigue, aim to determine 12RM in 3 trials. All attempts should be recorded on the 12RM testing sheet.
7. Rest period of at least 2 minutes between each trial. Keep the patient motivated during the task through constant encouraging.
8. Extrapolating the estimated h1RM can be done using the following formula:
   When using kilogram (kg), please use:
   100*(weight in kg/(101.3-2.67123*repetitions))
   When using pounds (lb), please calculate the kg using:
   45.3592*(weight in lb/(101.3-2.67123*repetitions))

12-RM testing in patients with bone metastases:
In case of bone metastases, do not load the affected region (see Table 1), that means, 12-RM testing is not performed.