Physiotherapy

Imhoff · Beitzel · Stamer
Klein · Mazzocca

Rehabilitation in Orthopedic Surgery

- An overview of surgical procedures
- Physiotherapy
- Sports therapy

Springer

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Eds.

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Second Edition

An overview of surgical procedures
Physiotherapy
Sports therapy

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Foreword

The idea for this book arose many years ago from daily cooperation with physiotherapists on patients that had recently undergone surgery. We wanted to create a tried and tested handbook that briefly presents the relevant operative and outlined steps of a surgery, as well as the major physiotherapeutic stages, in a way that is simple, understandable and demonstrated using images.

In a team of physiotherapists, ergotherapists, sports scientists, orthopedic technicians, social education workers and doctors, the courses of treatment that form understandable and comprehensible guidelines for all involved, as well as for the patients at the center of the team, must be defined. They must also continue to be useful after the time in the first surgical clinic if further treatment is to be provided in a specialized rehabilitation center or by freelance physiotherapists on an inpatient or outpatient basis. We have therefore restricted ourselves to the most important and common surgical techniques on the upper and lower extremities, as well as the spine.

Our intensive cooperation with physiotherapists and doctors from clinics in the Medical Park Group formed the foundation that we expanded into a practical handbook. Dr. Trudi Volkert, former editor at Springer publishing house, and Dr. Hubert Hörterer, former Head Physician at Medical Park St. Hubertus Clinic, again provided us with significant support at the start, and gave us the encouragement that allowed this unique work to come to life. We owe both of them our heartfelt thanks. We also received considerable support in terms of development and design from Prof. Thomas Wessinghage, current Medical Director of Medical Park Bad Wiessee St. Hubertus Clinic and his employees Knut Stamer and Elke Klein. However, the book was only made possible thanks to the generous financial contribution from Medical Park AG. The current international edition was only possible thanks to the contribution from Medi GmbH. We would also like to extend our thanks to them.

Further thanks are owed to Burkhard Schulz, the photographer, and to Kathrin Schöffmann, our model, who posed for each of the stages of physiotherapy and made them come to life over an almost endless number of sessions, as well as to Rüdiger Himmelhan for the illustrations. We would also like to thank Prof. Maximilian Rudert and Dr. Michael Ulmer, who contributed their specialist knowledge on a number of specific chapters, as well as qualified sports scientist Klaus Remuta for his assistance in creating the practical guides for stage IV.

The handbook should serve as a valuable tool, assistance, and manual for all team members supporting patients throughout the various post-surgical phases, and as a guide, without neglecting the recommendations of the surgeon and personal experience of the therapists. We are delighted to be able to present some new features as part of the second edition.

We also are very honored that Prof. Gus Mazzocca, Dr. Andreas Voss and David Lam from the University of Connecticut helped us in editing and translating the second edition of our book.

For the editors:
Andreas Imhoff and Knut Beitzel
Munich, Fall 2015

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About the Authors

University Professor Andreas B. Imhoff

is Director of the Department for Orthopaedic Sportsmedicine at University Hospital Rechts der Isar, Technical University of Munich. He is a specialist in orthopedic surgery and traumatology, as well as sports medicine.

He was until 2014 an Executive Board member of the German Society of Orthopedics and Orthopedic Surgery (DGOOC) (First Secretary to the Management Board) and on the Executive Board of the German Society for Orthopedics and Trauma (DGOU).

Prof. Andreas B. Imhoff also holds the following positions: He was a member of the board of the German-speaking Society for Arthroscopy and Joint Surgery (AGA) from 1999 to 2013, and was Congress President in 1999 and President from 2000 to 2003. He has been an honorary member since 2013. Between 2007 and 2011, he was Chairman of the program committee of the International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS). He is currently an honorary member of the Arthroscopy Association of North America (AANA), honorary member of the Argentinian Shoulder Association, Corresponding Member of the Chilean Orthopedics and Trauma Association (SCHOT), Chilean Sports Orthopedic Association and American Society of Shoulder and Elbow (ASES), member of the board of trustees of the Association of Orthopaedic Research (AFOR) and board member of the German Knee Society (DKG). He also holds the Malaysian Federal Honorary Award of Darjah Kebesaran PANGLIMA JASA NEGARA (P.J.N.) "DATUK".

He is a member of the following associations: European Society of Sports Traumatology, Knee Surgery and Arthroscopy (ESSKA), Société Européenne pour la Chirurgie de l'Épaule et du Coude (SECEC), American Orthopaedic Society for Sports Medicine (AOSSM), Bayerischer Sportärzteverband (Bavarian Sports Medicine Association), Deutscher Sportärzteverband (German Sports Medicine Association), Deutsche Gesellschaft für Unfallchirurgie (German Society for Traumatology; DGU), Schweizerische Gesellschaft für Orthopädie (Swiss Orthopedics Assocation; SGO), Deutsche Vereinigung für Schulter und Ellenbogen (German Association for Shoulders and Elbows; DVSE).

Prof. Andreas B. Imhoff is Editor in Chief for the Zeitschriften für Arthroskopie (Springer) and Operative Orthopädie und Traumatologie (Springer), and is also Assistant Editor of the Journal for Shoulder and Elbow Surgery (Elsevier) and the American Journal of Sports Medicine (AJSM). In addition, he is a consultant for the following journals: Sportorthopädie/Sporttraumatologie (Springer), Deutsche Zeitschrift für Sportmedizin, Archives of Orthopaedic and Trauma Surgery (Springer), European Journal of Trauma and Emergency Surgery (Springer), Operative Techniques in Orthopaedics (Elsevier), Knee Surgery, Sports Traumatology, Arthroscopy (Springer).

Prof. Andreas B. Imhoff has received the following awards: Instructor in arthroscopic surgery AGA 1990, ASG Travelling Fellowship (USA, Canada and England) 1991, AGA Scientific Prize 1993, Education and Research Prize – Fellowship USA der AGA 1994/1995, Kappa Delta Young Investigator Award (AAOS/ORS) 1996, TUM nomination for the Leibnitz prize 2001, Scientific prize from the Association for Orthopaedic Research (AFOR) 2002, Center of Excellence 'Best Care' DKV 2002–2014, accreditation by the American Orthopaedic Academy AOA and ISAKOS as a teaching hospital since 1997. AGA-medi Award 2013: Structural and Biomechanical Changes in Shoulders of Junior Javelin Throwers – A Multimodal Evaluation as a Proof of Concept for a Preventive Exercise Protocol.

Associate Professor Knut Beitzel, M.A. (Sports Sciences)

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Knut Stamer (Physiotherapist/Osteopathist)

is a physiotherapist and head of treatment at Medical Park Bad Wiessee St. Hubertus. He completed his training at the Private School for Physiotherapy in Loges, Oldenburg. This was followed by a probationary year at the central clinic in Augsburg. He began his work in a private physiotherapy practice and then at an outpatient rehabilitation center in Augsburg, where he assumed leadership of sports rehabilitation and care for the Augsburger Panthers (DEL ice hockey) as well as first FC Augsburg (soccer). Since 1998, he has been head of treatment at Medical Park Bad Wiessee St. Hubertus. In addition, he coached the long distance swimming A-Squad team of the German swimming association at the Beijing Olympic Games in 2008. Since 2009, he has advised the Chinese women's national athletics team in the disciplines of discus, shot put and hammer throwing. Knut Stamer specializes in the following fields: Manual therapy, sports physiotherapy, sports rehabilitation training, medical training therapy, osteopathy, neural structures, craniomandibular dysfunctions, applied kinesiology, kinesiotaping, Terapi Master training system (sling exercise system) and functional movement screen, and is part of Dr. Schleip's team of fasciae experts.

Elke Klein (Physiotherapist/Osteopathist)

is a physiotherapist and has been Department Head at Medical Park Bad Wiessee St. Hubertus since 2007. There, her patients include the athletes at cooperation partner Bavaria Olympic Training Center, the German ski association and FC Bayern Basketball. She previously worked as a physiotherapist on the team at the clinic and polyclinic for sports orthopedics at Munich Technical University. She completed her physiotherapy training at the college for Physiotherapy at Ludwig-Maximilians University in Munich.
Elke Klein also holds further training in the fields of sports physiotherapy, manual therapy, PNF, kinesiotaping, and the Terapi Master training system. This was followed by five years of study in osteopathy at the International Academy of Osteopathy (Germany).

Professor Augustus D. Mazzocca, MS, MD

is the Director of the UConn Musculoskeletal Institute and Chairman, Department of Orthopaedic Surgery at the University of Connecticut Health Center. He is the Director of the University of Connecticut Human Soft Tissue Research Laboratory, which consists of integrated translational labs incorporating cell and molecular biology, histology, biomechanics, and clinical outcomes research. He is also the Director of the University of Connecticut Bioskills Laboratory. Dr. Mazzocca holds a joint faculty appointment at the University of Hartford in the Department of Civil, Environmental, and Biomedical Engineering, College of Engineering Technology and Architecture.
International collaboration in both education and research is a top priority for Dr. Mazzocca bridging over six countries including Brazil, Japan, Austria, Germany, Italy, France and five of the seven continents. Dr. Mazzocca is internationally renowned for his work in the following areas: biceps tenodesis, distal biceps for the elbow, anatomic coracoclavicular reconstruction for the treatment of chronic acromioclavicular separation, and biologic augmentation of failed rotator cuff repair using concentrated bone marrow and platelet rich plasma. The extent of this research has led to 69 book chapters, 130 abstracts and posters and 133 peer reviewed journal articles.
Dr. Mazzocca also holds the following positions: he was the Program Director for the American Orthopaedic Society for Sports Medicine (AOSSM) for the 2015 International Meeting and a member at large for the AOSSM Nominating Committee from 2014-2015. In 2014, he served on the Upper Extremity Program Committee for Specialty Day.
Dr. Mazzocca has been a part of the American Shoulder and Elbow Society (ASES) Continuing Education Committee since 2009 and is a member of the Closed Meeting Committee for 2015 and 2016 and the ASES Continuing Education Committee from 2014-2015. He is also a member of the Arthroscopy Association of North America (AANA) Research

Committee since 2010. In 2003, Dr. Mazzocca was a founder of the New England Shoulder and Elbow Society (NESES) and continues to be part of its executive governing board since its inception in 2003. He remains an active member of AOSSM, ASES, AANA, and NESES as well as the following professional societies: American Academy of Orthopaedic Surgeons (AAOS), International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS), The American Orthopaedic Association (AOA), Orthopaedic Research Society (ORS), European Society for Surgery of the Shoulder and Elbow (ESSE), American College of Sports Medicine Member (ACSM), and the Connecticut Academy of Science and Engineering (CASE).

Dr. Mazzocca has served on the editorial board for several orthopaedic publications including: Orthopedics Today Basic Science & Technology Section Editor 2014, Orthopedics Today Editorial Board from 2013 to present, Techniques in Shoulder and Elbow Surgery, Editorial Board from 2010 to present, Associate Editor – Journal of Bone and Joint Surgery-Shoulder and Elbow Newsletter from 2011 to present, Section Editor-Arthroscopy Section for the AAOS Orthopaedic Knowledge Update 4th Edition in 2011, Co-Editor of the AAOS Monograph Disorders of the Proximal Biceps Tendon in 2011. He also received several awards including: the Richard B Caspari Award- (Best International Upper Extremity Paper) ISAKOS in 2005, Albert Trillat Young Investigator Award and Scientific Award for Best Scientific Paper ISAKOS in 2009, and the American Academy of Orthopaedic Surgeons Distinguished Volunteer Service Award in 2014. He has been recognized as a America's Top Orthopedists Consumers' Research Council of America in 2007 and 2008, Outstanding Shoulder Surgeons and Specialists, Becker's Orthopedic & Spine Review in 2011, Best Doctor's in America® in 2014, Best Doctor *Hartford Magazine* from 2008 to 2015, a Castle Connolly Top Doctor from 2012 to 2015.

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Introduction

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1

1.1 Idea behind the Book

The purpose of this book is to provide an individualized, concise, but nevertheless comprehensive overview of aftercare recommendations.

There has long been a consensus regarding the great importance of aftercare treatment following surgical interventions in sports orthopedics. While it is important to constantly improve surgical procedures and applied techniques, aftercare must also be consistently evaluated, adapted and improved in line with the latest developments. It is only possible to achieve the best possible treatment result through highly accurate diagnosis, perfect surgical care and optimum rehabilitation. This allows patients to regain the best possible level of activity in their everyday life or even their athletic performance.

In order for this to be possible, intensive cooperation between the patient, doctor, therapist, nursing staff and the further rehabilitation team involved in the treatment is required (◘ Fig. 1.1). The Department for Sports Orthopedics at TU Munich and the Medical Park Bad Wiessee St. Hubertus rehab clinic have been working successfully together as part of such an interdisciplinary team for a long time. The recommendations made here are the result of such cooperation, and form the basis of our treatment strategies and the associated many years of success.

This book aims to provide users with an interdisciplinary overview of the measures we feel are necessary over the course of rehabilitation. It attempts to bring together all directly involved professional groups into a holistic overview and to offer corresponding measures during the rehabilitation process. This means that there is a concept at all times throughout rehabilitation that facilitates the classification of the current treatment situation and the planning of the further course of rehabilitation. This does not aim to replace the individual diagnosis as a basis for treatment measures, but rather to serve as a suggestion and guideline for rehabilitation. The goal is to present the procedures applied in our daily practice.

1.2 Rehabilitation: Physiotherapy – medical training therapy – athletic ability

As part of the rehabilitation process, it is important to select a broad therapeutic approach that attempts to integrate a number of concepts and methods and implement them according to the specific diagnosis. The focus here must always be on the diagnosis and the stage of rehabilitation.

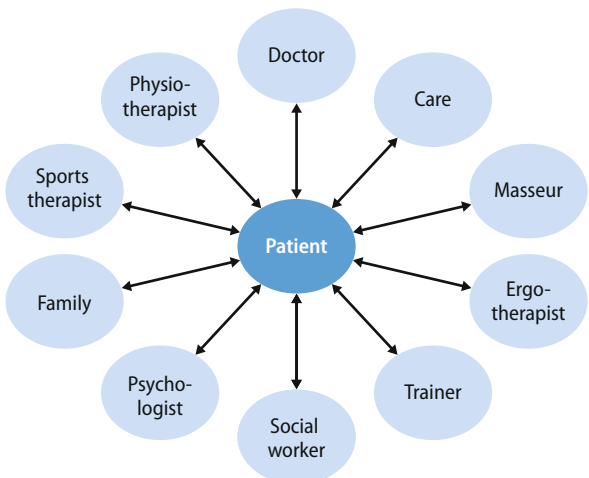
The treatment concept from the areas of physiotherapy and medical training therapy (MTT) form the focus of our rehabilitation concepts (◘ Fig. 1.2). They are supplemented by measures from the fields of ergotherapy, physical medicine (massage, hydrotherapy, electrotherapy etc.) and concomitant psychological measures. Often, it is not possible to put together a rehabilitation team with members from all fields due to financial and infrastructural reasons (inpatient rehabilitation → extended outpatient rehabilitation → remedies). In this case, the aftercare therapist (usually the physiotherapist) assumes the roles from the different treatment areas and allows as broad a spectrum of treatment content as possible to be covered as part of a combination treatment.

At the start of the rehabilitation process, measures from the areas of physical therapy and physiotherapy are the most prevalent. Further on, the proportion of traditional physiotherapeutic, ergotherapeutic and physical applications decreases, with MTT measures increasing and gaining significance accordingly. This results in a fluid transition throughout the entire course of rehabilitation, which then in the best cases leads to the resumption of sport-specific training, or to fully returning to work.

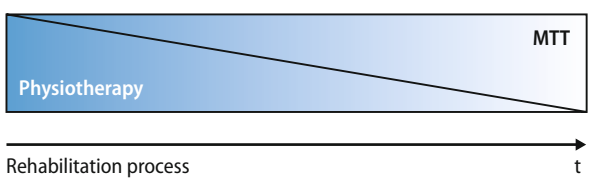
1.2.1 Rehabilitation process

Structure of the rehabilitation process

The structure of the rehabilitation process can be seen in ◘ Fig. 1.3.



◘ **Fig. 1.1** Composition of the rehabilitation team



◘ **Fig. 1.2** Course of treatment specialisms

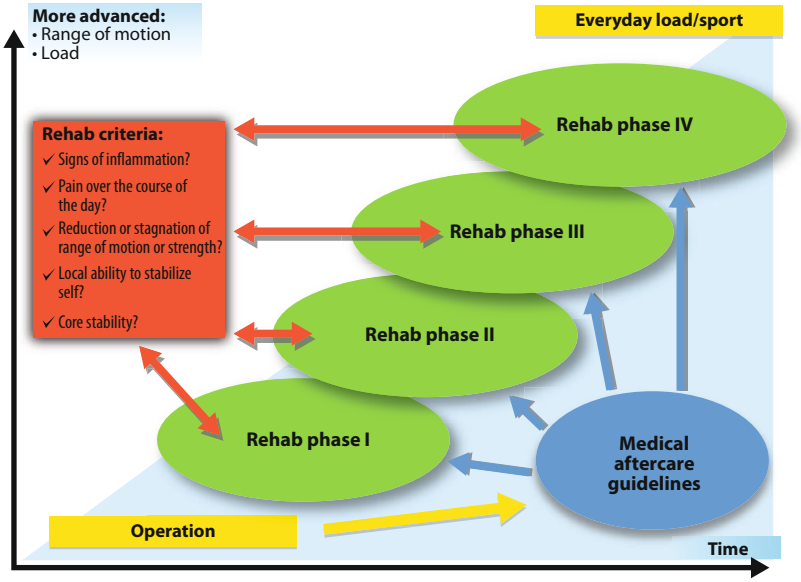


Fig. 1.3 Structure of the rehabilitation process

Principles of the rehabilitation process

- The time-related scheduling of the medical aftercare guidelines and therefore the progression of the phases of rehabilitation are determined from the factors of the **patient's character** (his/her secondary illnesses, sports experience etc.) and **operation** (technique, materials, complications etc.).
- The most important factors are continuous health assessment, comparison with the actual situation and adaptation of the treatment content by the therapists!
- Over the course of rehabilitation, when the physical load and range of motion are increased and under what circumstances is decided based o the doctor's aftercare guidelines.
- The rehabilitation criteria must be continuously reviewed – especially when it comes to increasing physical load!
- Using ICF criteria, specific goals are also set for each phase of rehabilitation, and their fulfilment is assessed.
- The treatment involved in the individual rehab phases must be applied in close alignment with the medical aftercare guidelines.

Features of the stages of rehabilitation

Fig. 1.4 provides an overview of the features of the individual stages of rehabilitation.

Phase	Features
Phase I	Post-operative acute phase
Phase II	Gradual increase in the range of motion and load (progression)
Phase III	
Phase IV	Approved range of movement and load

Fig. 1.4 Features of the stages of rehabilitation

1.2.2 Physiotherapy

The **first principle** in the management of treatment measures is the observance of individual load limits specified by the doctor. These are primarily based on the phases of wound and tissue healing (Table 1.1) as well as the biomechanical properties of surgical techniques.

The **second principle** is continuous monitoring for signs of inflammation (dolor, tumor, rubor, calor, and functio laesa), which indicate that the patient is undergoing excessive load. These also include general signs of exhaustion and excessive load (tiredness, fatigue, loss of motivation etc.) that are a result of excessive training or overly intensive treatment. At the same time, the onset of the above symptoms means that the development of an infection must be considered and ruled out where necessary.

Due to the complex reactions and compensation strategies the body has to injuries, degenerative damage, and following surgery, particular attention should be paid to secondary dysfunctions in terms of the chain of cause and effect throughout rehabilitation. We see this as the **third principle**, as here each primary physical dysfunction has an effect on the other parts of the body linked via a chain

Table 1.1 Treatment measures depending on the phase of wound and tissue healing

Wound and tissue healing phases	Focus points of treatment
Acute phase	Rest, elevation, vegetative therapy, nutrition
Inflammatory phase	Vegetative therapy, local blood circulation stimulation, pain ↓, matrix load, manual therapy level 1, proprioception, nutrition
Proliferation phase	O_2↑, mobilization with increasing load, manual therapy stages II-II, coordination, proprioception, training therapy
Remodeling phase	Functional movement, mobilization, specific loads, forced training therapy, sport-specific training

of effects. It is important for these to be observed regularly and included in treatment where appropriate. Some examples of chains of cause and effect can be found in ▶ Section 7.3.1 and in ▶ Section 15.3.1.

As a **fourth principle**, another important factor in all of our aftercare stages is posture. Optimum core stability forms the basis for the best possible force distribution along the kinetic chain, which makes it possible for the limbs to be used correctly and powerfully. Strength in the extremities is generated in the core. Posture training and improvement as well as improving coordination and strength should therefore be integrated into each stage of rehabilitation.

Continuous communication with the patients and within the rehabilitation team regarding the treatment methods, course of therapy, incidence of illness and the associated limitations in activity is the **fifth principle**. This includes continuously explaining and educating the patient about his/her condition and the treatment methods used (education).

The Five Principles of Physiotherapy
- Physician prescriptions and personal load limits
- Signs of inflammation and excessive load
- Chain of cause and effect
- Posture
- Communication and education

In addition to the underlying principles, particular attention should be paid to the following treatment principles, especially during the application of individual physiotherapeutic measures.

General Principles of Physiotherapeutic Treatment
- Subjective patient sensations
- Patient compliance
- Pain-free position
- Do not exercise beyond the individual pain threshold (maximum level 3-4 of VAS)
- For tissue techniques, give the tissue time for the mechanic impulse to take effect so that a tissue reaction can take place
- Inhibition/mobilization/stabilization
- Vasoregulation and lymphatic/venous drainage
- Treatment takes place distally to proximally in the event of acute neural pain symptoms

1.2.3 Medical training therapy (MTT)

In addition to the points already specified for physiotherapy, MTT is based upon the principles of general training methods. The decisive stimuli for the prescription of training load are controlled via the load components:

Load components of medical training therapy
- Intensity
- Density
- Duration
- Scope
- Frequency

In addition to load components, in MTT, the quality of movement is a main criterion when it comes to increasing loads. The load should only be increased once the optimum quality of the movement performed has been reached (flow, rhythm, and extent of movement).

In addition, the load extent and duration are increased first of all, and then the load intensity and density are increased. Major content of medical training therapy lies in the transfer of coordinative skills. The patient should relearn or improve his/her pre-traumatic economic and coordinated movements. Any pre-existing deficits can be corrected and their recurrence can be avoided.

The content of the individual therapy should build upon each other and facilitate progression, which leads to effective load stimuli. After an appropriate break, these lead to the eventual supercompensatory adaptation of the organism. The following principles arise in MTT as pre-requisites for training therapy without damaging stimuli:

Principles of medical training therapy
- No training if signs of inflammation are present
- Training only within the pain-free range
- Training within the range of free mobility
- Training within the crepitation-free range
- Training with pre-stretching only from phase III
- Avoiding shear loads
- Adjusted weight load (Cave: Overload)
- No rapid or explosive movements (up to and including phase III)
- The training must remain stable for at least three days of exercise. Only thereafter can the load be increased

Taking these principles into account, an increase in load is strived for in accordance with the following training principles:

General training principles
- Easy to difficult
- Simple to complex
- Limited to full range of motion (ROM)
- Large to small support surfaces
- Stable to unstable surface
- Short to long lever
- Slow to fast
- One-dimensional to multi-dimensional
- General to sport-specific

In addition to the passive and active application and types of training, machine-supported training enables the training content and stimuli to be expanded. The patients can perform their exercises on specific machines independently following introduction and under constant supervision. In addition, the high overall number of reps offers the option to automate the flows of movement. Nevertheless the regular supervision and further development of exercises on the basis of training theory laws are indispensable. The focus of training therapy should always lie in functional, three-dimensional forms of exercise, as these represent a higher challenge for the patient in terms of coordination. Furthermore, closed-chain training with core involvement is preferred and should be used as much as possible. Open chain training supplements the functional approach in everyday and sport-specific exercises.

The following underlying aspects must be considered during machine-supported training:

Underlying aspects of machine-supported training
- Therapeutic and biomechanical aspects
- Position of the resistance
- Correct axial alignment of the patient
- Prescribing load components
- Reduction of damaging accompanying movements
- Choice of movement path
- Choice of starting position
- Functional direction of the training content in accordance with the phases of rehabilitation

The principles set out here only represent the most important basis of the forms of therapy applied in rehabilitation. They are expanded and thereby are only rounded off by the specific perspectives of the individual schools and theories of physiotherapy and sports therapy. It is only possible to provide a brief overview of the principles in the context of this book, however.

1.2.4 Athletic ability

The importance of sporting activities in health and general well-being is now undisputed. In addition, many sports orthopedics patients want to resume the sporting activities they previously participated in following the surgical treatment of an injury or a degenerative illness, and enjoy physical activities. Over the course of rehabilitation, the question as to whether or when it will be possible to resume sporting activities often arises.

Even when sports activities are recommended, for example especially in the case of endoprosthetic care, it is only possible to give an answer after having taken into account the patient's personal requirements, the underlying surgical procedure, and the rehabilitation. In this respect, intensive communication within the rehabilitation team has proven to be extremely helpful: in particular, the type of underlying injury/illness, the operation performed, any complications that may have arisen and any additional pre-existing illnesses are key here. Of similarly great significance is whether the patient wishes to commence a certain type of sport that s/he used to practice intensively or whether s/he wishes to take it up for the first time (life-time athlete/returnee/beginner). This has a drastic influence on the suitability of a particular sport for the individual patient.

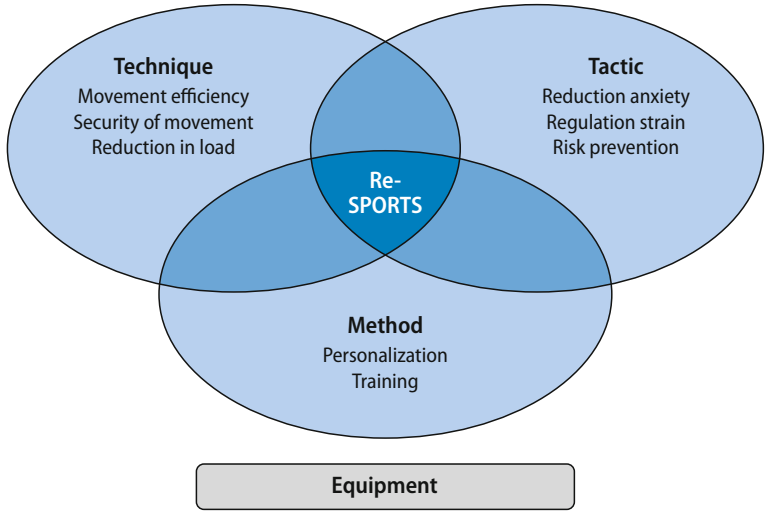


Fig. 1.5 Features of the Medical Park ReSPORTS® concept

It should always be borne in mind that a sport can also be practiced in a modified way (more relaxed technique when skiing, adapted swing when playing golf, no participation in competitions, etc.).

In our daily practice, the following additional criteria with regard to the intended type of sport have proven to be reliable:

Criteria for resuming sports activities

- Absence of signs of inflammation and excessive load
- Expected stability of the implants, fixations or reconstructions to be applied
- Sufficient pain-free passive and active mobility
- Sufficient muscular and ligament stability (absence of evasive movements)
- Sufficient conditional characteristics (especially coordination, strength, endurance)
- General ability to resume sporting activities with regard to secondary illnesses
- Adapted patient motivation and understanding regarding any potential risks and restrictions in the intended type of sport (e.g. in the case of endoprostheses)

The patient often sees the time until s/he is ready to resume their sport physical activity as the most crucial factor, but this should be of secondary importance. The fulfilment of the specified criteria is the most important factor, with this resulting in the optimum time to resume sporting activities. This keeps the illness-related risk of an injury or harm due to load as low as possible.

In the perfect case, the rehabilitation team will support the patient until s/he is ready to commence sport-specific training and to rejoin the training process. Even among leisure and amateur sports players, success has been demonstrated in the application of the Medical Park ReSPORTS® concept (Fig. 1.5). In this concept, the patients are integrated into specific sports (skiing, golf, etc.) by specially trained therapists, trainers and doctors. Through intensive information measures, the demonstration of specific adapted techniques, the preparation of optimum environmental conditions and mental support, it is possible even for less sporty patients to learn a new sport or resume an old one.

The following graded recommendations apply to the aftercare guidelines presented here accordingly. Once full load-bearing ability has been achieved, the desired type of sport can be resumed for running, swimming and cycling. This includes training for sport-specific load types. In this respect, targeted types of movement for the intended sport can be practiced or relearned while protecting the parts of the body that underwent surgery or with modified techniques. The load can only be increased later once the patient has regained full training ability.

The terms contact and high-risk sports refer to sports with an increased risk of injury. These include sports with opponent contact (handball, soccer, etc.), but also those such as skiing. These should be taken up later on in the course of rehabilitation, and require intensive preliminary treatment through adjusted sport-specific training.

1.3 ICF Model: Objective and planning of the course of rehabilitation

The goal of surgical care and rehabilitation in sports orthopedics is to achieve the best possible restoration of the pa-

tient's everyday and sporting ability. The primary goal of a rehabilitation program therefore lies in creating an environment in which various wound healing processes can run as best as possible, and where all negative and obstructive factors can be eliminated.

From our perspective, the definition of goals and planning of the rehabilitation process begins upon the primary diagnosis and treatment decision. At this point, the treatment and rehabilitation goals are determined in close cooperation between the team members and the patient (as a valuable team member). The patient's hopes and requirements should be adapted to the expected treatment or rehabilitation prognosis through information and explanations.

The International Classification of Functionalities (ICF) was introduced by the World Health Organization in 2001 as a basis for goals in rehabilitation. They enable the rehabilitation process to be considered as a whole, which covers the areas of bodily functions/structure, activity and participation (Fig. 1.6). In this case, the rehabilitation targets should not only focus on the injured or operated part of the body, but rather the patient as a whole, and thereby optimize treatment.

Realistic and clearly defined rehabilitation goals are defined on the basis of the ICF and in conjunction with the underlying illness/injury, patient expectations, the achievable result of surgery and the available resources. These are divided into long-term and medium-term goals according to the phase-based course of rehabilitation. In addition, specific short-term goals can be defined for individual treatment measures.

The medical aftercare guidelines specified have a decisive influence on planning and the setting of objectives. They specify time frames in which physiological healing processes are facilitated and excessive loads must be avoided. The course of aftercare is not only based on these time-related requirements, but also on the individual rehabilitation potential and the abilities and skills of the patients.

For this reason, we prefer a combined time-based and symptom-based approach. Depending on the defined goals and the actual condition, the course of rehabilitation should be constantly evaluated on the basis of symptoms and adjusted where appropriate. This makes it possible for the rehabilitation process to be personalized even further. This approach requires the intensive exchange of information between the team members involved and the patient being continuously informed.

As the aftercare guidelines are defined according to the surgical procedure and its specific characteristics by the treating physician, any adjustment can only be made in consultation with this doctor.

Corresponding objectives and suggested criteria that we feel are necessary in the respective phases can be seen in the rehabilitation concepts and aftercare guidelines displayed. They should be considered as a suggestion and adapted according to individual requirements.

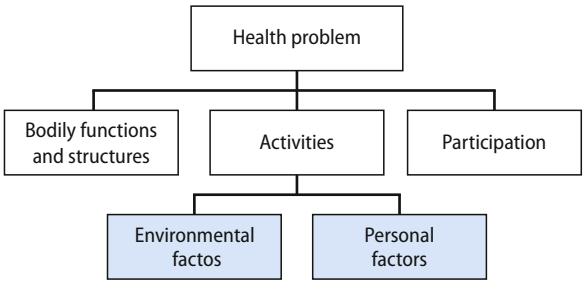


Fig. 1.6 Structure of the International Classification of Functionalities (ICF)

1.4 Principles of Diagnostics

The principles of diagnostics can be presented in the form of an overview below. Furthermore, reference is made to current reference books (▶ Section 1.5) as well as relevant training courses from the professional associations.

The examination should always take place in an atmosphere in which the patient feels comfortable. Privacy should always be guaranteed. The course and purpose of the examination should be explained to the patient. The patient should adopt a position as relaxed and pain-free a as possible during the examination.

The physiotherapeutic functional examination complements the medical diagnosis. Functional diagnostics can be divided into subjective and objective examinations. In this case, not only the current problem but also contributing or maintaining processes that could exacerbate or affect the patient's discomfort should be ascertained. Mental and social aspects should also be recorded (ICF used as a basis). A working hypothesis is then developed and goals are agreed upon with the patient.

Diagnostics should always take place in a standardized way that is described briefly below. This routine is the only way to ensure the comparability and reliability of results.

1. Medical history

Current and general state of health; initial suspected diagnosis or identification of structures that could cause discomfort.

a. Current medical history
b. General medical history
   - Medications taken: which and what for?
   - Discomfort/illnesses:
     Exercise equipment?
     Heart/cardiovascular?
     Lungs/breathing?

Digestive system?
Urogenital?
Endocrine?
- Trauma: when and what?
- Operation: when and what? Ongoing discomfort?
- Profession and hobby
- Height and weight
- Stimulants and eating habits

c. Specific medical history
d. Pain
- What, when, how, by what means, with what?
- Pain location
- Periods of pain
- Pain characteristics
- Triggering pain
- Pain improvement
- Concomitant circumstances

Info regarding the patient potentially being referred back to the doctor to discuss symptoms further: Pain progression, lasting pain, pain at night, immediate pain when bearing weight

2. Inspection

a. Everyday movements (putting on and taking off clothes, lifting and carrying, walking)
b. Changes in the skin
c. Changes in bodily relief (scars, fascial retractions, muscular atrophy, edema, swelling, connective tissue massage zones)
d. Change in posture (post-urology)
- Rotation type: Deviations on horizontal level
  Reference points: Calacanei, SIPS, scapula
- Lateral bending type: Deviations on frontal level
  Reference points: imaginary perpendicular sagittal structure – medial scapula – spinous process – gluteal fold
- Extension/flexion type: Deviations on sagittal level
  Reference points: Perpendicular external ear canal – shoulder – pelvic – knee – external ankle
- Spine: Spinal shape on sagittal and frontal level, thorax shape, head and neck position, swelling between the erector spinae muscle and spinosus, skin changes
- Shoulder: Shoulder elevation, winged scapula, rotation position of the scapula, scoliosis of the thoracic spine, flat back or kyphosis of the thoracic spine, protraction of the shoulder girdle, anterior position of the humeral head
- Hip: Pelvic position, leg-pelvic angle, muscle relief
- Knee: Patella position, swelling, effusion, atrophy of the muscles, tibial torsion, antetorsion angle, leg axis
- Foot: Arch shape, heel bone axis, forefoot and toe position, position of external and internal ankle, circulatory disorders, swelling, calluses, toe nails

3. Palpation

a. Irritation in the area of the dermatome
b. Changes in connective tissue: CTM zones, neuro-lymphatic reflex points, neurovascular points, Head zones
c. Changes in muscle tone: Trigger points, tender points, changes in the tone of the muscle as a whole

Swelling, tension or pain are considered upon palpation. In the case of pain, the radiation (dermatome-related or not), character, severity and duration of the pain should be considered. It should also be determined whether the pain lingers.

All conspicuous structures upon palpation should be examined precisely and treated accordingly, as these could be a potential cause of the discomfort or could be exacerbating it.

4. Functional examination

Active and passive examination of structures such as bones, joints, muscles, ligaments, capsules.

a. Axial system
- Head joints
- Vertebral joints
- Costovertebral joints
- Sacrum and sacrococcygeal joint

Examination of the spine:
- Examination of the groin-pelvic-hip region while standing:
  - Flexion while standing – extension areas?
  - Extension while standing – flexion areas?
  - Lateral bending
  - Forward flexion phenomenon: further inspection of sacroiliac joint during
    ilium rotations, inflate and outflare, sacrum lesions, up slip and down slip
    Sitting
    in prone position, supine position, lateral position
  - Prone position: Springing test or p.a. boost
- Examination of the thoracic spine and ribs
  - Sitting
  - in prone position, supine position, lateral position
- Examination of the cervical spine
  - Sitting
  - In supine/prone position

For the connections to vegetative nervous systems as well as the organ system, see ▶ Section 19.2.1.

Abnormal findings regarding loss of movement, swelling, misalignment are divided into group lesions (at least three vertebral segments in a certain direction) or individual lesions (one vertebral segment).

In the case of group lesions, the relevant organs, vessels, muscles, etc. are treated first. Where still necessary, group lesions can be corrected subsequently. Techniques to treat organ fascia are only displayed if there is a restriction in movement.

In the case of individual lesions, the blockage must first be cleared.

Neurotension test: Slump, SLR and PNB, should there be indications from the medical history (points along the track).

b. Extremities

The movement test consists of the following:

- Active and passive movements (including end point), pain when stretching
- Distraction and compression of the joint
- Muscle function testing
- Measuring joint mobility in accordance with the neutral zero method

5. Provocation test

Pain as an indicator of a problem; provocation test as exclusion test for potential contraindications or to confirm a previous suspected diagnosis.

The structures are provoked via:

- Contraction (active)
- Compression (passive)
- Distraction (passive)
- Stretching (active or passive)
- Convergence (active or passive)

6. Neurological and angiological examinations

- Reflexes, reference muscles
- Sensitivity testing
- Motor skills
- Coordination and vegetative deregulation
- Walking distance
- Risk factors: Age, smoking, obesity, metabolic disorder, physical inactivity, vasculopathy, family history
- Skin temperature
- Pulse status

7. Functional tests

Lumbar spine:

- Movement control test:
  - "waiter's bow"
  - "pelvic tilt"
  - "rocking forwards"
  - "rocking backwards"
  - Knee flexion in prone position
  - Knee extension while sitting

Scapula:

- Activation pattern:
  - Wiping exercise for trapezius muscle/levator scapulae muscle
  - Biceps curl for pectoralis major muscle
- Assessing the upward/downward movement of the scapula in the case of elevation on scapular level
- Static stability:
  Plank against the wall or in quadrupedal position to assess the strength development of the serratus anterior muscle

Lower extremity/entire body:

- Gait analysis
  - Gait
  - Up and downstairs
  - Test for medial collapse
  - Walking speed test

8. Special tests

- Controlling core stability when standing on one leg
- Impingement test in accordance with Neer and Hawkins
- Instability tests:
  - Front and rear apprehension test
  - Load and shift test
  - Relocation test
- Inferior instability testing: Sulcus sign
- SLAP stability test: Supine flexion resistance test
- Functional movement screening

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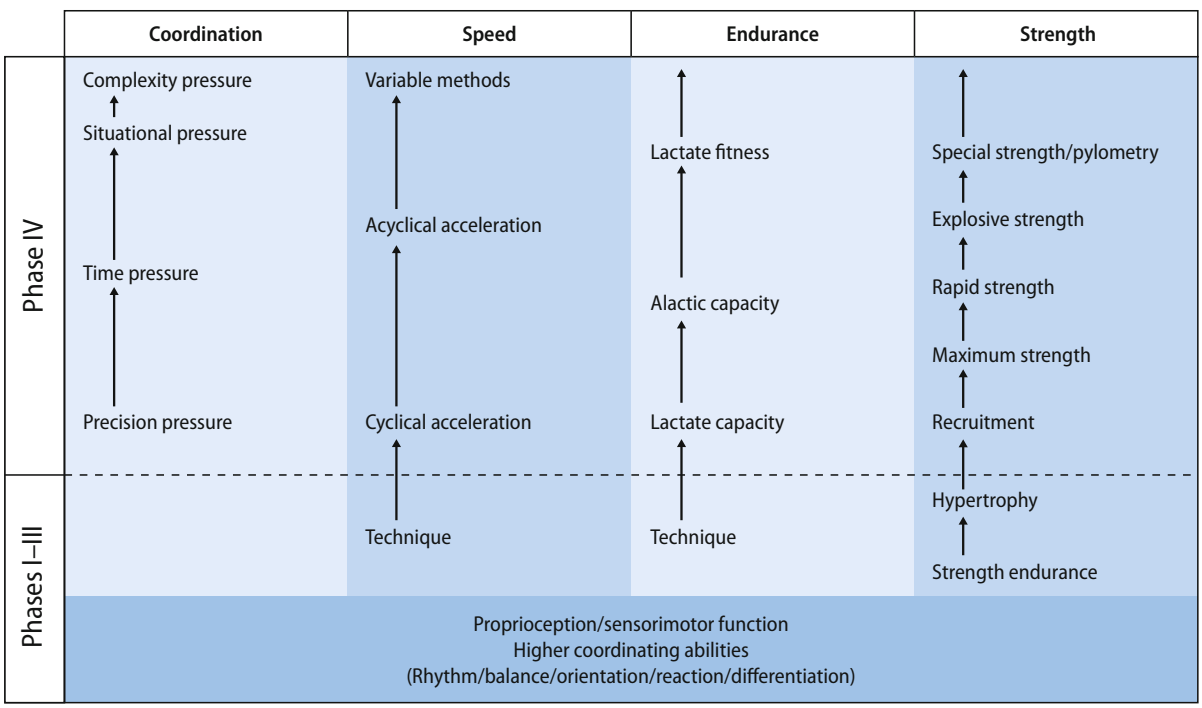
Upper Extremity

Strategy for the rehabilitation of the upper extremities (stages I-IV)

- Safeguarding the result of the surgery:
  - Patient education,
  - Anatomical, biomechanical, pathophysiological and neurophysiological knowledge (wound healing phases, tissue regeneration time),
  - Knowledge of the surgical procedure,
  - Patient/athlete compliance.
- Improving the mobility of the shoulder and scapulothoracic joint as well as the surrounding structures.
- Inhibition of incorrect muscle involvement.
- Scapular setting ("static control" and "dynamic control").
- Humeral head centering.
- Sensorimotor function/coordination/hand-eye coordination.
- Core stability.
- Coordinating the entire shoulder girdle musculature with core involvement along the entire kinetic chain.
- Exercise: Strength, endurance and speed of the entire shoulder girdle/core (see rehab phase IV).
- Throwing, kicking.
- General and sport-specific training.

Weighting of treatments over the different phases			
	Phase II	Phase III	Phase IV
Physiotherapy	35%	15%	5%
Sensorimotor function	25%	30%	25%
Strength training	10%	25%	35%
Sport-specific training	10%	10%	25%
Exercising local stabilizers	20%	20%	10%

Training content of sports therapy for the upper extremities



- The contents are divided into four conditional areas of coordination/speed/endurance/strength.
- Each area begins with proprioception or sensorimotor function and ends once all stages have been passed through. No points are to be skipped, where possible.
- In addition, the areas are connected in parallel, i.e., the content for strength also applies to the content on the same level for endurance, coordination and speed.

Shoulder: Surgical procedure/aftercare

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2.1 Muscle/Tendon Repair

2.1.1 Reconstruction of the rotator cuff

In principle, the reconstruction of tendon defects in different areas follows the same surgical technique. Modifications may be made depending on the size and location of the defect. A distinction is made between **partial** and **complete tendon rupture**, where complete rupture refers to the tendon having torn completely from the articular side to the bursal side. (**Cave:** no information regarding the size of the rupture has been defined here!) The location of the lesion can be differentiated into: **anterior, anterosuperior, superior, and posterosuperior**.

Indication

- Acute traumatic lesion of the rotator cuff tendons (RC) [supraspinatus muscle (SSP), infraspinatus muscle (ISP), teres minor muscle (TM), subscapularis muscle (SSC)].
- Degenerative lesions in the tendons of the rotator cuff.
- Traumatic shoulder dislocation rupture of the rotator cuff

Surgical method

- General anesthesia and scalene catheter for regional analgesia (continues for approx. three days postoperatively).
- Arthroscopy via standard dorsal access to assess the existing articular pathology. Intraarticular care of SSC lesions is accomplished by releasing the tendons and refixation using suture anchors depending on the extent of the lesions. In the event of additional lesions on the long biceps tendon, an arthroscopic tenodesis of the tendon with refixation using suture anchors or tenodesis screws is necessary.
- Change to the subacromial space, bursectomy, denervation, electrothermic hemostasis and subacromial decompression with the shaver (acromion type III).
- Representation of tendon lesions on the bursal side, mobilization of the tendons, the lysis of adhesions and the debridement of the insertion site at the greater and lesser tubercles.
  (In the mini-open technique, this step takes place via an approx. 4cm long skin incision with split in the deltoid muscle.)
- Retraction and refixation of the tendons using suture anchors.
- Potentially additional securing of the reconstruction through a second lateral series of suture anchors using a double row technique to increase the size of the insertion area (◘ Fig. 2.1).
- With additional biceps tendon pathology: fixation of the previously proximally separated tendon with suture anchor (LBS tenodesis) or suture of the tendons (soft tissue tenodesis) in the bicipital groove. Alternatively, the tendon can also be detached at the point of origin (LBT tenotomy).

Aftercare

An overview of aftercare can be found in ◘ Table 2.1, ◘ Table 2.2 and ◘ Table 2.3.

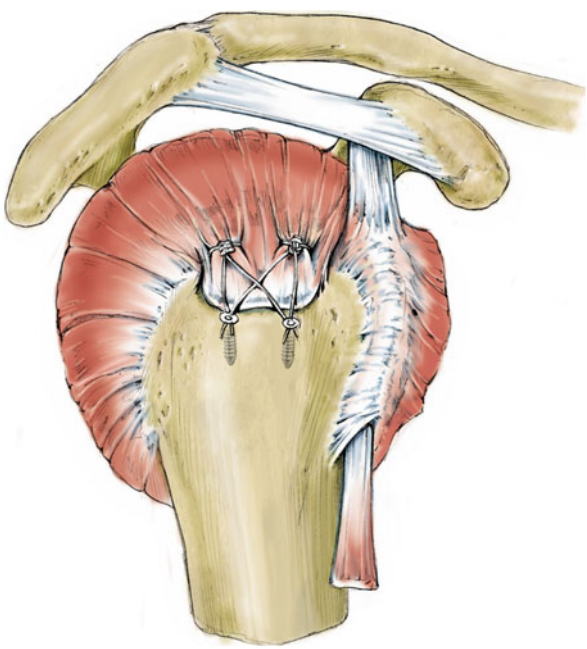
2.1.2 Latissimus dorsi transfer

Indication

- Non-reconstructable superior and posterosuperior defects in the rotator cuff of the active patient with market functional and movement restrictions (no signs of arthrosis and intact subscapularis muscle).

Surgical method

- Anterolateral skin incision with split of the deltoid muscle between the anterior and medial pars.
- Debridement of the supraspinatus and infraspinatus muscles and tenodesis of the LBT.
- Second incision dorsally, z-shaped on the front edge of the latissimus dorsi muscle in the direction of the rear axillary fold.
- Preparation and mobilization of the muscle, then separation at the insertion site.



◘ **Fig. 2.1** Reconstruction of the supraspinatus and infraspinatus muscles using the suture bridge technique

Table 2:1 Reconstruction of the anterior RM lesion (SSC). Shoulder abduction orthosis in 15° abduction (e.g., medi® SAS 15) for 4-6 weeks

Phase	Range of motion and permitted load	
I	1st to 3rd weeks post-op:	Passive abduction/adduction: 90°/15°/0° Passive flexion/extension: 90°/15°/0° Passive IR/ER: free/0°/0° Active assisted ER: up to 0°
II	4th to 6th weeks post-op:	Active assisted abduction/adduction: 90°/15°/0° (passive: free) Active assisted flexion/extension: 90°/15°/0° (passive: free) Passive IR/ER: free/0°/0° Active assisted ER: up to 0°
III	from 7th week post-op:	Free active assisted mobility
	from 9th week post-op:	Free active mobility
	from approx. 12th week post-op:	Jogging
IV	approx. 4 months post-op:	Cycling, swimming (no raising arm above the head, e.g., no crawl or butterfly stroke)
	approx. 6 months post-op:	Sport-specific training subject to consultation with a physician (e.g. starting golf/tennis/skiing)
	approx. 9 months post-op:	Contact and high-risk sports

Table 2.2 Reconstruction of the anterosuperior RM lesion (SSC and SSP). Shoulder abduction orthosis in 30° abduction (e.g. medi® SAK) for 4–6 weeks

Phase	Range of motion and permitted load	
I	1st to 3rd weeks post-op:	Passive abduction/adduction: 90°/30°/0° Passive flexion/extension: 90°/30°/0° Passive IR/ER: free/0°/0° Active assisted ER: up to 0°
II	4th to 6th weeks post-op:	Passive abduction/adduction: free/30°/0° Active assisted abduction/adduction: 90°/30°/0° Passive flexion/extension: free/30°/0° Active assisted flexion/extension: 90°/30°/0° Passive IR/ER: free/0°/0° Active assisted ER: up to 0°
III	from 7th week post-op:	Free active assisted mobility
	from 9th week post-op:	Free active mobility
	from approx. 12th week post-op:	Jogging
IV	IV approx. 4 months post-op:	Cycling, swimming (no raising arm above the head, e.g. no crawl or butterfly stroke)
	approx. 6 months post-op:	Sport-specific training subject to consultation with a physician (e.g. golf)
	approx. 9 months post-op:	Contact and high-risk sports (e.g. tennis)

- Leading the muscle through the interval between the posterior deltoid muscle and long tendon of the triceps brachii muscle and fixation in abduction and external rotation position in the region of the lesion on the greater tubercle using an suture anchor system (Fig. 2.2).

Aftercare

Table 2.4 provides an overview of aftercare.