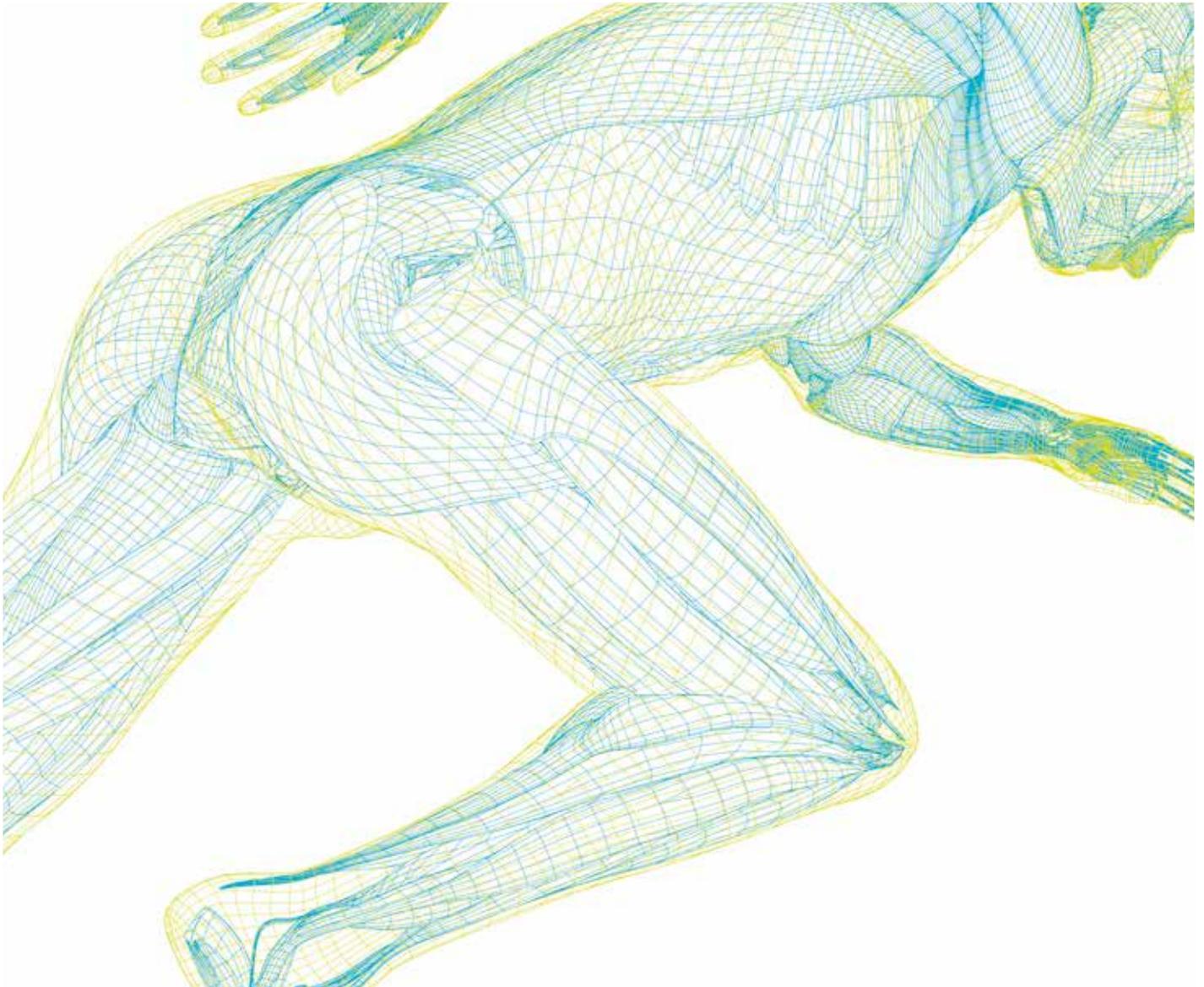


# BIOMECHANICAL DIAGNOSTICS AND THERAPY

-  **CON-TREX®:**  
Neuromuscular Diagnostics and Therapy Systems
-  **Computer-Supported Test and Training Systems (CTT):**  
Motor Controlled Feedback System for the Spine/Trunk
-  **PHYSIOMED Strength Line:**  
Strength Training Units
-  **PHYSIOMED Cardio Line:**  
Cardiovascular Training Units
-  **PHYSIORUN:**  
Treadmill System with Gait Correction Training
-  **COBS:**  
System for Coordination, Balance and Sensorimotor Effects





# CON-TREX®

## Biomechanical testing, training and therapy modules

CON-TREX® modules are biomechanical testing, training and therapy machines for rehabilitation, sport and research. They work in isokinetic, isometric and isotonic movement modes as well as with continuous passive motion (CPM), freely definable position profiles and feedback. The CON-TREX® modules are a system that detects the user's movements, uses this information to "make decisions" and provides visual and sensory feedback to the patient. The characteristics of an individual movement (evaluation) can be precisely measured, and feedback provided.

CON-TREX® modules enable the analysis of both the static and dynamic strength of a joint and the resulting targeted functional muscle-strength training and improvement to coordination skills with possible monitoring and correction during training or therapy. Depending on the direction of motion, the following muscular load types exist in dynamic modes: concentric/concentric, concentric/eccentric, eccentric/concentric and eccentric/eccentric. Unique to CON-TREX® are the combined load types: con/CPM, CPM/con, CPM/ecc and ecc/CPM.

CON-TREX® modules support strengthening of direct muscle activity or in its synergistic chain, promote muscle empowerment, muscle elongation, proprioception and restoration of lost neuromuscular functions (relative to the healthy side). Furthermore it allows direct observation of the therapeutic activity in real time, offering an objective criterion for the development of the process. With the CON-TREX® modules, modifications can be implemented and adapted to the various joints during examination or treatment.

The CON-TREX® dynamometer technology by definition ensures precision in isokinetic dynamometry by assessing the dynamically exerted muscular strength over a defined range of motion at a constant and programmable speed. Its unprecedented precision sets new benchmarks if it comes to providing quality in diagnostic and therapeutic work.

It is worth mentioning that currently isokinetic tests are legally accepted as objective measurements indicating existing joint and muscle deficits. At present, they are usually a valid criteria for the determination of parameters to define the patient's degree of disability. It functions play-free and with a 100 % digitally controlled drive system. The controls are optimised to be simple in usage and easy to clean, while making sure that the risk of injury is kept to a minimum. The entire drive and controls system can be adapted at any time to future trends in physiotherapy thanks to the easy software upgrade and smoothly updated to the latest computer technologies.

In its ballistic mode, the dynamometer can take into account the effects of gravity and correct them. It comprises a unique system of controls. In this mode, inertia is compensated and the expected motional development is calculated beforehand and the generated „inner strength“ is continuously equalised. To this user, this means the following: the motion can be executed functionally, realistically and for longer at the desired target speed – particularly with minimal effort, at high motion speeds or when large body segments are being moved. CON-TREX® ballistic mode enables both isokinetic and isotonic work.

By another feature, the active compensation for gravitational force, external forces influencing the treated body segments can be continuously offset or reduced.





# CON-TREX<sup>®</sup>: Neuromuscular Diagnostic and Therapy Systems



# Areas of application of CON-TREX® in rehabilitation, sport and research

CON-TREX® can be used in diagnostic and preventative therapy for injuries to the musculoskeletal system in out-patient rehabilitation and in the clinic. It is mainly used in scientific research, performance optimisation and high-performance sports and facilitates the careful and specific analysis of problems and thus the highly efficient training of top athletes. Thanks to its versatile measuring capabilities and the intuitive exercise software, CON-TREX® is excellently suited to the following applications:

## ORTHOPAEDIC REHABILITATION AND TRAUMATOLOGY

CON-TREX® enables the diagnosis and prevention of damages or injuries to the musculoskeletal system in out-patient rehabilitation and in clinical use.

### DIAGNOSIS AND REHABILITATION OF MUSCULOSKELETAL DEFICIENCIES

Muscular dysbalances can disrupt the ideal sequence of movements and may have damaging effects on the joints or, depending on the type of sport, can even be desirable or required. CON-TREX® helps to record, detect and analyse these dysbalances. In addition, CON-TREX® machines can be used to efficiently eliminate or produce muscular dysbalances. One particular benefit is in the fact that the tested movement can be trained at the same time.

### JOINT REPLACEMENT

CON-TREX® machines can be used in the area of geriatric rehabilitation after artificial joint replacement in particular. Even at very low available muscular strength patients can actively train and improve their muscularity at a sensible speed of motion. This means that the loss of strength is kept to a minimum and the mobility of the joints either remains the same or is improved.

## OPTIMISED PERFORMANCE IN COMPETITIVE SPORTS

CON-TREX® machines are used in competitive sport, most of all when it comes to objectively evaluating physique and optimising the progression of training of competitive and top-level athletes. Various strength tests which can be carried out at regular intervals provide both trainers and athletes with precise feedback on the effectiveness of their training methods. Within the framework of motion analyses for the optimisation of motion sequences specific to particular sports, precise problem analyses can also be generated using combined EMG evaluations. When rehabilitating top athletes after injuries, CON-TREX® machines facilitate highly efficient training sessions and contribute towards the sensible use of the injury period.

## NEUROLOGICAL REHABILITATION

If performance is diminished for neurological reasons, for example, after a brain injury or a stroke, rehabilitation work focuses on restoring coordination and control of the work done by the muscles. The German Society for Neurology demands the early functional mobilisation of patients who are after having suffered a stroke. CON-TREX® is suited to this task thanks to its exercise and training function in a continuously passive motion mode: The affected patient's limb is moved by CON-TREX® while the patient can simultaneously attempt to autonomously control and move the limb. CON-TREX® simultaneously visualises the ongoing performance of the patient, that is, training can be followed in real-time on the monitor and even the smallest of advances is immediately reproduced on the screen. This adds to the patient's motivation to increase the effectiveness of the rehabilitation through their active cooperation. This can only be achieved to a limited extent using „classic“ training methods. Feedback training, especially with a submaximal load, not only enables efficient correction of muscular deficiencies, but is also an excellent method of improving coordination abilities.

## SCIENCE AND RESEARCH

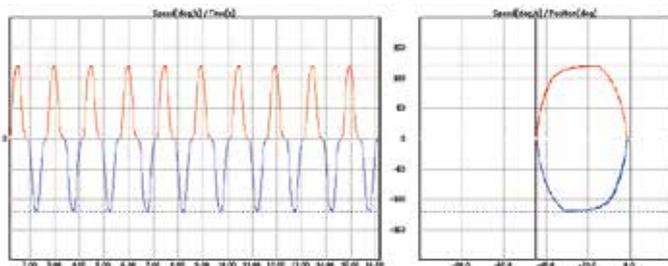
Thanks to the high levels of precision of CON-TREX® machines, the objective evaluation of every patient's data at the highest validity rates possible is given. CON-TREX® archives all relevant system parameters which could be of importance to scientific evaluation. In addition, the unique ballistic mode ensures the smooth execution of both motion sequence and measurement. This active gravity compensation facilitates both absolute and relative observation of the values. When used in science and research, the CON-TREX® machines set previously unequalled high standards in regard to accuracy of measurement and reproducibility of the collected parameters.



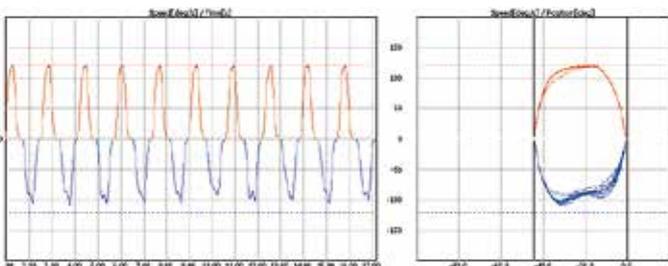
# Ballistic mode and active compensation for gravitational force

Smart unique selling features for improved therapeutic results

## BALLISTIC MODE



In isokinetic ballistic mode, the patient can efficiently achieve the desired target speed in extension and flexion and can work for longer at this desired target speed. The symmetry of the progression curves shows this emphatically.



In isokinetic classic mode, the patient, as can be seen in the illustration, does not achieve the specified target speed of 120°/sec in the flexion. The progression curves show a clear asymmetry.

The ballistic mode of CON-TREX® allows isokinetic as well as isotonic work. The main difference between isotonic ballistic and classic mode is in the performance of acceleration. Ballistic mode accelerates quickly, even with little available force, and to higher speeds and ramps with a final stop. The isokinetic ballistic mode allows the user to perform training activities at more functional speeds that are closer to real life. In patients with a limited range of joint motion, muscle weakness or also in the presence of spastic activity, the isokinetic ballistic mode facilitates the moment of inertia and supports the movement in patients who are unable to generate a lot of force when starting the movement.

The ballistic control mode allows greater acceleration and hence faster movement by means of movement prediction. This results in substantial reduction of the influence of inertia by use of CON-TREX ballistics. The ballistic mode allows complete training and evaluation of your patients and athletes at optimum speeds of movement.

## ACTIVE COMPENSATION FOR GRAVITATIONAL FORCE DURING TRAINING AND DIAGNOSIS

Patients with little strength are often unable to move individual segments of their bodies without assistance. This means that active compensation for these static weight influences is required. While the movement is being performed, the dynamometer can continuously reduce the external forces or even compensate for them completely; this produces a „gravity-free“ situation for the patient where every movement can be performed with minimal expenditure of force.

CON-TREX® software also offers the option of merely measuring the forces acting on the movement, without active compensation. When evaluating data, the measured values can then be displayed as „gravity-corrected“.

## ADVANTAGES OF BALLISTIC MODE AND ACTIVE COMPENSATION FOR GRAVITATIONAL FORCE

Ballistic mode allows patients in early functional rehabilitation to actively train even at very low available muscular strength and improve their muscularity at a sensible speed of motion. In general, exercise can be performed at higher absolute speeds\*. Performance diagnosis, training and rehabilitation are also possible at high functional movement speeds. In addition, the ballistic movement itself is far closer to the functional movement than with classical systems. Despite these complex types of control, the force can be applied in the direction of the movement (concentric), counter to the direction of movement (eccentric), or as a combination of both types of movement.

\*Renowned institutes at German universities confirm that patients using CON-TREX® systems attain up to 30 % higher movement speed than with conventional isokinetic training equipment.





# CON-TREX® human kinetics

CON-TREX® human kinetics is an excellent application for managing, testing and training of patient and subject data and for reliable data processing ensuring proper reporting

## CON-TREX® HUMAN KINETICS: INTELLIGENCE AT THE HEART OF THE SYSTEM

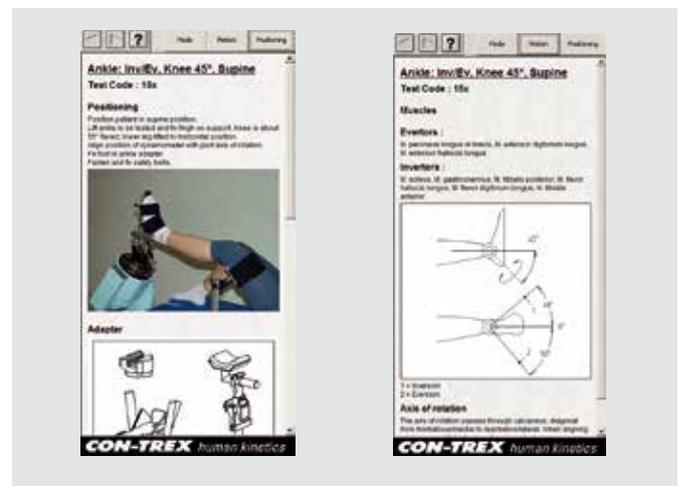
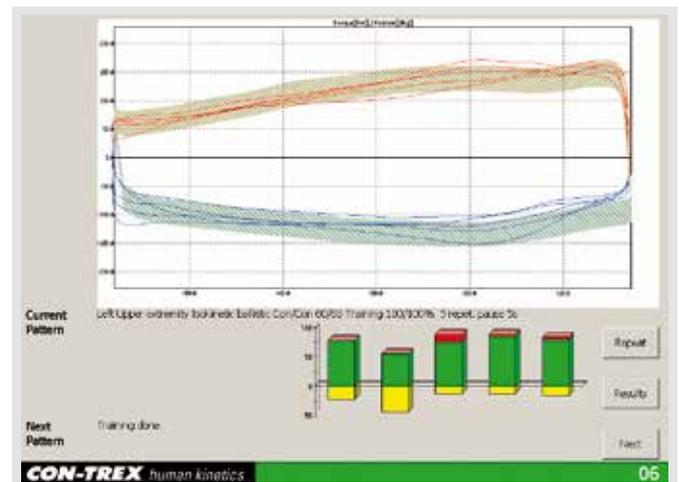
CON-TREX® human kinetics software integrates on a regular time base the newest relevant findings in biomechanics, training theory, rehabilitation and other relevant research areas. First and foremost, the high-performance CON-TREX® human kinetics programs control the settings, loading and the testing and training protocols. Online Help texts are shown continuously to enhance user comfort. Second, as a standard feature, CON-TREX® human kinetics offers a wide range of task-specific reports and evaluations with graphic presentation. CON-TREX® human kinetics also offers feedback in training mode - real time visual feedback processed in curve form.

### IDEAL TOOL FOR:

- » Assessment of high-speed parameters of movement
- » High-intensity power trainings
- » Rehabilitation of musculoskeletal disorder
- » Neurorehabilitation

## FEEDBACK TRAINING

The chart shows an example of highly successful movement monitoring: the measured force values (blue and red lines) for almost all the movements are within the target specification (shaded area).



Online Help texts are shown continuously to enhance user comfort. CON-TREX® human kinetics offers a wide range of task-specific reports and evaluations with graphic presentation. CON-TREX® human kinetics also offers feedback in training mode – real time visual feedback processed in curve form.

| Movement modes  | Load types   |
|---|--|
| Isokinetic mode, Classic and ballistic                                  | con/con, con/ecc, ecc/con, ecc/ecc                       |
| Isotonic mode, Classic and ballistic                                    | con/con, con/ecc, ecc/con, ecc/ecc                       |
| Isometric mode  | pull, push   |
| Continuous Passive Motion (CPM)   | at constant speed  |
| Combined load types   | con/CPM, CPM/con, CPM/ecc, ecc/CPM                       |
| Specific position-related profiles such as complex movement simulations | to reproduce realistic physiological loads, e.g. walking |

CON-TREX® was investigated in following scientific papers:

#### Reliability and validity

Caruso J., Brown L.E., Tufano J.J. (2012): The reproducibility of isokinetic dynamometry data. *Isokinet Exerc Sci* 20:239–53. doi:10.3233/IES-2012-0477.

Cotte T., Ferret J.M. (2003): Comparative study of two isokinetic dynamometers: CYBEX NORM vs. CON-TREX® MJ. *IOS Press Isokinetics and Exercise Science* 11(1), 37-43.

Guilhem G., Giroux C., Couturier A., Maffiuletti N.A. (2014): Validity of trunk extensor and flexor torque measurements using isokinetic dynamometry. *J Electromyogr Kinesiol* <http://dx.doi.org/10.1016/j.jelekin.2014.07.006>.

Maffiuletti N.A., Bizzini M., Desbrosses K., Babault N., Munziner U. (2007): Reliability of knee extension and flexion measurements using the Con-Trex isokinetic dynamometer. *Clin Physiol Funct Imaging* 27, 346-353.

Müller S., Baur H., König T., Hirschmüller A., Mayer F. (2007): Reproducibility of isokinetic single- and multi-joint strength measurements in healthy and injured athletes. *Isokinetics and Exercise Science* 15, 295-302.

Müller S., Mayer P., Baur H., Mayer F. (2011): Higher velocities in isokinetic dynamometry: A pilot study of new test mode with active compensation of inertia. *IOS Press, Isokinetics and Exercise Science* 19, 63–70 63, DOI 10.3233/IES20110398.

Müller S., Stoll J., Müller J., Mayer F. (2012): Validity of isokinetic trunk measurements with respect to healthy adults, athletes and low back pain patients. *Isokinet Exerc Sci* 20, 255–66. doi:10.3233/IES-2012-00482.

Müller J., Müller S., Stoll J., Fröhlich K., Baur H., Mayer F. (2014): Reproducibility of maximum isokinetic trunk strength testing in healthy adolescent athletes. *Sports Orthop. Traumatol.* 30, 229–237.

#### Clinical and scientific application

Baray A.L., Philippot R., Farizon F., Boyer B., Edouard P. (2014): Assessment of joint position sense deficit, muscular impairment and postural disorder following hemi-Castaing ankle ligamentoplasty. *Orthop Traumatol Surg Res* 100 (6 Suppl), 271-4. doi:10.1016/j.otsr.2014.02.014. Epub 2014 Aug 22.

Baray A.L., Philippot R., Neri T., Farizon F., Edouard P. (2016): The Hemi-Castaing ligamentoplasty for chronic lateral ankle instability does not modify proprioceptive, muscular and posturographic parameters. 24(4), 1108-15. doi:10.1007/s00167-015-3793-3.

Baur H., Müller S., Hirschmüller A., Huber G., Mayer F. (2006): Reactivity, stability and strength performance capacity in motor sports. *Br J Sports Med* 40, 906-911.

Baur H., Müller S., Pilz F., Mayer P., Mayer F. (2010): Trunk extensor and flexor strength of long-distance race car drivers and physically active controls. *J Sports Sci* 28: 1183–1187.

Edouard P., Castells J., Calmels P., Roche F., Degache F. (2010): Cardiovascular and metabolic responses during isokinetic shoulder rotators strength testing in healthy subjects. *ISSN 0959-3020/10 Isokinetics and Exercise Science* 18, 23–29 23 doi:10.3233/IES-2010-0363 IOS Press 23-29.

Edouard P., Bankolé C., Calmels P., Beguin L., Degache F. (2013): Isokinetic rotator muscles fatigue in glenohumeral joint instability before and after Latarjet surgery: a pilot prospective study. *Scand J Med Sci Sports* 23(2), 74-80. doi:10.1111/sms.12011. Epub 2012 Nov 1.

Edouard P., Degache F., Oullion R., Plessis J.Y., Gleizes-Cervera S., Calmels P. (2013): Shoulder strength imbalances as injury risk in handball. *Int J Sports Med* 34(7), 654-60. doi:10.1055/s-0032-1312587. Epub 2013 Feb 26.

Francis P., Toomey C., Mc Cormack W., Lyons M., Jakeman P. (2016): Measurement of maximal isometric torque and muscle quality of the knee extensors and flexors in healthy 50- to 70-year-old women. *Clin Physiol Funct Imaging* 28, n/a–n/a. doi:10.1111/cpf.12332.

Hirschmüller A., Konstantinidis L., Baur H., Müller S., Mehlhorn A., Kontermann J., Grosse U., Südkamp N.P., Helwig P. (2011): Do changes in dynamic plantar pressure distribution, strength capacity and postural control after intra-articular calcaneal fracture correlate with clinical and radiological outcome? *Injury* 42, 1135–43. doi:10.1016/j.injury.2010.09.040.

Hirschmüller A., Andres T., Schoch W., Baur H., Konstantinidis L., Südkamp N.P., Niemeyer P., (2017): Quadriceps Strength in Patients With Isolated Cartilage Defects of the Knee: Results of Isokinetic Strength Measurements and Their Correlation With Clinical and Functional Results. *Orthopaedic Journal of Sports Medicine* 5:232596711770372. doi:10.1177/2325967117703726.

Liebensteiner M.C., Platzer H.P., Burtscher M., Hanser F., Raschner C. (2012): The effect of gender on force, muscle activity, and frontal plane knee alignment during maximum eccentric leg-press exercise. *Knee Surg Sports Traumatol Arthrosc* 20, 510–516. DOI 10.1007/s00167-011-1567-0.

Mueller J., Mueller S., Stoll J., Baur H., Mayer F. (2014): Trunk Extensor and Flexor Strength Capacity in Healthy Young Elite Athletes Aged 11–15 Years. *Journal of Strength and Conditioning Research* 28, 1328–34. doi:10.1519/JSC.0000000000000280.

Mueller S., Mueller J., Stoll J., Cassel M., Hirschmüller A., Mayer F. (2017): Back Pain in Adolescent Athletes: Results of a Biomechanical Screening. *SMIO* 01, E16–E22. doi:10.1055/s-0042-122713.

Mueller S., Mueller J., Stoll J., Engel T., Mayer F. (2017): Back pain risk factors in adolescent athletes: suitability of a biomechanical screening tool? *British Journal of Sports Medicine* 51, 364–5. doi:10.1136/bjsports-2016-097372.205.

Rahm S., Spross C., Gerber F., Farshad M., Buck F.M., Espinosa N. (2013): Operative treatment of chronic irreparable Achilles tendon ruptures with large flexor hallucis longus tendon transfers. *Foot Ankle Int* 34(8), 1100-10. doi:10.1177/1071100713487725. Epub 2013 Apr 26.



# CON-TREX® MJ

Multijoint module for testing and training the major joints



With the control module PM and a wide range of adapters which are needed for the scheduled tasks, the CON-TREX® MJ multijoint module is a versatile, rotatory testing, training and therapeutic system to test and train all major joints of the upper and lower limbs in the open kinetic chain. The highly flexible mechanism with excellent operator guidance makes objective and reproducible test results possible in every work mode. The mechanical design of the CON-TREX® MJ is extremely user-friendly: the position of the seat, the seat length, and the inclination of the backrest can be electronically adjusted at the touch of a button. The upholstered seat and backrest offer a maximum of comfortable seating even during long training sessions and are easy to clean.

Training while sitting or standing, measurements in the prone or supine position: CON-TREX® MJ offers maximum flexibility in

every case. It enables the analysis of both the static and dynamic strength of a joint and the resulting targeted functional muscle-strength training and improvement to skills of coordination with possible monitoring and correction during training or therapy.

## TECHNICAL DATA

Dimensions (L x W x H): 203 x 73 x 151 cm

Weight: 350 kg

Nominal voltage: 230 VAC, internally adjustable to 200 V and 215 V

Nominal frequency: 50/60 Hz

Nominal current rating: 10 A

Patient weight allowance: 200 kg

Torque accuracy: 0.5 % of full scale

# CON-TREX® TP 500

Back module for trunk flexor and extensor muscles



CON-TREX® TP is a special back module, ideal for the testing and training of straight trunk musculature with its flexor and extensor muscles. It is connected to the CON-TREX® MJ system, the measuring range of version TP 500 being designed for rehabilitation and leisure.

The many customisation options, easy positioning and numerous different load types of CON-TREX® human kinetics software make possible various testing and therapeutic applications of the trunk.

Together with the various load modes operated by the PM control module, the freely definable scope of motion in the range between  $-15^\circ$  and  $+105^\circ$  enables the therapeutic handling of numerous problems related to longitudinally-running trunk musculature. The height of both the footplates and knee rests can be electroni-

cally adjusted to facilitate easier positioning of the patient. The kneerests are synchronised with the footplates. Just one finger is all it takes to easily change the position of even those heavier-set patients already standing in the machine.

## TECHNICAL DATA

Dimensions (L x W x H): 141 x 77 x 152 cm

Weight: 220 kg



# CON-TREX® LP

Leg press for testing and training the lower limbs in closed kinetic chain



The CON-TREX® LP leg press is a testing and training machine for the entire leg extensor and flexor chain. It can provide metered, measurable forces from a few N to 6000 N at speeds of up to 1 m/sec. Separate footplates allow unilateral training (on the left or right), bilateral training with both legs, or alternating mode. The adjustable footplate fixtures can be varied for selective testing and improvement of ankle joints in various positions. The inclination of the backrest can be electrically lowered to the horizontal position, the seat angle is synchronized with the adjustment of the backrest. The low seat height facilitates placement of patients with reduced mobility.

The high level of precision of the metered, measurable forces and the exceptional properties of the motion monitor through the drive system produce an extremely versatile area of application on a minimum workspace of just 1.8 x 2.5 meters including the control module.

Due to the functional motion, the entire muscle chain of the lower limbs is strengthened, while the coordination is simultaneously improved and the joint stability increased. The optimally adjusted load and strain of the (atrophied) musculature beyond the entire radius of motion can bring about a very sharp increase in the muscle strength and a significant improvement to coordination. All of this occurs without any excessive strain on the joint, especially in physiologically awkward positions.

## TECHNICAL DATA

Dimensions (L x W x H): 238 x 73 x 127 cm

Weight: 300 kg

Nominal voltage: 230 VAC, internally adjustable to 200 V and 215 V

Nominal frequency: 50/60 Hz

Nominal current rating: 10 A

Patient weight allowance: 200 kg

Torque accuracy: 1.0 % of full scale

# CON-TREX<sup>®</sup> WS

Work simulation for the analysis and practice of the complex motion patterns of working environments, sports or activities of daily living (ADL)

CON-TREX<sup>®</sup> WS was developed to imitate motions of working environments, sports and everyday domestic life. In order to be able to follow the unique and often extremely complex patterns of movement, the height of the dynamometer can be electronically adjusted from down close to the ground to up over the patient's head. For realistic simulation of unusual movements the CON-TREX<sup>®</sup> WS can be rotated and swivelled. The possibility of reproducible assessment of work capacity is thus provided. Various movements from the everyday life of a craftsman (such as screwing, lifting objects, butting levers or sawing) can be simulated and trained. In addition to preparing for difficult working conditions (such as working overhead), CON-TREX<sup>®</sup> WS can be used to compose a specific and highly effective muscular workout. In practice, a minimum working area of only 2 x 2 meters is sufficient.

## TECHNICAL DATA

Dimensions (L x W x H): 95 x 50 x 228 cm

Weight: 200 kg

Nominal voltage: 230 VAC, internally adjustable to 200 V and 215 V

Nominal frequency: 50/60 Hz

Nominal current rating: 10 A

Patient weight allowance: 200 kg

Torque accuracy: 0.5 % of full scale





# Movement Patterns

The CON-TREX® modules facilitate the performance of various movement patterns

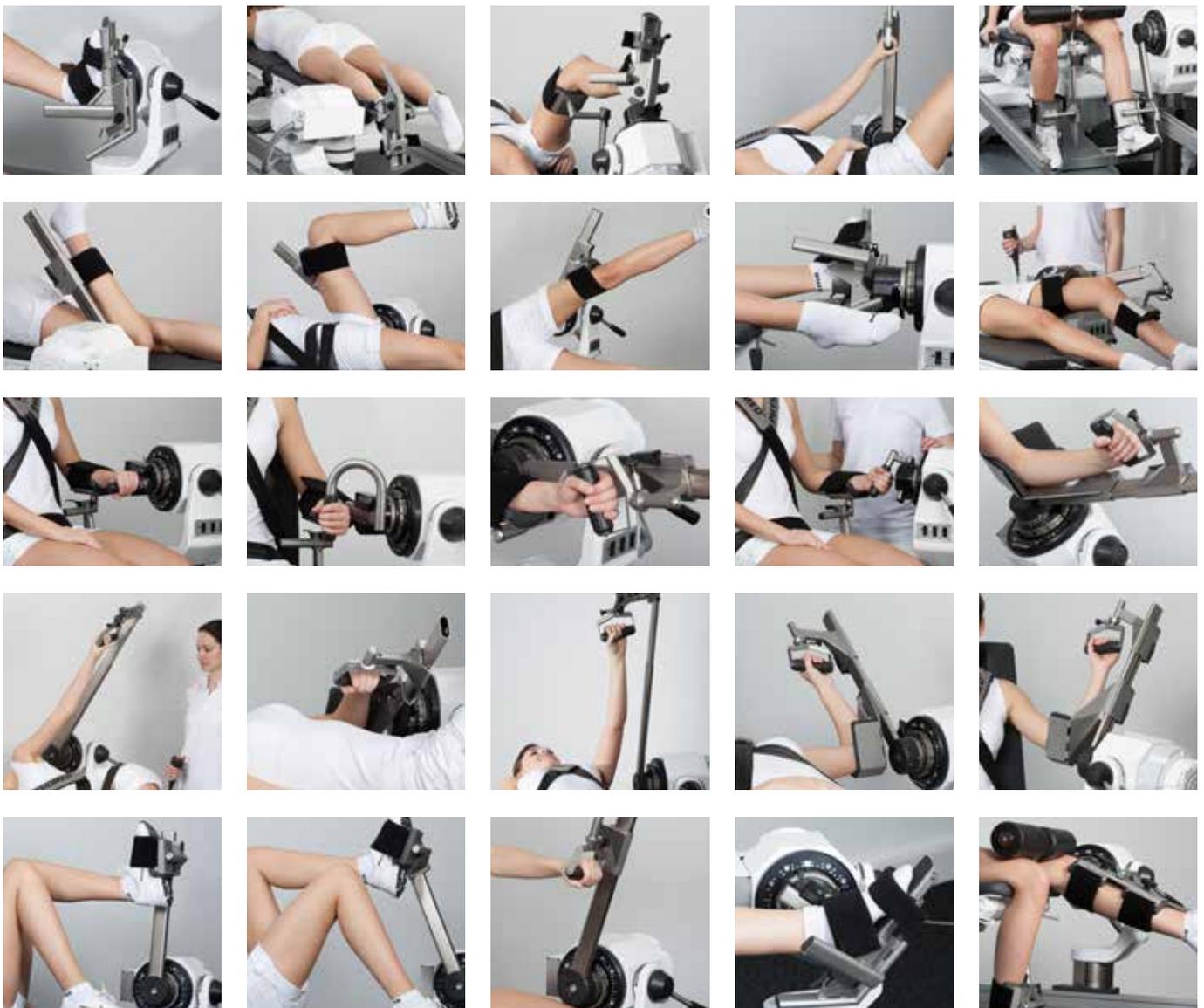
With the anatomically matched and continuously adjustable adapters, the various modules allow practice of virtually all single-joint

and multi-joint patterns of movement. Isolated as well as free movement tests provide a reliable basis for assessment and therapy.

## Movement Patterns MJ

Thanks to its flexible system, the CON-TREX® MJ allows adjustment close to the joints with maximum stability. The adapters are perfectly adjustable to the anatomical situation of the subject.

Isolated joint tests as well as free movements are possible with the wide range of accessories.



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## Movement Patterns LP

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The CON-TREX® LP is universally designed for functional testing and training of the leg extensor and flexor chain. Both in

the alternating, single-sided or double-sided mode, rigid or flexible foot plates can be used.



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## Movement Patterns WS

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With the CON-TREX® WS, a wide variety of functional as well as of natural movement patterns can be performed for therapy

and diagnostics related to activities of daily life and work.



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TECHNOLOGY FOR THERAPY

**PHYSIOMED**<sup>®</sup>