HUBER improves neuromuscular performance in elderly

• Marcovic G et al. 2015 (Croatia)
• Randomised controlled trial on 30 elderly women compared HUBER training with Pilates training for the effect on strength, static balance and body composition (fat %)

Huber training was significantly more effective than Pilates for improving trunk & leg strength, balance and body composition in elderly women.

HUBER in chronic low back pain

- Bojinca M et al. 2006, 2007 (Romania)
- Randomised controlled study – 50 patients
  - 25 patients exercise program with the Huber device
  - 25 patients classic exercise program
- 2 sessions/week during 2 months, 1h each session, total 15 sessions

<table>
<thead>
<tr>
<th>TEST</th>
<th>HUBER (15)</th>
<th>CONTROL 15</th>
<th>p (t-test) HUBER/CONTROL</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS</td>
<td>31.8 +/- 10.47</td>
<td>39.9 +/- 12.86</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>SHIRADO-ITO</td>
<td>92.85 +/- 41.44</td>
<td>80.07 +/- 37.61</td>
<td>&lt; 0.05</td>
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<tr>
<td>QUEBEC</td>
<td>14.95 +/- 7.06</td>
<td>22.5 +/- 15.53</td>
<td>&lt; 0.05</td>
</tr>
</tbody>
</table>

Compared with classic exercise program, the program using the Huber device induced significantly more improvement for pain, trunk flexors muscles strength, and functional status.

HUBER improves balance in general population

- Couillardre et al. 2008 (France)
- 12 healthy adults (divided into a sedentary group and an active group) took part in a 2-month training programme on the HUBER
- 3 sessions/week, 1h each session, total 24 sessions
- Postural control was measured through the surface of the displacement of the center of foot pressure on a Satel® platform

After training on HUBER the area of gravity centre oscillations decreases significantly indicating improved postural control.

HUBER improves balance in athletes

- Galozzi R & Faina M, 2005 (Italy)
- 22 sporty subjects were trained on the Huber during 2 months
- 2 sessions/week, 1h each session, total 16 sessions
- Postural control was measured before and after training through baropodometry: measure of the plantar pressures and gravity centre oscillations during 4 exercises in a standing position, open or closed eyes in monopodal and bipodal position.

After training on HUBER, the area of gravity centre oscillations decreased significantly indicating **improved balance**.

Galozzi R, Faina M. HUBER® platform: an innovative methodology for postural re-education techniques. Abstract presented at 15th World Congress of Aesthetic Medicine; May 5-8, 2005; Rome, Italy.
HUBER improves balance in aging subjects

- Saginni R, 2005 (Italy)
- 40 aging subjects (55-75y) were assigned to 3 months Huber training (2 sessions/week) or standard balance training.
- Stabilometry data showed a significant improvement in balance after training at 3 months and at follow-up at 6 months in the Huber group while not in the control group.

![Graphs showing improvement in balance](image)

**Significantly better balance** at 3 and 6 m with HUBER versus standard balance training. Additionally, HUBER produced a **significant reduction in the energy consumption** during a 400m walk at 3 and 6 months.

Huber in orthopaedic and neurologic conditions

- Maertens de Noordhout B et al. 2006 (Belgium)
- Randomised controlled trial on 72 subjects
  - 9 patients with lower limb amputation
  - 9 patients with knee or hip arthroplasty
  - 4 patients with Parkinson syndrome
  - 48 patients with MS
  - 1 paraplegic D4 level
- Positive effect on balance, proprioception (trunk & limbs), muscle recruitment and psychomotor functions.
- The technique was very well accepted by the patients.
- Specifically, for patients with multiple sclerosis, an improvement of walking speed is noticed after 10 light training sessions with HUBER®.

Authors conclude the range of applications of HUBER® in physical and rehabilitation medicine is very broad.

Maertens de Noordhout B et al. Using the HUBER Technique in Physical Medicine and Rehabilitation subjects. 15th European Congress of Physical and Rehabilitation Medicine (ESPMR); May 16-20, 2006; Madrid.
Maertens de Noordhout B et al. Using the HUBER® technique for the rehabilitation of patients with multiple sclerosis. Annual Meeting of Rehabilitation In Multiple Sclerosis (RIMS), XVIII technical workshop; May 10-12, 2006; Barcelona.
HUBER for predictive evaluations of ankle sprain

- Fabri S et al. 2009 (France)
- Goal of the study was to establish reliable, reproducible and operator independent assessment modalities that have a predictive value for ankle sprain
- Coordination of 58 healthy young athletes was tested on the HUBER on three occasions over 5 months.
- The 5 subjects that sustained an ankle sprain over the course of the study had been assessed on the HUBER to have a 13% coordination deficit in their lower limbs as compared to the subjects that remained free of ankle sprain.
- Assessment of coordination with HUBER has a predictive value for ankle sprain, allowing to put in place a prophylactic exercise program.

HUBER is a valuable predictive assessment tool in ankle sprain prevention

HUBER for overweight management

- Fabre JB, 2014 (France)
- This controlled study compared the effect of a ‘whole body strength training’ program on HUBER with a walking program and no training (control group) on body composition in 38 subjects.
- The HUBER group had a significantly greater reduction of % body fat than the walking and control groups.

Strength training on HUBER has a **positive effect on body composition**

HUBER in cardiovascular rehab

- Guiaud T et al. 2015 (France)
- 22 patients with coronary heart diseases performed 2 sessions on the HUBER at resp. 40% and 70% of VO2max.
- Aim of the study was to investigate the safety and tolerance of HUBER for this patient group, and to optimise exercise protocols.
- No significant arrhythmia or abnormal blood pressure responses and no muscle soreness were reported.
- Patients had good energy expenditure without adverse effects on ventilation.
- HUBER seemed to be well tolerated, safe, and feasible in this group of coronary heart disease patients.
- HUBER may improve adherence of coronary patients to a cardiac rehabilitation program.
- HUBER can also be used safely in other rehabilitation programs in patients with cardiac comorbidities.

Role of proprioception, neuromuscular control and core stability training in rehabilitation
Aging and Knee OA are associated with changes in postural control that increase falling risk.

**The role of neuromuscular changes in aging and knee osteoarthritis on dynamic postural control.** Takacs J et al. 2013 Canada.


- Aging alone is associated with significant changes in dynamic postural control, a key factor in the risk of falling.
- These include deficits in proprioception, vestibular and visual changes, muscular weakness, reduced power and fatigue. Other neuromuscular changes have been hypothesized to play a role in dynamic postural control, including reduced motor unit discharge rate, contraction velocity, interlimb coordination, tendon stiffness and voluntary activation capacity.
- Research has highlighted the importance of eccentric strength in the elderly: eccentric strength appears to be more resistant to the effects of aging and may be critical in recovering from postural perturbations by generating force rapidly.
- Subjects with knee OA exhibit neuromuscular changes beyond that seen with aging, and evidence suggests that the risk, and rate, of falling is greater in this population. Neuromuscular changes seen in knee OA that negatively impact postural control include joint pain, reduced proprioception, muscle weakness and reduced power, alterations in motor unit firing characteristics and a reduced voluntary activation capacity.

**Relevance to HUBER: these Neuromuscular changes/deficits can typically be trained on HUBER**
Fall prevention for aging patients

**Static platform**
- Balance game
- Moving frontward
- The center of pressure

**Dynamic platform**
- Core Strengthening
- Spiral trajectory
- Keeping the center of pressure frontward
Subjects with knee OA have reduced varus/valgus proprioception and impaired active knee stabilisation

**Impaired varus-valgus proprioception and neuromuscular stabilization in medial knee osteoarthritis.** Chang AH et al. 2014 USA


- The objectives of the study were to compare knee varus-valgus proprioception, isometric muscle strength, and active muscular contribution to stability between persons with medial Knee OA and healthy controls.
- 14 knee OA patients were compared with 14 healthy controls
- The knee frontal plane sensorimotor control system is compromised in persons with medial Knee OA.
- The results suggest varus-valgus control deficits in both the afferent input (proprioceptive acuity) and muscular effectors (muscle strength and capacity to stabilize the joint).
- “These findings suggest that intervention strategies aiming to address active muscular stabilization and sensory acuity in the frontal plane may be beneficial in improving knee stability, ultimately reducing pain and improving function in persons with knee OA.”

Relevance to HUBER: sensorimotor control as well as muscle strength can typically be trained on HUBER
Varus Valgus stabilization on HUBER 360

**Static platform**
Balance game
Lateral trajectory of the center of pressure

**Dynamic platform**
Slow lateral tilts
Keeping center of pressure in the target, generating varus and valgus control
Strength & Balance are important in people with Knee OA

Factors Associated With Dynamic Balance in People With Knee Osteoarthritis.
Takacs et al. 2015 Canada

*Arch Phys Med Rehabil. 2015 Jul 14. [Epub ahead of print]*

- Objective: to identify potential neuromuscular factors associated with dynamic balance in individuals with knee OA.
- Subjects: 52 OA patients with radiographic confirmed knee OA.
- Dynamic balance was assessed using the Community Balance and Mobility Scale (CB&M).
- Potentially modifiable neuromuscular factors associated with dynamic balance were measured, including the sum of concentric and eccentric lower-extremity muscle strength, 2 quadriceps-hamstrings muscle strength ratios, knee joint proprioception (joint position sense), anticipatory postural control velocity, and knee joint range of motion.
- The results suggest that muscle strength and, to a lesser extent, knee joint range of motion are important factors associated with dynamic balance as measured by the CB&M and should be considered in dynamic balance interventions.

Relevance to HUBER: the conclusion of this study supports the combined use of (wireless) estim and Huber
Quadriceps and core strengthening

Dynamic platform
Quad and core strenghtening on a dynamic balance exercise.
Absorb platform movements (∞ pattern), knee bended,
Keeping center of pressure in the target
Proprioceptive exercises improve balance & WOMAC in severe knee OA

Assessment of the impact of proprioceptive exercises on balance and proprioception in patients with advanced knee osteoarthritis. Duman I et al. 2012 Turkey

*Rheumatol Int. 2012 Dec;32(12):3793-8.*

- **Objective:** to investigate the impact of proprioceptive exercises on balance, proprioceptive perception and clinical findings in advanced-stage knee OA.
- **Subjects:** 54 patients with advanced knee OA (≥ grade 3)
- **Patients were randomised into a study group that received a 3 week proprioceptive rehab program, and a control group.**
- **Patients in study group showed greater improvements in static balance and WOMAC score.**
- **In the treatment for advanced knee osteoarthritis, adding exercises specifically targeting the proprioceptive and balance dysfunction might be useful.**

*Relevance to HUBER: proprioception & balance can typically be trained on HUBER*
Proprioceptive exercises improve function in patients with knee OA


• Objective: to determine the effectiveness of proprioceptive exercises for knee OA using meta-analysis.
• 7 RCTs including 560 subjects with knee OA were included. All studies compared a proprioceptive exercise regime, against a non-proprioceptive exercise programme or non-treatment control.
• Compared to a non-treatment control, proprioceptive exercises significantly improved functional outcomes in people with knee OA.
• When compared against a general non-proprioceptive exercise programme, proprioceptive exercises demonstrated superior results with respect to joint position sense-related measurements such as timed walk over uneven ground and joint position angulation error.
• The results of this meta-analysis suggest proprioceptive exercises are efficacious in the treatment of knee OA.

Relevance to HUBER: proprioception can typically be trained on HUBER
Neuromuscular training improves pain & function in severe knee/hip OA

Effects of neuromuscular training (NEMEX-TJR) on patient-reported outcomes and physical function in severe primary hip or knee osteoarthritis: a controlled before-and-after study. Ageberg E et al. 2013 Sweden

*BMC Musculoskelet Disord. 2013 Aug 8;14:232*

- Objective: to examine the effects of neuromuscular training on patient-reported outcomes and physical function in patients with severe primary hip or knee OA.

- 87 patients with severe knee/hip OA who were awaiting total joint replacement had ‘NEMEX-TJR’ training program: this program is based on principles of neuromuscular training with the aim of improving sensorimotor control and achieving compensatory functional stability.

- About half of the patients displayed a clinically meaningful improvement (≥15%) in HOOS/KOOS subscales by training.

- Neuromuscular training with an individualized approach and gradual progression showed promise for improving patient-reported outcomes and physical function even in older patients with severe primary OA of the hip or knee.

*Relevance to HUBER: progressive neuromuscular training is a core exercise modality on HUBER*
Neuromuscular training improves pain & function in severe knee/hip OA

Immediate efficacy of neuromuscular exercise in patients with severe osteoarthritis of the hip or knee: a secondary analysis from a randomized controlled trial. Villadsen et al. 2014 Denmark


- Objective: to evaluate the efficacy of a neuromuscular exercise program in patients with clinically severe hip or knee OA.
- Randomised controlled trial, including 165 patients with severe knee or hip OA awaiting joint replacement.
- The intervention group received an 8-week NEMEX-TJR program as adjunct to standard care. Control group received standard of care only.
- The neuromuscular training group had significantly better improvements of pain, ADL, functional performance tests.
- Neuromuscular training is feasible and effective in patients with severe knee or hip OA that are awaiting total joint replacement.

*Relevance to HUBER: neuromuscular training is a core exercise modality on HUBER*
Gradual progression for severe Hip OA

Goal:
- Strengthening of hip stabilizers
- Functional mobilization angled towards opposite side from lesion in order to maintain range of motion up to motor limit

Progression
From Static to dynamic
From low to large amplitude
Preoperative neuromuscular training enhances postop recovery in TKA/THA

Postoperative effects of neuromuscular exercise prior to hip or knee arthroplasty: a randomised controlled trial. Villadsen et al. 2014 Denmark

- Objective: to investigate the postoperative efficacy of a supervised preoperative neuromuscular exercise programme prior to hip or knee arthroplasty.
- Randomised controlled trial, including 165 patients with severe knee or hip OA
- The intervention group received an 8-week preoperative neuromuscular supervised exercise programme (twice a week for 1h) as adjunct to standard care. Control group received standard of care only.
- The intervention group experienced a statistically significant benefit in ADL and pain at 4 weeks postop, but not at 3 months postop.
- Preop neuromuscular training produced short term postop benefit in ADL and pain, suggesting an earlier onset of postoperative recovery.

Relevance to HUBER: neuromuscular training is a core exercise modality on HUBER
Goal:
- Strengthening of hip stabilizers
- Isometric reinforcement, both healthy and pathologic side, non-weight bearing to protect injured joint
- Reinforcement of healthy limb in preparation for crutch walking

Focus: Center of pressure located under injured limb
Dynamic balance: toward antero-posterior ellipse pattern
Balance training should be incorporated in TKA rehabilitation

Balance is an important predictive factor for quality of life and function after primary total knee replacement. Schwarz et al. 2012 Israel


- This study investigated the extent to which improved balance relative to pain relief correlates with the success of total knee replacement (TKR).
- 62 patients with a mean age of 73 underwent static and dynamic assessment of balance pre-operatively and one year post-operatively.
- There was a significant improvement in dynamic balance ($p < 0.001$) one year after TKR, and better balance correlated with improved mobility, functional balance and increased health-related quality of life.
- As it seems that balance, and not only pain relief, influences the success of TKR. Balance skills should be better addressed during the post-operative rehabilitation of patients who undergo TKR.

Relevance to HUBER: balance can typically be trained on HUBER
TKA post op balance training

**D1 to D5 post op: Weight bearing recovery**
- Soft mobilization for range of motion recovery
- Stretching of posterior chain to limit flexion
- Isometric contraction with angle increase (respect no-pain rule)
- Dynamic balance on a Tilt pattern on posterior sector of the injured side

**D5 to D20 post op: Trunk Strengthening**
- Weight bearing recovery and proactive workout
- Down on opposite side
- Strengthening of operated leg non-weight bearing
- Maintain range of motion
- Work on healthy leg instability
- Dynamic balance on tilt pattern on antero posterior tilt axis under injured leg
Proprioceptive and balance training are beneficial for patients with ACL injury


• This systematic review investigated the effect of proprioceptive and balance exercise on outcomes following injury and surgical reconstruction of the ACL.

• Five studies of high quality that offered empirical evidence by comparing one rehabilitation program to another were included in this review. 4 studies investigated ACL deficient patients and one study ACL reconstructed patients.

• The results suggest that proprioceptive and balance exercise may improve outcomes in people with ACL deficiency, and that some modest benefits are apparent for people who have undergone ACL reconstruction.

• Improvements in joint position sense, muscle strength, perceived knee joint function, and hop testing were reported.

• No detrimental effects - such as increased passive joint laxity or decrease in strength - were noted when compared with standard rehabilitation programs for both ACL-deficient and ACL-reconstructed individuals.

Relevance to HUBER: proprioception & balance can typically be trained on HUBER
Neuromuscular and proprioceptive assessment & training are key in ACLD/ACLR.


- Goal of this review is to provide the clinician and the clinical scientist with sufficient background information for the development of quantitative methods to evaluate a patient's functional capacity and to assist in preventative, preoperative, and postoperative decision-making strategies.

- Conclusions:
  - after ACL reconstruction, patients continue to have defects in proprioception and neuromuscular joint control at least 6 months and in some cases beyond 1 year when compared with a control group.
  - patients with ACL deficiency have impaired proprioception and neuromuscular control of the knee in the involved and noninvolved limbs when compared with a control group.
  - when assessing proprioception and neuromuscular control of patients with either ACL deficiency or after reconstruction, the contralateral limb may not be a suitable control because of the bilateral deficits.
  - it is important to incorporate beginning, intermediate, and advanced proprioceptive training exercises throughout the postoperative rehabilitation protocol. (-> Huber offers multiple training levels)
  - females with anterior cruciate ligament deficient knees and after ACL reconstruction have greater deficits in proprioception and neuromuscular control of the knee and possibly more functional instability than their male counterparts.

- Some relevant quotes from this review:
  - ‘The need to assess proprioceptive ability and neuromuscular control accurately is widely accepted in the scientific community’
  - ‘Functional neuromuscular and proprioceptive training should provide the athlete with a dynamically functional joint that is prepared to respond to the extreme forces generated during athletic competition, reducing the risk of reinjury.’
  - ‘Functional neuromuscular and proprioceptive training may be defined as movement training progressions that facilitate the development of multi-joint neuromuscular engrams that combine joint stabilization, acceleration, deceleration and kinesthesia through intermittent protocols that progress from low intensity movements focused in a single plane to multiplanar power training.’
  - ‘The first level of proficiency that must be attained before return to sports participation is the ability of the injured knee to maintain balance and stability. Improvement of an athlete’s postural balance should decrease risk of reinjury.’
POST OP ACL PROPRIOCEPTIVE TRAINING

D1-to D5 post op
Weight bearing recovery and proactive workout
Down on opposite side
Strengthening of operated leg
non-weight bearing
Maintain range of motion
Work on healthy leg instability
Antero-posterior tilt pattern with
Unlocked stool

D20-D60 post op
Trunk Strengthening
Maintain active range of motion
Progressive weight bearing recovery until unipodal stance, from static to dynamic
Dynamic balance on a rosette pattern progressively increasing the range of motion
Core stability training may have a key role in ACL rehabilitation


- Background: ACL injury is associated with abnormal gait patterns and knee OA. In order to accelerate recovery, the introduction of core stability exercises into the rehabilitation program is proposed.
- The theory underlying the use of core stability exercise relates to changes in the central nervous system and neuroplasticity that follows ACL injury.
- Core stability also demonstrates a negative correlation with the incidence of anterior cruciate ligament injury.
- Therefore, the authors propose that core stability exercises may improve the rehabilitation of ACL injuries by increasing core motor control. Specialized core stability exercises aimed at rectifying biomechanical problems associated with gait and core stability may play a key role in the management of anterior cruciate ligament injury.

Relevance to HUBER: core stability can typically be trained on HUBER
Dynamic core strengthening
Absorb platform movement (random pattern) keeping focus on forward center of pressure. Pulling/pushing on handles.

**Progression:** % of maximum force applied on the handles, amplitude, speed and acceleration of the platform.
Balance training improves function and postural control in chronic ankle instability.

**Balance training improves function and postural control in those with chronic ankle instability.** McKeon PO et al. 2008 USA


- The purpose of this randomized controlled trial was to determine the effect of a 4-wk balance training program on static and dynamic postural control and self-reported functional outcomes in those with chronic ankle instability (CAI).
- 31 young adults with self-reported CAI were randomly assigned to an intervention group or a control group.
- The intervention consisted of a 4-wk supervised balance training program that emphasized dynamic stabilization in single-limb stance.
- **4 weeks of balance training significantly improved self-reported function, static postural control, and dynamic postural control.**

*Relevance to HUBER: balance can typically be trained on HUBER*
Cochrane recommends neuromuscular training in chronic ankle instability

**Interventions for treating chronic ankle instability.**

De Vries JS et al. 2011 The Netherlands

*Cochrane Database Syst Rev. 2011 Aug*

- Objective: to compare different treatments, conservative or surgical, for chronic lateral ankle instability.
- 10 randomised controlled trials were included.
- Neuromuscular training was the basis of conservative treatment evaluated in 4 trials. Neuromuscular training compared with no training resulted in better ankle function scores at the end of 4 weeks training.
- 2 trials (70 participants) compared functional mobilisation with immobilisation after surgery. These found early mobilisation led to earlier return to work.
- This Cochrane review supports neuromuscular training for conservative treatment and early functional mobilisation after surgical interventions, leading to better and earlier functional recovery.

*Relevance to HUBER: ankle neuromuscular control and mobility can be trained on HUBER*
Neuromuscular training + brace offer optimal ankle sprain prevention

Optimising ankle sprain prevention: a critical review and practical appraisal of the literature. Verhagen EA et al. 2010 The Netherlands


- **Objective:** to establish the effect of preventive measures and assert the optimal prevention strategy for acute lateral ligament injury to the ankle.
- **A total of 24 relevant studies met the criteria for inclusion and were analysed.**
- **Conclusion:** Based on these outcomes, a combination of an external prophylactic measure (tape or brace) with neuromuscular training will achieve the best preventive outcomes with minimal burden for the athlete.

Relevance to HUBER: ankle neuromuscular control can be trained on HUBER
Dynamic postural control for Ankle instability

Ankle proprioceptive training
Keeping focus on a lateral center of pressure following platform movement (spirale pattern) centered on injured ankle axis.

Dynamic strengthening
Absorb platform movements (rosette pattern) while pushing on injured leg to keep center of pressure in the target.
Ankle pads can be used.

Left ankle instability
Postural stability can be improved with training in unstable ankles

Twelve-week biomechanical ankle platform system training on postural stability and ankle proprioception in subjects with unilateral functional ankle instability.

Lee AJ et al. 2008 Taiwan


- Objective: to examine the effects of 12-week biomechanical ankle platform system (BAPS board, Spectrum therapy) training on static postural stability and ankle reposition sense in subjects with unilateral functional ankle instability.
- Subjects: 12 university students with unilateral functional ankle instability.
- A 12-week training program and a progression test for controlling the platform in certain directions and advancing to next training level was given to each subject.
- Differences in postural stability and ankle proprioception between each limb before and after the training period were determined.
- The mean radius of center of pressure on unilateral standing and the absolute error from pre-selected ankle angle in the functional ankle instability limb were significantly reduced after 12 weeks of training.
- These improvements in postural stability appear to reflect improved neuromuscular ability along with enhanced functional joint stability, as ankle proprioception also demonstrated the same positive improvements after training.
POSTURAL STABILITY TRAINING

Full body postural training
Surfing game. Keeping center of pressure in the target while platform is moving following a random pattern

Progression:
Increase amplitude, speed, acceleration, target size (fix or sliding)
Core stability & balance training are important in rehab of shoulder instability

Is there a relation between shoulder dysfunction and core instability?
Radwan A et al. 2014 USA


- **Purpose:** to analyze the difference between healthy athletes and those with shoulder dysfunction in regard to core stability measures. Secondary purpose was to explore the relationship between measures of core stability and measures of shoulder dysfunction.
- **Subjects:** 61 overhead athletes
- **Balance deficiency was found in athletes with shoulder dysfunction.**
- **According to this study, greater shoulder dysfunction is correlated with greater balance and stability deficiency.**
- **Therapists and trainers should consider incorporating balance training as an integral component of core stability into rehabilitation of athletes with shoulder dysfunction.**

**Relevance to HUBER:** core stability and balance can typically be trained on HUBER
Core exercises are important in overhead athletes

**Integrating shoulder and core exercises when rehabilitating athletes performing overhead activities.** Brumitt et al. 2009 USA


- **Purpose:** to review the activity of trunk musculature during upper extremity exercise and present a rehabilitation exercise progression for the shoulder girdle that integrates core muscle strengthening and activation.
- **Dysfunction within the kinetic chain will affect how forces are generated, summated, or transferred from proximal segments (legs, hip, torso) to the upper extremity.**
- **Research has documented that weakness within the core may contribute to the development of an overuse upper extremity injury.**
- **Core weakness needs to be identified in athletes performing overhead activities.**
- **Integrating shoulder and core exercises** can address potential musculoskeletal dysfunctions.
- **The inclusion of integrated core and shoulder exercises may help to bridge the gap between the initial rehabilitation exercises and later functional rehabilitation exercises targeting return to sports.**

*Relevance to HUBER: core stability & strength can typically be trained on HUBER*
CORE TRAINING FOR ATHLETES
Core stability exercises improve pain & function in LBP


- Objective: to review the effects of core stability exercise or general exercise for patients with chronic low back pain (LBP).
- 5 RCTs involving 414 participants were included in the analysis.
- Compared to general exercise, core stability exercise is more effective in decreasing pain and may improve physical function in patients with chronic LBP in the short term. However, no significant long-term differences in pain severity were observed between patients who engaged in core stability exercise versus those who engaged in general exercise.

Relevance to HUBER: core stability can typically be trained on HUBER
Lumbar stabilization is important for athletes with LBP


- LBP is a common condition that may affect athletes at a greater prevalence than the general population.
- Evidence in the literature has identified the importance of local stabilization exercises for the management of LBP.
- The spinal extensors, Multifidi, and Transversus Abdominis are adversely affected following an episode of LBP.
- LBP is associated with reduced Transversus Abdominis and Multifidi activation.
- LBP is associated with atrophy of the Multifidi and spinal extensor musculature.
- Training the Transversus Abdominis and Multifidi reduces the recurrence of LBP.

Relevance to HUBER: exercises to challenge and activate the local stabilizers can be performed on HUBER
**CORE STABILITY FOR LOW BACK PAIN**

**LOMBAR MOBILITY AND CORE STABILITY**

Focusing on the center of pressure control, the patient absorbs anterior tilts. Generating lumbar flexion extension and core muscles strengthening.

**Progression**

Tilt amplitude and angle
Size of the target
Trunk balance & flexibility exercises improve physical function in LBP

Efficacy of trunk balance exercises for individuals with chronic low back pain: a randomized clinical trial. Gatti et al. 2011 Italy


- Background: the majority of exercises focusing on restoring lumbopelvic stability propose targeting the feedforward control of the lumbopelvic region. Less attention has been paid to feedback control during balance adjustments.
- In this RCT 79 patients were randomised to receive trunk flexibility exercises plus either balance exercises or strengthening exercises.
- **Trunk balance exercises combined with flexibility exercises** were found to be more effective than a combination of strength and flexibility exercises in reducing disability and improving the physical component of quality of life in patients with chronic low back pain.

Relevance to HUBER: trunk balance & mobility can typically be trained on HUBER
TRUNK FLEXIBILITY AND MOBILITY

TRUNK FLEXIBILITY
Focusing on the center of pressure control, the Patient absorbs rotating movement. Generating stretch of back and thoracic muscles chains.

TRUNK MOBILITY
Focusing on the center of pressure control, the Patient absorbs rotating movement. Generating spine and Thorax mobilization, stretch of muscular posterior chains.
Balance training improves neck pain

The effect of balance training on cervical sensorimotor function and neck pain.
Beinert K et al. 2013 Switzerland


- **Objective:** to evaluate the effect of balance training on cervical joint position sense in people with subclinical neck pain.
- **RCT** including 34 patients who were randomised to balance training or to stay active.
- Sensorimotor function was determined before and after 5 weeks of training by assessing the ability to reproduce the neutral head position and a predefined rotated head position.
- After balance training, the intervention group showed improved joint repositioning accuracy and decreased pain whereas no effects were observed in the control group.
- A weak correlation was identified between reduced neck pain intensity and improved joint repositioning.
- The present data demonstrate that balance training can effectively improve cervical sensorimotor function and decrease neck pain intensity.

**Relevance to HUBER: balance can typically be trained on HUBER**
BALANCE TRAINING

BALANCE TRAINING PROGRESSION
Manage static then Dynamic control on the center of pressure.
From predictive basic to complex trajectories movement up to random movements
Keeping different postures