Anne Benjaminse, PhD

Feedback to optimize movement technique in cutting sports

@AnneBenjaminse
The Influence of In-Season Injury Prevention Training on Lower-Extremity Kinematics during Landing in Female Team Handball Players: A Prospective Intervention Study Over Three Seasons

Effectiveness of a Neuromuscular and Proprioceptive Training Program in Preventing Anterior Cruciate Ligament Injuries in Female Athletes

2-Year Follow-up

The Effects of Plyometric vs. Dynamic Stabilization and Balance Training on Power, Balance, and Landing Force in Female Athletes

GREGORY D. MYER, KEVIN R. FORD, JENSEN L. BRET, AND TIMOTHY E. HEWETT
Anterior Cruciate Ligament Injury in National Collegiate Athletic Association Basketball and Soccer

A 13-Year Review


Julie Agel, MA, ATC,* Todd Rockwood, PhD,† and David Klossner, PhD, ATC‡
The changes aimed to make the exercises more specific to team handball, as well as more challenging. However, the focus of the exercises (i.e., to improve awareness and knee control during standing, cutting, jumping, and landing) did not change. The players were encouraged to be focused and conscious of the quality of their movements, with emphasis given to core stability and hip and knee position in relation to the foot (the “knee over toe” position). The players were also asked to watch their partner closely and to give feedback to each other during training.
Motor learning is relatively permanent.
Motor Learning

Internal Focus

External Focus: Retention & Transfer

Circle: Of Movement Technique and Performance
MOTOR LEARNING IS RELATIVELY PERMANENT

SEPARATE RELATIVE PERMANENT FROM TEMPORARY EFFECTS BY:

1) RETENTION TEST: SAME TASK AS PRACTICED > EVALUATE THE EXTENT TO WHICH THE TASK HAS BEEN RETAINED OVER TIME

2) TRANSFER TEST: NEW (VARIATION OF THE) TASK
Motor learning is relatively permanent.
Oke, stap naar de bal.
EXTERNAL vs INTERNAL MOTOR LEARNING

EXTERNAL FOCUS

- No or little knowledge about rules of movement execution
- Subconscious

INTERNAL FOCUS

- Verbal: goal directed analogy
- Visual: imagery
  -especially verbal
  -conscious (cognitive)
Motor Learning

Knowledge of performance

Knowledge of results

Stimulates automatic learning processes

Better resistance to physical or psychological fatigue > transfer
Knowledge of performance

IMPORTANT

When viewed from the front, the hip, knee and foot of your supporting leg should be in a straight line

Do not let your knee buckle inwards

Always keep the hip and knee of your supporting leg slightly bent

Keep your weight on the ball of your foot

Keep your upper body stable and facing forwards

Keep your pelvis horizontal and do not let it tilt to the side

Knowledge of results
Optimizing Performance Through Intrinsic Motivation and Attention for Learning

Self-Controlled Feedback (Mode/Frequency/Timing)
Optimization of the Anterior Cruciate Ligament Injury-Prevention Paradigm: Novel Feedback Techniques to Enhance Motor Learning and Reduce Injury Risk
Balance

- Brace

- Ankle disk training
  - ↓ reaction time ankle muscles
  - ↓ 'giving way' feeling
  - ↑ coordination and balance
  - ↑ strength

The Effect of a Balance Training Program on the Risk of Ankle Sprains in High School Athletes

Timothy A. McGuine,* PhD, ATC, and James S. Keene, MD
From the University of Wisconsin, Hospital and Clinics, Sports Medicine Center, Madison, Wisconsin

Handoll 2001
Focus of Attention

“KEEP YOUR BALANCE BY STABILIZING YOUR BODY”

“KEEP YOUR BALANCE BY STABILIZING THE PLATFORM”

Effect of Focus of Attention on Transfer of a Postural Control Task Following an Ankle Sprain

Retention Transfer
**Verbal Instruction**

“KEEP YOUR BALANCE BY STABILIZING **YOUR BODY**”

“KEEP YOUR BALANCE BY STABILIZING **THE STICK**”

**INTERNAL FOCUS**

**EXTERNAL FOCUS**
Double legged squat

Real Time Visual Feedback

External focus

Pictures Kevin Ford
Balance

Squat

Lunge

Double legged drop vertical jump

Side step cutting

Jump shot
Balance

Squat

Lunge

Double legged drop vertical jump

Side step cutting

Jump shot

MECHANISM 1
VISUAL FEEDBACK

EXTERNAL FOCUS

MODELING (EXPERT OR SELF)

POSTERIOR VIEW
Enhanced retention of drop vertical jump landing technique: A randomized controlled trial

Wouter Welling, Anne Benjaminse, Alli Gokeler, Bert Otten

* University of Groningen, University Medical Center Groningen, Center for Human Movement Sciences, Groningen, The Netherlands
**School of Sport Studies, Netherlands University, Groningen, The Netherlands

Frontal-Plane Motion

1. Stance width
   - Normal (0)
   - Wide (1)
   - Narrow (1)

2. Maximum foot-rotation position
   - Normal (0)
   - Externally rotated (1)
   - Internally rotated (1)

3. Initial foot contact
   - Symmetric (0)
   - Not symmetric (1)

4. Maximum knee-valgus angle
   - None (0)
   - Small (1)
   - Large (2)

5. Amount of lateral trunk flexion
   - None (0)
   - Small to moderate (1)

Sagittal-Plane Motion

6. Initial landing of feet
   - Toe to heel (0)
   - Heel to toe (1)
   - Flat (1)

7. Amount of knee-flexion displacement
   - Large (0)
   - Average (1)
   - Small (2)

8. Amount of trunk-flexion displacement
   - Large (0)
   - Average (1)
   - Small (2)

9. Total joint displacement in the sagittal plane
   - Soft (0)
   - Average (1)
   - Stiff (2)

10. Overall impression
    - Excellent (0)
    - Average (1)
    - Poor (2)

---

**Male vs Female**

[Graph showing data for male and female participants]
Motor learning strategies in basketball players and its implications for ACL injury prevention: a randomized controlled trial

Anne Benjaminse¹,² · Bert Otten¹ · Alli Gokeler¹ · Ron L. Diercks³ · Koen A. P. M. Lemmink¹
Visual Feedback

Modeling
(expert or self)
Balance
Squat
Lunge
Double legged drop vertical jump
Sidestep cutting
Jump shot
Effect of video feedback on 2-dimensional landing kinematics in elite female handball players.

Anne Benjaminse, PhD*; Wytze Postma, MSc*; Ina Janssen, PhD‡; Bert Otten, PhD*
Range of Motion over time

Flexion angle (')

Hip ROM CG, Hip ROM VG, Knee ROM CG, Knee ROM VG, Ankle ROM CG, Ankle ROM VG

Pre, TR1, TR2, Post

p<0.05
Visual Feedback

Expert or Self-modeling
Take Home Message 1

Superior results EF vs IF:

- Performance
- Kinematics/Kinetics
- Electromyography

Retention & Transfer
Take Home Message 2
Feedback Techniques to Target Functional Deficits Following Anterior Cruciate Ligament Reconstruction: Implications for Motor Control and Reduction of Second Injury Risk

Alli Gokeler · Anne Benjaminse · Timothy E. Hewett · Mark V. Paterno · Kevin R. Ford · Egbert Otten · Gregory D. Myer
RELEVANCE

RETURN TO SPORT

55% !

≥20% !
Abnormal landing strategies after ACL reconstruction

A. Gokeler¹, A. L. Hof¹², M. P. Arnold³, P. U. Dijkstra¹⁴, K. Postema¹, E. Otten¹²

IS STRENGTHENING ALONE SUFFICIENT IF PATIENTS DON’T LOAD THE LEG?
Quad weakness?

Quadiceps function following ACL reconstruction and rehabilitation: implications for optimisation of current practices

Alli Gokeler · Marsha Bisschop · Anne Benjaminse · Greg D. Myer · Peter Eppinga · Egbert Otten
Limb Asymmetries in Landing and Jumping 2 Years Following Anterior Cruciate Ligament Reconstruction

Mark V. Paterno, PT, MS,*†‡ Kevin R. Ford, MS,*† Gregory D. Myer, MS,*† Rachel Heyl, PT,*†‡ and Timothy E. Hewett, PhD*†§
Movement Patterns of the Knee During Gait Following ACL Reconstruction

Reference: by Kaur et al. in Sports Medicine March 2016

Designed by @YLMSportScience

This systematic review and meta-analysis compared lower limb movement patterns between ACLR participants and uninjured controls.

Knee peak adduction moments are lower in ACLR participants 3.5 years following reconstruction compared with controls.

After 4–5 years post-reconstruction, adduction moments are higher than for uninjured controls.

Peak knee flexion moments are still lower after 5 years of surgery in ACLR participants than in uninjured controls.

The differences for knee moments indicate that the knee function is not fully restored following reconstruction, and long-term maintenance programs may be needed.

do we as PT’s provide the right stimuli to target asymmetries?
Brain Activation for Knee Movement Measured Days Before Second Anterior Cruciate Ligament Injury: Neuroimaging in Musculoskeletal Medicine

Dustin R. Grooms, PhD, ATC, CSCS*; Stephen J. Page, PhD, OTR/L, FAHA†; James A. Onate, PhD, ATC, FNATA†

*Division of Athletic Training, Ohio University, Athens; †School of Health and Rehabilitation Sciences, The Ohio State University, Columbus

INCREASED ACTIVATED AREAS:
- Motor-Planning
- Sensory-Processing
- Visual-Motor Control

LEVEL CORTICAL PROCESSING
Original Research

Effect of fatigue on landing performance assessed with the Landing Error Scoring System (LESS) in patients after ACL reconstruction. A pilot study.

Authors: Gokeler A, Eppinga P, Dijkstra PU, Welling W, Padua DA, Otten E, Benjamise A
Original Research

Effect of fatigue on landing performance assessed with the Landing Error Scoring System (LESS) in patients after ACL reconstruction. A pilot study.

Authors: Gokeler A, Eppinga P, Dijkstra PU, Welling W, Padua DA, Otten E, Benjamise A
Original Research

Effect of fatigue on landing performance assessed with the Landing Error Scoring System (LESS) in patients after ACL reconstruction. A pilot study.

Authors: Gokeler A, Eppinga P, Dijkstra PU, Welling W, Padvua DA, Otten E, Benjaminse A
Original Research

Effect of fatigue on landing performance assessed with the Landing Error Scoring System (LESS) in patients after ACL reconstruction. A pilot study.

Authors: Gokeler A, Eppinga P, Dijkstra PU, Welling W, Padua DA, Otten E, Benjaminse A
Real Time Visual Feedback
Feedback Techniques to Target Functional Deficits Following Anterior Cruciate Ligament Reconstruction: Implications for Motor Control and Reduction of Second Injury Risk

Alli Gokeler · Anne Benjaminse · Timothy E. Hewett · Mark V. Paterno · Kevin R. Ford · Egbert Otten · Gregory D. Myer
Verbal instruction

EXTERNAL FOCUS

INTERNAL FOCUS
Mechanisms for Noncontact Anterior Cruciate Ligament Injuries

Knee Joint Kinematics in 10 Injury Situations From Female Team Handball and Basketball

Hideyuki Koga,* MD, PhD, Atsuc Nakamae, MD, PhD, Yosuke Shima, MD, PhD, Junji Iwasa, MD, PhD, Grethe Myklebust, PT, PhD, Lars Engebretsen, MD, PhD, Roald Bahr, MD, PhD, and Tron Krosshaug, PhD

IC 23°

INTERNAL FOCUS
Take Home Message 3

The knee is not normal after ACLR - paradigm change?

We cannot solve our problems with the same thinking we used when we created them.

-Albert Einstein
Knowledge, knerves and know-how: The role of explicit versus implicit knowledge in the breakdown of a complex motor skill under pressure

R. S. W. Masters*

PRESSURE & EXPLICIT KNOWLEDGE? > PERFORMER (ALREADY IN AUTOMATIC STAGE) AGAIN USES THIS KNOWLEDGE IF NO EXPLICIT KNOWLEDGE IS AVAILABLE > NO REINVESTMENT POSSIBLE IN COORDINATION OF MOVEMENT
An external focus of attention is a conditio sine qua non for athletes: a response to Carson, Collins, and Toner (2015)

Gabriele Wulf

Department of Kinesiology and Nutrition Sciences, University of Nevada, Las Vegas, NV, USA

“There is no convincing evidence that performers’ preferences, or their familiarity with a certain focus, have a moderating effect.”