Motor learning in ACL injury prevention

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Julie Agel, MA, ATC,* Todd Rockwood, PhD,† and David Klossner, PhD, ATC‡
Prevention of Anterior Cruciate Ligament Injuries in Female Team Handball Players: A Prospective Intervention Study Over Three Seasons

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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.
1) **RETENTION**: SAME TASK AS PRACTICED

2) **TRANSFER**: NEW (VARIATION OF THE) TASK

**MOTOR LEARNING IS RELATIVELY PERMANENT**
Motor learning

Oke, stap naar de bal.
Motor learning

**Knowledge of Performance**

- No or little knowledge about execution of movement (subconscious)

**Knowledge of Results**

- Stimulates automatic learning processes
- Better retention with physical or psychological stress
Motor learning

Explicit learning / Internal focus

Implicit learning / External focus
Motor learning

**VERBAL:**
- Focus on goal
- Analogy

**VISUAL:**
- Imagery
- Dyad-training
- Video

Implicit learning → Cognitive load
Squat

DOUBLE LEGGED DROP VERTICAL JUMP

SIDESTEP CUTTING
Real Time Visual Feedback

External focus

pictures Kevin Ford
Real Time Visual Feedback

McCough 2011
“PRETEND YOU ARE GOING TO SIT ON A CHAIR”
Squat

Double legged drop vertical jump

Sidestep cutting
VERBAL / VISUAL INSTRUCTION / FEEDBACK

“Pretend you are landing on eggs”

POSTERIOR VIEW

MODELING

EXTERNAL FOCUS
Enhanced retention of drop vertical jump landing technique: A randomized controlled trial

Wouter Welling, Anne Benjaminse, Alli Gokeler, Bert Otten

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 (6)
   - 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)

6. Initial landing of feet
   - Toe to heel (0)
   - Toe 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)
   - Stiff (2)

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

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

DOUBLE LEGGED DROP VERTICAL JUMP

SIDESTEP CUTTING
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:

SELF-MODELING

VERBAL INSTRUCTIONS:

When making the cut...
1) Move your body towards the goal
2) Point your toes towards the goal
3) Push yourself off of the ground as hard as possible
Optimizing performance through intrinsic motivation and attention for learning: The OPTIMAL theory of motor learning

Gabriele Wulf¹ · Rebecca Lewthwaite²,³

SELF-CONTROLLED FEEDBACK (MODE/TIMING)
dyad training
positive feedback
contextual interference
self-control
visual/imagery learning
external focus/implicit (verbal)
individualized
VERBAL INSTRUCTION / VISUAL FEEDBACK

INTERNAL FOCUS  EXTERNAL FOCUS

MODELING

GEORGE J. DAVIES - JAMES A. GOULD
EXCELLENCE IN CLINICAL INQUIRY AWARD

Benjaminse et al., JOSPT 2015
“PUSH YOURSELF OFF OF THE GROUND AS HARD AS POSSIBLE”
EXTERNAL vs INTERNAL
CHOKING UNDER PRESSURE

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*

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