NEW ZEALAND DEFENCE FORCES
LOWER LIMB INJURY
PREVENTION PROJECT

Lower Limb
Proprioceptive
Exercises

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PARTICIPANT SCREENING

As part of preparatory screening for dynamic proprioceptive training, consideration needs to be given to the following:

- age
- gender
- weight
- fitness level and recent training history
- injury history, particularly overuse injuries of the lower limb
- shoes
- landing surface
- fatigue level (timing of training relative to other physical exertions and duties)
- preparatory activity (warm up and dynamic range of motion)
- progression
- movement quality

TRAINING STRATEGIES AND INITIAL INSTRUCTIONS

- Encourage participants to use the whole lower limb kinetic chain during landing, ie use hips, knees and ankles to absorb landing forces.
- Have participants turn their body and position themselves appropriately for the task
- Move the feet if need be to avoid rotational landing forces at the knee and ankle - step out
- Expect the unexpected - land as if on an unstable surface
- Dare to fall - don’t be afraid of losing balance but have a plan for loss of balance so as to avoid injury - i.e. always under control

EXERCISE MONITORING AND EVALUATION

As quality of movement should be emphasised for all exercises, it helps to clearly specific the objective of each exercise and the key points to consider during the movement. Check for

- range of motion in the target joints and ensure that each joint is contributing
- symmetry of movement - make contra lateral comparisons where possible
- even weight distribution and transfer of weight
- prolonged foot contact between jumps - emphasis should be on brief but controlled foot contacts
- excessive wobbling or shaking which may indicate fatigue or weakness in some of the supportive muscles
- posture - should be upright with good alignment in the frontal plane
- arm and leg coordination
changes in the amplitude of movement
sequencing of head and trunk movement
use of all joints in the lower limb (kinetic chain) to contribute to force absorption and minimize ground reaction forces
knee position - the centre of the patella should track over the 1st and 2nd toe to avoid stressors on the medial and lateral elements of the knee joint
foot position and contact with the surfaces - check alignment and full sole contact with the surface
reliance on escape postures/movements or steps that signal a loss of balance. This may be acceptable for the more advanced exercises but should not occur with the basic and low demand exercises

PROGRESSIONS

static exercises to dynamic tasks
increased demand for balance
increased demand for strength - usually through increased horizontal or vertical amplitude of movement
increased demand for movement control + coordination
increased demand (loading + amplitude)
increased reactivity demands - ie tasks with less opportunity to preplan movements
decreasing attention investment - most tasks can be completed with ease when the participant concentrates on the movement. Some would argue that the real test of how routine a movement is can be assessed by whether they can perform the task when forced to concentrate on something else. Mental distraction tasks can be used to take the focus off the movement.
NZDF Exercise Group 1

Floor exercises

Exercise Objective:
Range of motion training, strength and balance

Exercise instruction

• Walk along a line

Observation points

• Check foot part contact
• Check maintenance of balance
• Check range of motion

Progressions

A. Walk along a line
B. Walk on toes
C. Walk on heels
D. Walk on inside of foot
E. Walk on outside of foot
F. Walk ‘toed in’
G. Walk ‘toed out’
H. Eyes closed
NZDF Exercise Group 2

In place tasks

Exercise Objective:
Dynamic balance

Exercise instruction
- Standing on single leg
- Perform a slow controlled 1/4 squat and return to standing

Observation points
- Check full foot contact
- Check that the entire lower limb kinetic chain contributes to the movement
- Check maintenance of balance
- Check body alignment

Progressions
A. Perform a slow controlled 1/4 squat and return to standing
B. Perform a slow controlled ½ squat and return to standing
C. Eyes closed
D. Reach and pick up a weight from the floor
E. Balance on toes
F. Balance on heels
G. Non-stance leg extended behind, out to the side or flexed forward
NZDF Exercise Group 2 continued

Toes  Heels

Non-stance leg to the side  Front  Rear
NZDF Exercise Group 3

Rocker board exercises

Exercise Objective:
Range of motion training, strength and balance

Exercise instruction
• Place feet in parallel stance across the board
• Move board through full range of motion

Observation points
• Check full foot contact
• Check maintenance of balance
• Check full range of motion

Progressions
A. Plantar/dorsiflexion controlled range of motion
B. Eversion/Inversion controlled range of motion
C. Change feet position to 45° angle or 135° angle - controlled range of motion
D. Single foot - all 4 foot positions - controlled range of motion
E. Balance - all 4 foot positions - double then single foot
F. Balance - all 4 foot positions - eyes closed - double then single foot
G. Step on
H. Lunge on, lunge off
I. Hop on
NZDF Exercise Group 4

Wobble board exercises

Exercise Objective:
Range of motion training, strength and balance

Exercise instruction
- Place feet in parallel stance across the board
- Move board through full range of motion

Observation points
- Check full foot contact
- Check maintenance of balance
- Check full range of motion

Progressions
A. Two foot - run the circumference
B. Two foot - balance
C. Single foot - balance
D. Eyes closed - run circumference - balance
E. Single leg 1/4 and 1/2 squat
F. Step on
G. Lunge on, lunge off
H. Catch and pass
I. Hop on and balance
NZDF Exercise Group 5

Sway Limits

Exercise Objective:
Explore limits of sway in double limb and single limb stances - balance recovery

Exercise instruction
- Stand with feet one foot width apart
- Sway as far forward, backward, and to each side as possible without losing balance or having to step out

Observation points
- Ensure full foot contact at all times
- Use an external marker e.g. a pole to monitor limits

Progressions
A. Double foot sway limits
B. Single foot sway limits
C. Reach forward for an object at waist/chest level
D. Reach forward from a tandem stance
E. Reach forward from a single limb stance
F. Reach to the side
G. Reach across body
H. Complete from a 1/4 and ½ squat position
NZDF Exercise Group 6

Single Leg Dynamic Exercises

Exercise Objective:
Complete exercise under control

Exercise instruction
- Assume a single leg stance
- Complete a controlled squat to 90° of knee flexion
- Return to stance position

Observation points
- Ensure mid point of patella passes over the middle toe of the forward foot
- Emphasise slow controlled movement
- Check for lateral stability

Progressions
A. Rise on toes first to initiate upward movement
B. Repeat with closed eyes
C. Add hand held weights
D. Hop and land in same position under balance
E. Flying crunch - elbow to opposite knee
F. 5 way lunge - lunge forwards, at 45°, 90°, 135° and backwards - for 135° twist body around at the hips and step diagonally and to the rear so that upper body is facing to the left (or right) - rear.
NZDF Exercise Group 7

Single Leg Squat Lunge

Exercise Objective:
Complete a controlled squat lunge

Exercise instruction
• Assume a tandem stance (2 foot lengths from toe of rear foot to heel of forward foot.
• Complete a controlled squat to 90° of knee flexion (forward leg)
• Return to lunge position

Observation points
• Ensure midpoint of patella passes over the middle toe of the forward foot
• Emphasis slow controlled movement
• Check for lateral stability

Progressions
A. Elevate rear foot on low stool or chair (shifts weight forward)
B. Rise on toes to initiate upward movement
C. Add hand held weights
D. Close eyes
E. Continuous alternate leg lunges in place
F. Progressive walking lunge with trunk twist
NZDF Exercise Group 8

Partner Single Leg Squat

Exercise Objective:
Complete a controlled single leg squat with a partner

Exercise instruction
• Assume a single right leg stance facing a partner
• Lean forward and flex left hip forward grasping partners left ankle
• Hop to adjust position so that both participants have a single leg stance and are
supporting their partner’s left leg
• Perform a 1/4 squat
• Return to stance position

Observation points
• Ensure mid point of patella passes over the middle toe of the forward foot
• Emphasis slow controlled movement
• Check for lateral stability

Progressions
A. Perform a ½ squat
B. Coordinate with partner to hop forward, backwards and to the side
C. Close eyes
D. Coordinate with partner to circle clockwise or counterclockwise
NZDF Exercise 9

Star Excursion

Exercise Objective:
Touch various locations with non support foot without losing balance or stepping out

Exercise instruction
• Stand steadily in single L leg support
• Squat 1/4
• Reach forward with R foot as far as possible NW, N, NE, E, SE, S, SW

Observation points
• Check for good body alignment
• Check maintenance of balance
• Gauge distances reached

Progressions
• Eyes closed
NZDF Exercise Group 10

Line Hops

Exercise Objective:
Hop continuously over the line for the specified repetitions

Exercise instruction
- Complete low amplitude hops over the line
- L foot landing on L side of the line and R foot landing on R side

Observation points
- Check for good body alignment
- Ensure full foot contact and that hip and knee contribute to force acceptance and force production
- Check that participant clears the line with each repetition

Progressions
- A. Increase landing distance from line i.e. increase lateral movement
- B. Single leg hops - L to L, R to R
- C. R foot landing on L side of the line and L foot landing on R side
- D. Progress forwards along the line
- E. Progress backwards
- F. Increase lateral jumping distance
NZDF Exercise Group 11

Hop and hold

Exercise Objective:
Dynamic balance and landing

Exercise instruction
- Standing on single leg
- Hop forward as far as possible and ‘stick’ the landing

Observation points
- Check full foot contact
- Check that the entire lower limb kinetic chain contributes to the movement
- Check maintenance of balance
- Check body alignment

Progressions
A. Eyes closed
B. 2 hops and ‘stick’ the landing
C. sideways and backwards hops
D. hop in square pattern in each direction
NZDF Exercise Group 12

Tethered movements

Exercise Objective:
Complete an arced side stepping movement while resisting the bungy cord pull

Exercise instruction
- Tether the bungy cord securely to a fixture.
- Secure the other end of the bungy cord to the participant’s waist
- Move to stretch the bungy cord until the participant is just able to maintain single leg balance
- Side-step slowly in an arc, maintaining tension in the bungy cord

Observation points
- Check for good body alignment
- Emphasis slow controlled movement so that the participant emphasises single leg stance
- Check that participant does not move closer to the tethering fixture

Progressions
A. Cross-over steps
B. Single leg hops
C. Add obstacles to hop over
D. Hop further away from the bungy tether and ‘stick’ landing
E. Turn to have left, right, and back facing the bungy tether - repeat various exercises
F. Close eyes for exercises
G. Perform exercises while catching and throwing a ball
NZDF Exercise Group 13

Beam exercises

Exercise Objective:
Complete exercises on the beam without losing balance or stepping out

Exercise instruction
- Tandem walk along the beam

Observation points
- Check body alignment
- Check ranges of movement

Progressions
A. Eyes closed
B. Tandem walk on toes
C. Tandem walk on heels
D. Sideways shuffle along the beam
E. Cross over sideways walk along the beam
F. Sideways calf raise
G. Tandem walk pivots
H. Tandem walk dips (1/4 and ½ squats)
I. Tandem walk - hop and stick landing
J. Use rounded side of the beam
NZDF Exercise Group 14

Alternate beam exercises

Exercise Objective:
Dynamic balance, weight transfers

Exercise instruction
- Standing side on on the beam on toes
- Step back to drop and land

Observation points
- Check full foot contact
- Check that the entire lower limb kinetic chain contributes to force absorption
- Check maintenance of balance

Progressions
A. Standing side on on the beam on toes - step back to drop and land
B. Eyes closed
C. Jump up to land on beam then over to land on the other side
D. Continuous jumping laterally over with one foot always on the beam
E. Hop on and balance
NZDF Exercise Group 15

River Rocks

Exercise Objective:
Dynamic balance and landing

Exercise instruction
- Move across the imbedded rocks

Observation points
- Check that the entire lower limb kinetic chain contributes to the movement
- Check maintenance of balance
- Check body alignment

Progressions
A. Walk forwards, backwards and sideways
B. Eyes closed
C. Jump continuously from rock to rock
NZDF Exercise Group 16

Inversion/Eversion Board

Exercise Objective:
Move under control along and across the boards

Exercise instruction
- Walk along with feet either side of the eversion board (gutter)
- Walk along with feet either side of the inversion board (roof)
- Walk across boards

Observation points
- Check for full foot contact
- Check maintenance of balance
- Check that the knee and hip movement also contribute to movement

Progressions
A. Eyes closed
B. Hop 2 foot along roof, along gutter
C. Hop 2 foot - roof, gutter, roof
D. Hop 1 foot along board
E. Hop 2 foot - roof, 180° spin, roof, gutter, 180° spin, gutter
F. Hop 1 foot across board
G. Hop 1 foot - roof, 180° spin, roof, gutter, 180° spin, gutter
NZDF Exercise Group 17

Spin jump

Exercise Objective:
Complete a low amplitude two footed jump, turning through 90°

Exercise instruction
• Initiate a low amplitude two footed jump
• Turn your body through a 90° counterclockwise turn
• Land safely on two feet

Observation points
• Aim for minimal jump amplitude
• Aim to complete all of the turn (rotation) in the air
• Land without any transferred body rotation
• ‘Stick’ the landing - that is no stepping or weight transfer to maintain balance

Progressions
A. Spin jump CCW, land, pause, spin jump CW back to starting position
B. Continuous movement with no pause between jumps
C. Continue CCW in 90° increments through a full 360° rotation
D. 180°, 270° and 360° spins
E. Single foot spin jumps

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