

Hamstring Injuries & Return to Play



Introductions



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Introductions to Invictus Performance Lab



- Invictus - High-performance ecosystem based out of Bengaluru, India
- Cater to 23 different sports across all levels
- Partnerships with professional teams, defence units & institutions
- Extensive assessment battery where ActivForce plays a key role



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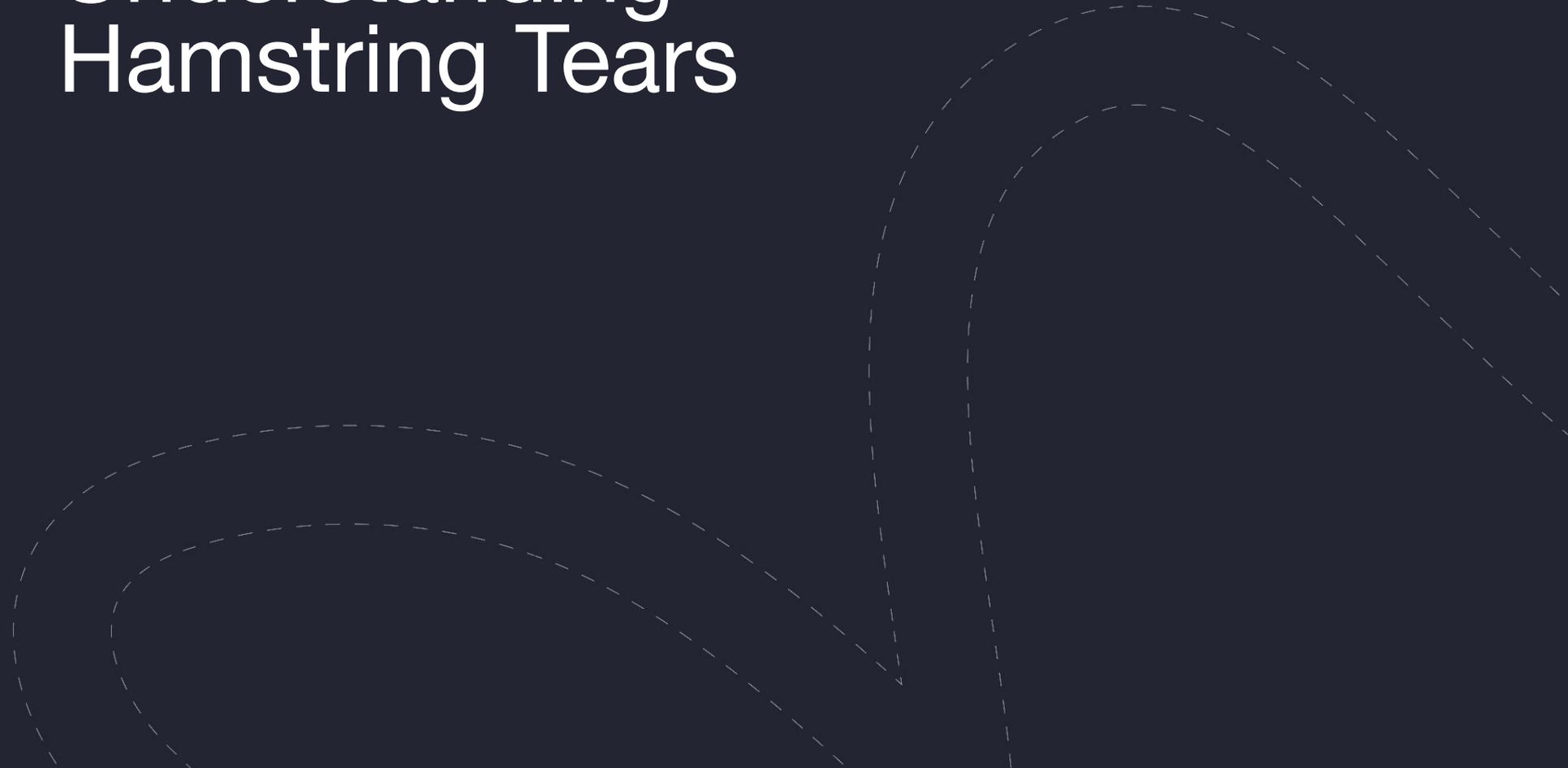


Agenda



- Applied Anatomy of Hamstring
- Demographics and Mechanism of Injury
- Common Causes and Risk Factors
- Case study
- Clinical Assessment with ActivForce
- Rehabilitation Journey
- Q&A

Understanding Hamstring Tears





What are Hamstring Tears?

- Hamstring Tears are acute muscle or musculotendinous injuries involving one or more of the hamstring muscles at the muscle belly, musculotendinous junction, or tendon attachment.
- Occur when the muscle is overstretched or overloaded, especially during high-speed or forceful movements

Injury severity can be:

- Grade I - Mild strain (microscopic fiber damage)
- Grade II - Partial tear
- Grade III - Complete rupture



Clinical Presentations



- Sudden sharp or stabbing pain in the posterior thigh
- Sensation of a “pop” or snap at the time of injury
- Pain with walking, running, or bending forward
- Localized tenderness along the hamstring
- Swelling or bruising (more common in moderate–severe tears)
- Loss of strength during knee flexion or hip extension
- Protective gait or limp



Mechanism of Injury

Most hamstring tears occur during:

- **Eccentric contraction** of the hamstrings
- **Terminal swing phase** of running (hip flexed, knee extending)

Activities involving:

- Sprinting
- Sudden acceleration or deceleration
- Kicking
- Jumping or landing
- Forced hip flexion with knee extension (e.g., slipping)



Mechanism of Injury





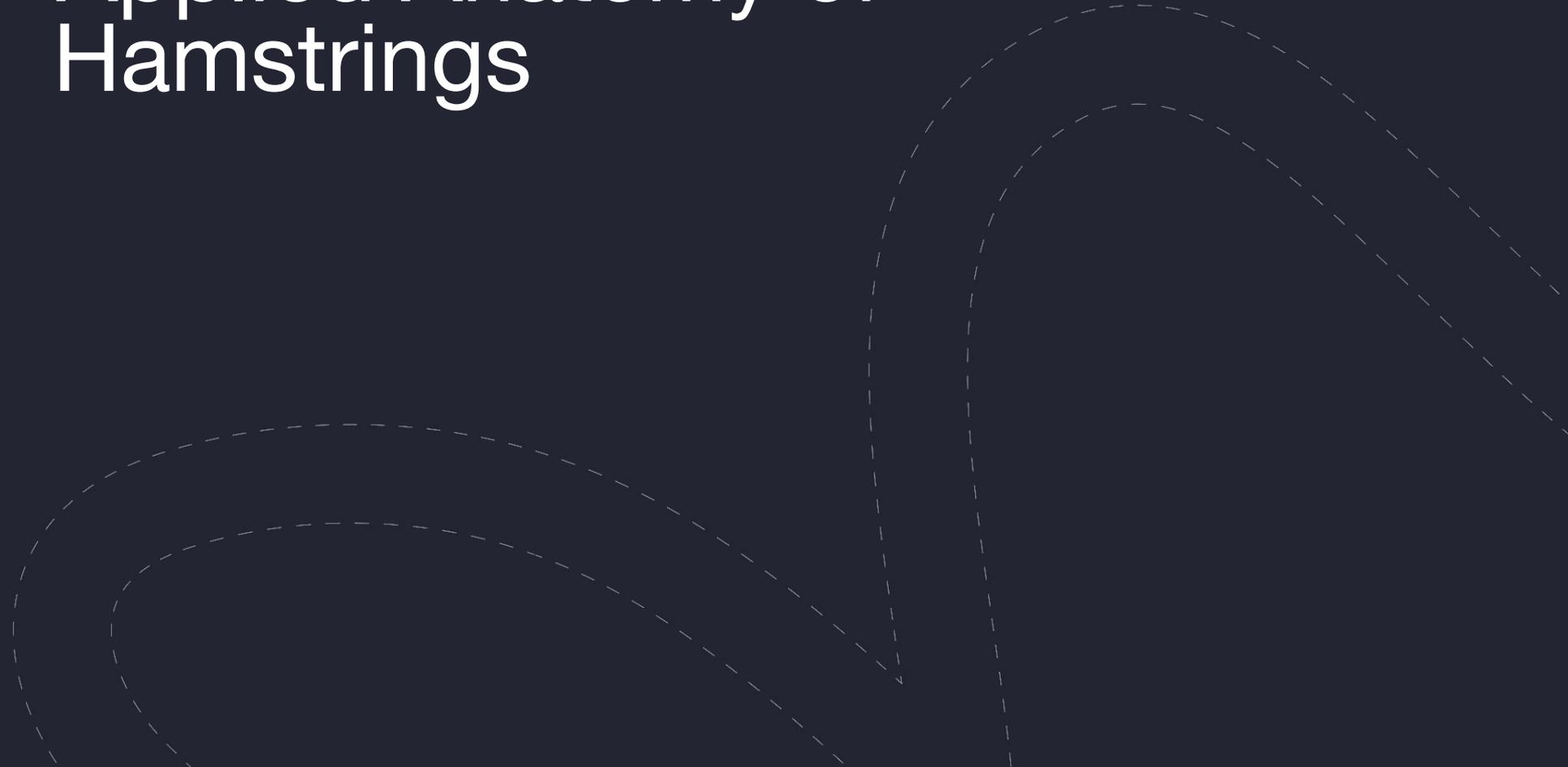
Common Risk Factors



- Previous hamstring injury
- Reduced eccentric hamstring strength
- Hamstring–quadriceps strength imbalance
- Poor flexibility or increased muscle stiffness
- Fatigue and poor load management
- Poor lumbopelvic control and running biomechanics
- Inadequate warm-up or preparation
- Increasing age
- High-speed, sprinting or kicking sport demands

Hamstring tears result from a combination of strength deficits, fatigue, biomechanics, and training load errors, rather than a single cause.

Applied Anatomy of Hamstrings





- Bi-articular force transmission system (hip ↔ knee)
- Not designed for isolated strength designed for coordination & force flow

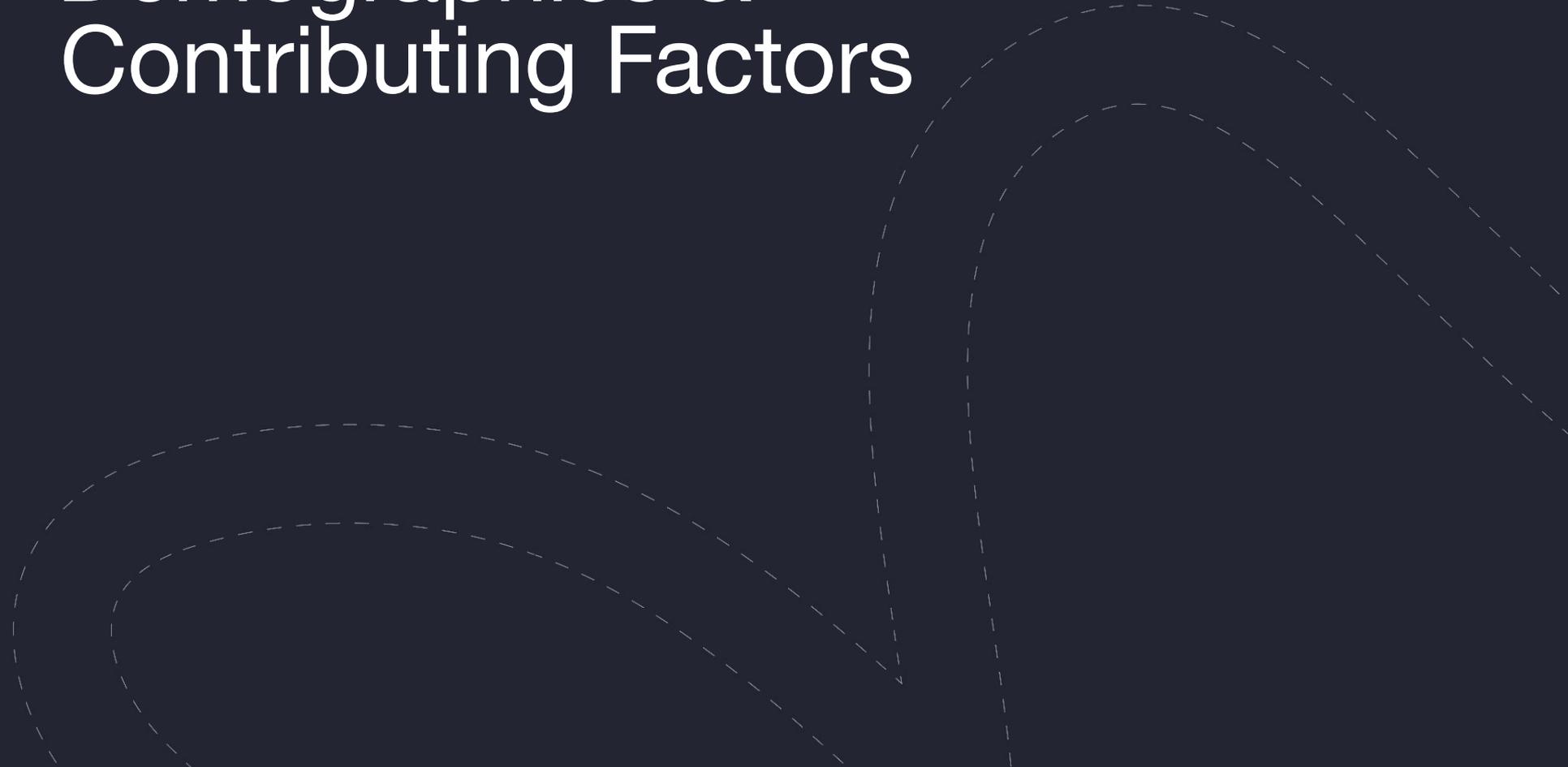
Three primary muscles:

- Semitendinosus (ST) – torque & rotational control
- Semimembranosus (SM) – deep stabilizer, force absorption
- Biceps Femoris (BF long & short head) – high-speed braking

Each muscle plays a unique role → each injured in different sporting actions



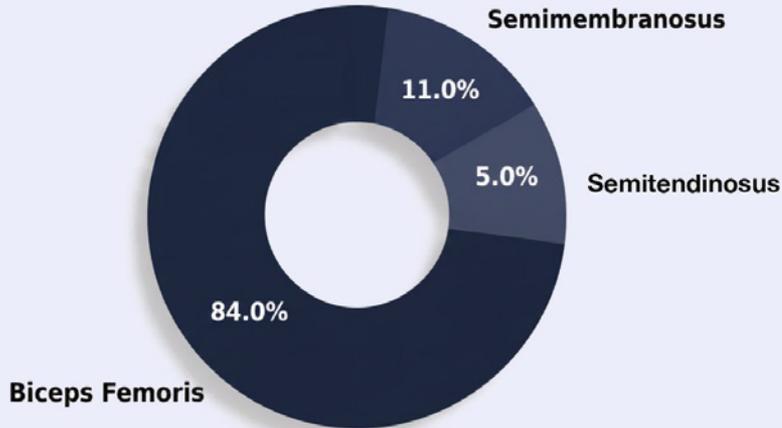
Demographics & Contributing Factors



Demographics & Contributing Factors



Distribution of Hamstring Injuries by Muscle



Parameter	Proposed Biomechanical Link to Hamstring Strain Injury	Biomechanical Evidence
Lumbo-Pelvic Control	Reduced control proposed to influence load transference to hamstrings due to anatomical connections between pelvis & hamstrings.	Prospective cohort studies: 1 study: ↑ GMed EMG [57] 1 study: ↓ GMax, Oblique & Erector spinae EMG [56] 1 Modelling study: Trunk muscles reduce BFLH stretch [35]
Anterior Pelvic Tilt	APT causes a rotation of the ischial tuberosity in the posterior and superior direction, lengthening the proximal hamstrings and increasing tissue strain.	1 prospective & 1 retrospective study: ↑ APT in injured individuals [54, 68] 1 prospective study: N.S.D APT injured v controls [55]
Forward Trunk Lean	Increases hamstring tissue lengths during stance. May also lead to compensatory kinematics & kinetics including, APT, overstride & ↑ hip extensor moments.	1 case study & 1 2D video analysis suggest ↑ trunk lean in subsequently injured individuals [96, 99] 1 modelling study: ↑ trunk lean ↑ hamstring length [94]
Trunk Lateral Flexion	Alters lever arms of trunk musculature resulting in reduced trunk muscle ability to stabilise the pelvis for force transfer.	Prospective cohort studies: 2 studies: ↑ Trunk Side Flexion [54, 55] 1 Modelling study: Trunk muscles reduce BFLH stretch [35]
Maximal Hip Flexion Angle	Possible performance v injury paradox. Greater MHF ↑ the distance for the lower limb to unfold during swing, generating ↑ angular accelerations of the lower limb & ↑ vGRF application. However, may ↑ hamstring tissue lengths, peak force & negative work.	Retrospective studies with conflicting findings: 1 report of ↑ MHF in HSI [68] 2 report ↓ in HSI [88, 89]
Back-Side Mechanics	Increases hip flexor lengths with subsequent impact on APT & contralateral hamstring stretch.	Theoretical evidence from 1 modelling study [35] 2 studies with inconsistent outcome measures (kick-back & inter-thigh angle asymmetries) report N.S.D [78, 83]
Overstride	Increases peak braking leading to ↑ hamstring requirements to reaccelerate the CoM Increases hip extensor moments during stance & tissue lengths at initial contact.	Conflicting findings & inconsistent reporting of parameters. 2 retrospective studies: 1 reporting ↑ HF angle at contact [68], 1 reporting N.S.D [89]
Lumbar Extension	Repeated extension may lead to nerve root irritation & altered motor neurone function. Possible influence via kinematic coupling with APT.	No supporting evidence: anecdotal theory.

Case Study





The bigger problem - Hamstring Re-injury

- Hamstring re injury rate: \approx 25–33% within the same season in 2 weeks
- Strength may recover but neuromuscular coordination does not
- Loss of muscle dissociation
- Disrupted inter- & intramuscular coordination - RFD curve
- Rehab must train Sequencing, timing and coordinated stiffness



OPEN ACCESS

Biceps femoris and semitendinosus—teammates or competitors? New insights into hamstring injury mechanisms in male football players: a muscle functional MRI study

Joke Schuermans,¹ Damien Van Tiggelen,¹ Lieven Danneels,¹ Erik Witvrouw^{1,2}

Bilateral differences in hamstring coordination in previously injured elite athletes

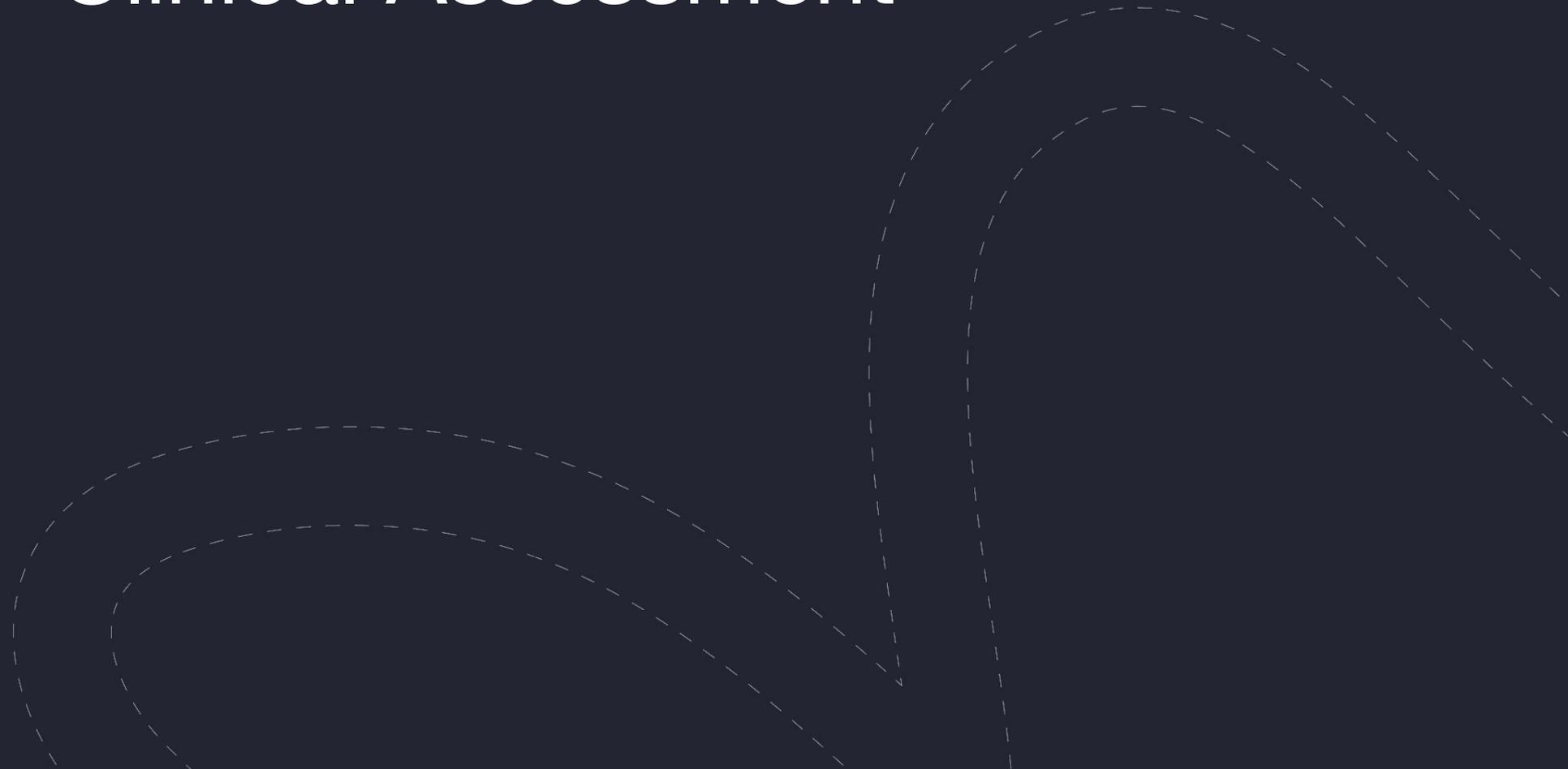
Simon Avrillon, François Hug, Gaël Guilhem



Why Isometric Testing Matters

- Safest early assessment no joint motion
- Reveals recruitment quality, not just force - Image of force time curve
- Identifies coordination deficits missed by dynamic tests - Decides Neuromuscular control
- Forms baseline for daily response & readiness tracking
- Test both at the hip and knee

Clinical Assessment



Knee dominant testing



Hip dominant testing



Glute drivers GLUTE-
HAMS-CLQL

Hamstring drivers
HAMS-CLQL-GLUTE

QL drivers
CLQL-HAMS-GLUTE



Treatment and Rehabilitation



Rehabilitation Journey



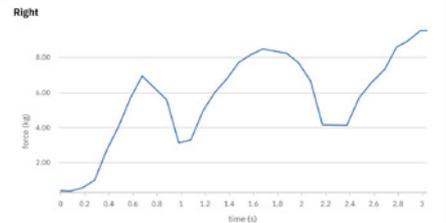
- Phase 1 - Recruit early - neuromuscular recruitment
- Phase 2 - Re-establish intermuscular balance
- Phase 3 - Restore Dynamic coordination
- Phase 4 - Movement pattern integration
- Phase 5 - Reintroduction to play and Monitoring



Phase 1: Early Neuromuscular Recruitment

- Restore **basic activation** of the injured muscle
- Reduce **neuromuscular inhibition**
- Re-establish **early isometric motor unit recruitment** at multiple angles
- Active-Force-guided 6–10 sec holds @ 60–80% effort
- Begin regaining **smooth contraction, stable force output**

Knee Flexion Prone



Average Values
Test 1 5.78 kg

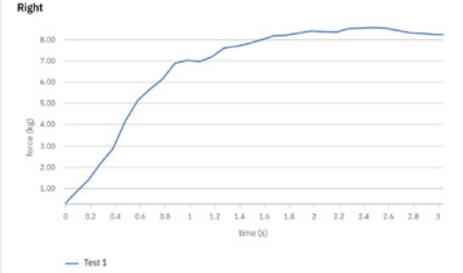
Peak Force (kg)
Right 9.53 kg

! This report was generated using ActivForce. © 2025 ActivBody, Inc.



Full Report 12/09/25
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Knee Flexion Prone



Average Values
Test 1 6.88 kg

Peak Force (kg)
Right 8.55 kg





Phase 2: Re-establishing Intermuscular Balance

- Correct post-injury **compensation patterns** - eg **SM injury**
- **Focus on integrated role of fascial lines**
- Build **endurance of coordination** (not just activation) - (45-60 sec)
- Average force vs Peak force



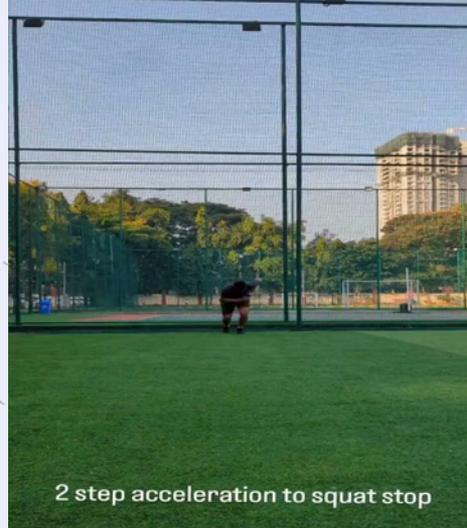


Phase 3: Dynamic Coordination Restoration

- Shift to **dynamic coordination drills** - Isometric progression framework
- Restore limb alternation timing (fundamental for running) - Switches
- Train reactive stiffness for braking & deceleration
- Introduce GPP training and integrate fundamental movement pattern along with eccentric and concentric training for hamstring.



Phase 4: Movement pattern reintegration





Phase 5: Reintroduction to play and monitoring

- Qualitative and quantitative assessments
- Sports specific skill introduction
- Alternate days self movement screens.

Strength and symmetry	≥90–95% Symmetry in Peak Force across 20°, 60°, 90° angles	Smooth Force Curve: Stable line on Activforce without "shaking" or spikes
Explosivity	RFD - Steepness of curve within 10% of healthy side.	Reactive "Lock": Immediate tensioning during catches with zero joint lag
Running Readiness	Max Velocity: ≥90% of pre-injury top speed (20m, 40m)	Proper front-side mechanics and foot stiffness during drills.
Training loads	Load Balance: Acute-Chronic Workload Ratio (ACWR) between 0.8–1.3	Skill Mastery: Fluid batting steps, wicket turns, and fielding cuts without guarding
Fatigue Tolerance	Fatigued Symmetry: ≥90% symmetry maintained post-high-intensity session.	Coordination Endurance: No breakdown in timing or sequencing when tired.







Summary



- Introduction
- Applied Anatomy of hamstring
- Demographics and Mechanism of injury
- Case study
- Assessment with Activ-force
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Questions?

