
GRADE 2

HAMSTRING STRAIN :
FORCES, HEALING AND
REHABILITATION

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WHAT DEFINES A GRADE 2 HAMSTRING STRAIN?

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A PARTIAL TEAR OF ONE OR MORE OF THE POSTERIOR THIGH MUSCLES (BICEP FEMORIS, SEMITENDINOSUS, SEMIMEMBRANOSUS)

SWELLING AND POSSIBLE BRUISING IN THE AFFECTED AREA

PAIN AND REDUCED STRENGTH IN THE ASSOCIATED TISSUES

LIMITED RANGE OF MOTION, PARTICULARLY ON KNEE FLEXION AND HIP EXTENSION

POSSIBLE DIFFICULTY WALKING AND FWB ON INJURED LEG

GAIT AND FUNCTION MAY BE AFFECTED DEPENDING ON SEVERITY

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HEIDERSCHEIT, B. C., ET AL. (2010).

FORCES IMPACTING THE HAMSTRINGS

- Stretching forces are applied to the hamstrings, especially during activities that include hip flexion (bringing the thigh toward the chest) or knee extension (straightening the knee)
- Acceleration and deceleration forces impact the hamstrings during activities like sprinting or abrupt stops, causing the muscles to encounter diverse forces while managing motion control, or landing from a jump to absorb the force of landing
- Shear and tensile forces arise when external forces act parallel or perpendicular to muscle fibres, forces are typically experienced during activities that entail changes in direction or sudden accelerations
- Most common injury in football (Up to 19%)

Ekstrand, J., et al (2023)

Sutton, G., (1984)



FORCES IMPACTING THE HAMSTRINGS

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- The forces acting upon the hamstring muscles can vary based on distinct activities and movements
- Concentric contraction forces involve the shortening of hamstring muscles during actions like knee flexion and hip extension
- Eccentric contraction forces occur when the hamstring muscles lengthen while contracting, commonly observed in activities involving controlled descent or lowering movements, such as lowering the torso in a deadlift
- Isometric contraction forces occur when the hamstring muscles contract to stabilize the knee or hip joint without causing significant movement, keeping the muscle length constant during contraction.

TYPES OF INJURY

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- Hamstring strains result from a sudden and forceful contraction or an abrupt stretching of the hamstring muscle group, leading to elevated mechanical stress
- Overexertion or excessive use occurs when the hamstring muscles are repetitively and intensely engaged without sufficient rest, often seen in sports involving sprinting, jumping, or changes in direction. This is where plastic deformation can occur
- Muscle imbalances arise when there is weakness or uneven strength distribution among the muscles adjacent to the hamstrings. This imbalance can heighten stress on the hamstrings, increasing their vulnerability to strains

- **TYPES OF INJURY**

Individuals who have experienced a prior hamstring injury face an elevated likelihood of encountering another

Fatigued or weakened muscles are at a higher risk of injury. Muscles lacking sufficient flexibility may struggle to withstand the force exerted during specific activities

Muscle imbalance could be a precursor to a hamstring injury. In cases where the quadriceps muscles on the front of the thigh are stronger and more developed than the hamstring muscles, the likelihood of hamstring injury may increase

Excessive anterior pelvic tilt will place the hamstring muscle group at longer lengths and some studies proposed that this may increase the risk of strain injury

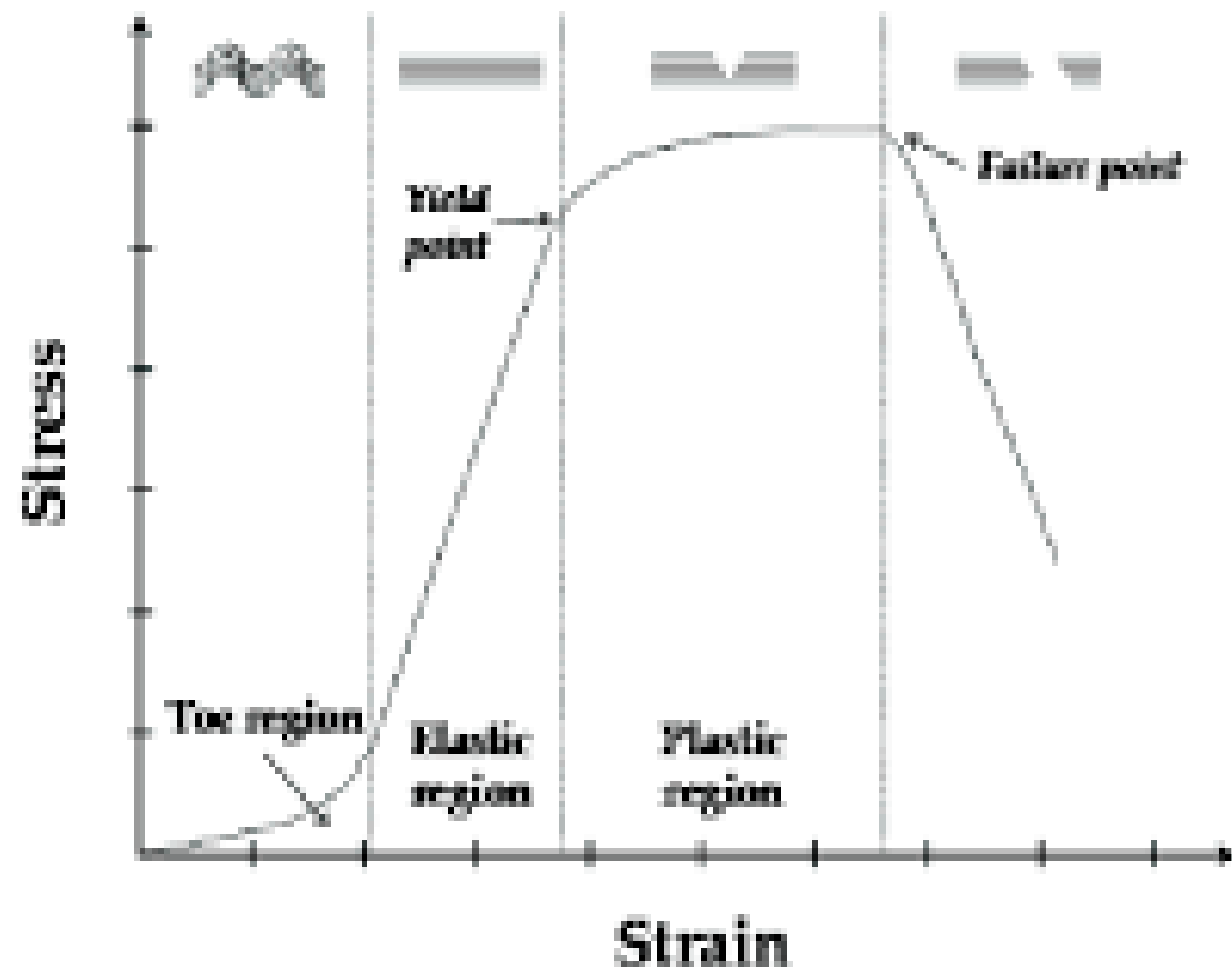
Contusions can occur when a forceful blow is applied to the area, causing compression and tissue damage

RISK FACTORS

- Previous injury or trauma to the area
- Increased age
- Poor flexibility and mobility
- Strength imbalance
- Previous knee injuries
- Ethnicity
- Osteitis Pubis
- Hypertonic hip flexor muscles
- Sudden acceleration or deceleration
- Poor biomechanics
- Inadequate recovery

Prior, M., Guerin, M. and Grimmer, K., (2009)

MUSCLE STRESS STRAIN CURVE



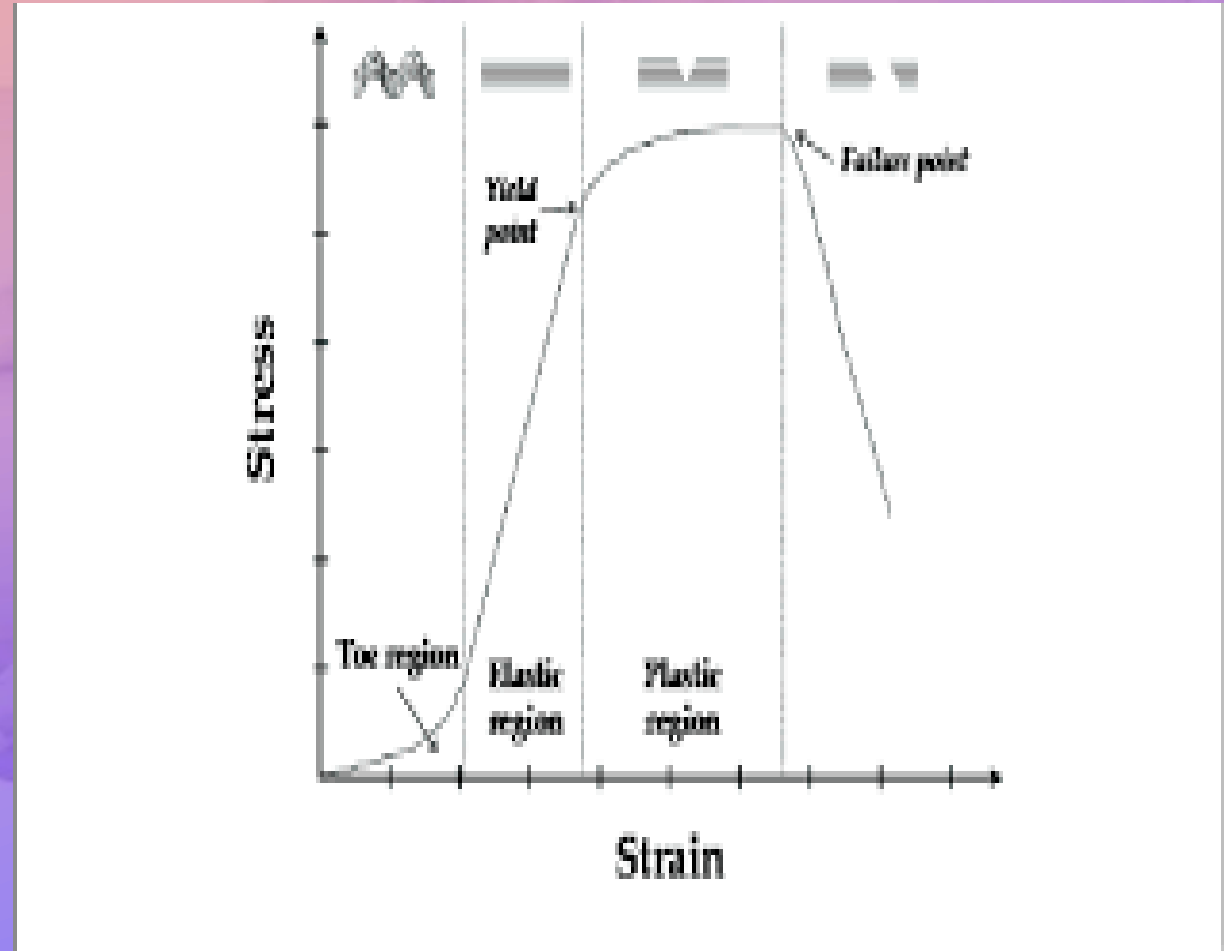
STRESS STRAIN CURVE EXPLAINED

The slope of the curve signifies the presence of stiffness

The region beneath the curve reflects the capacity of the muscle to store strength and energy.

Yield point refers to the stress at which the muscle initiates plastic deformation

The muscle's strength is denoted by the maximum load it can endure prior to reaching a point of failure



PHYSIOLOGICAL CORRELATION

TOE REGION

- Corresponds to the initial stretch and reorientation of muscle fibers, involving some slack in the connective tissues

ELASTIC REGION

- Muscle fibres or other structural elements start to undergo irreversible changes, possibly involving microtears

YIELD POINT

- Region corresponds to the point where the muscle is undergoing damage, potentially leading to injury or strain

PLASTIC REGION

- Involves more substantial and permanent changes in the muscle structure

FAILURE POINT

- Represents the point at which the muscle tissue cannot withstand the applied stress any longer, resulting in a complete failure

TISSUE HEALING

- The process of muscle regeneration typically initiates within the initial 4–5 days following an injury, reaching its peak around the second week and gradually subsiding 3 to 4 weeks post-injury
- The process comprises several steps, involving the activation and proliferation of satellite cells, the repair and maturation of injured muscle fibres, and the formation of connective tissue
- Achieving a complete recovery of the contractile muscle function requires a delicate balance among these mechanisms

Laumonier, T. and Menetrey, J., (2016)



THE HEALING PROCESS

- **Grade 2:** a partial tear of one or more of the hamstring muscles
- ⁺The healing time for a grade 2 hamstring strain can vary widely and is influenced by factors such as the individual's overall health, the severity of the strain, and the effectiveness of the treatment and rehabilitation, but often takes 2-3 months
- **Acute Phase (First Few Days):** During the initial days after the injury, the focus is on rest, ice, compression, and elevation (R.I.C.E.) to reduce swelling and pain management



THE HEALING PROCESS

- Degeneration/inflammation phase involves the
 - + rupture and necrosis of myofibres, the
 - o formation of a hematoma, and a significant inflammatory reaction (1-3 days)
- Proliferation phase involves the phagocytosis of damaged tissue, followed by the regeneration of myofibres, leading to the activation of satellite cells (Day 4/5 to 3 to 4 weeks)
- Re-modelling phase includes the maturation of regenerated myofibres, resulting in the recovery of muscle functional capacity, along with the formation of fibrosis and scar tissue (Up to 12 months)



DIFFERENTIAL DIAGNOSIS

- Several other injuries could present similarly to a Grade 2 Hamstring Strain

- - Sacroiliac Joint deficiency
 - Adductor Strains
 - Avulsion Fractures
 - Piriformis Syndrome
 - Sciatic Nerve Irritation
 - Hamstring Tendinopathy
 - Ischial Bursitis

Heiderscheit et al (2010)

AIMS OF REHAB

Promote	Promote healing and recovery
Restore	Restore the patient's Range of Motion
Rebuild	Rebuild their muscular strength and endurance
Improve	Improve stability and balance
Address	Address pain and inflammation
Enhance	Enhance neuromuscular control
Provide	Provide psychological support to the patient/athlete
Facilitate	Facilitate functional capacity
Prevent	Prevent re-injury
Achieve	Achieve optimal performance



STAGES OF REHAB

PHASE 1: Pain Management (Inflammatory Phase) 1-3 days post injury

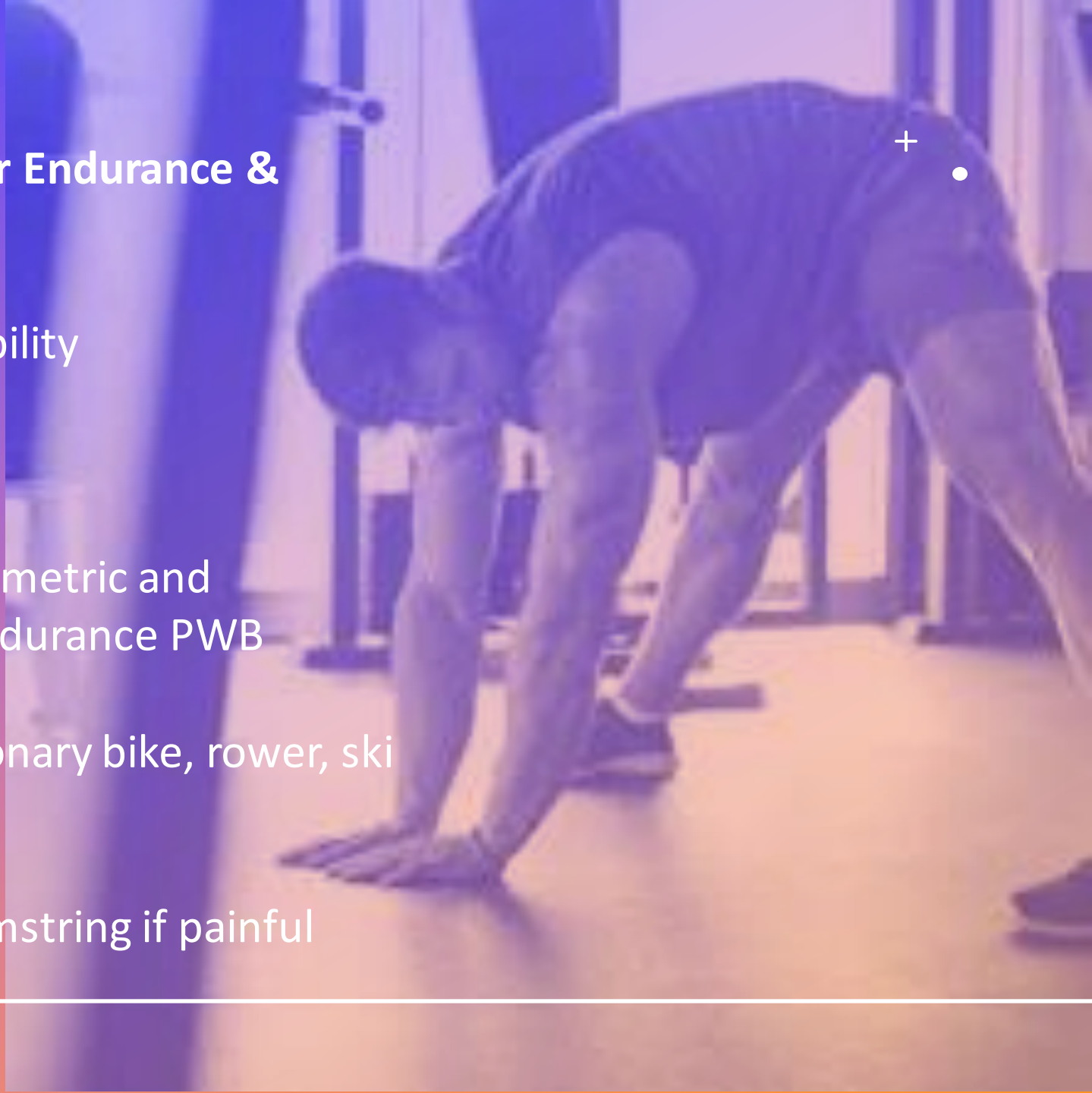
- TENS, Ultrasound, Heat/Ice, Compression,
- Avoid aggravating factors and modify existing habits
- Light soft tissue/massage, light flexibility if possible
- Mobilise as soon as possible, pain permitting
- Avoid excessive active or passive lengthening of the hamstrings



STAGES OF REHAB

PHASE 2: Maturation Phase (Muscular Endurance & Motor Control) 72 hrs to 3 weeks

- Address Range of Motion and Flexibility
 - Tackle motor control deficiencies
 - Addition of resistance exercises (isometric and concentric) to improve muscular endurance PWB
 - Maintain CV capacity through stationary bike, rower, ski erg etc
 - Avoid end-range lengthening of hamstring if painful
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STAGES OF REHAB

PHASE 3: Re-modelling phase (Muscular Strength/Resistance Training) Week 3-3 months post injury

- Graded exposure and Progressive Overload through eccentric and concentric loading
- STM/IASTM
- Normal concentric and eccentric strength through full ROM
- Treadmill moderate to high intensity to maintain CV capacity



REHAB EXERCISES – Increase ROM at hip joint

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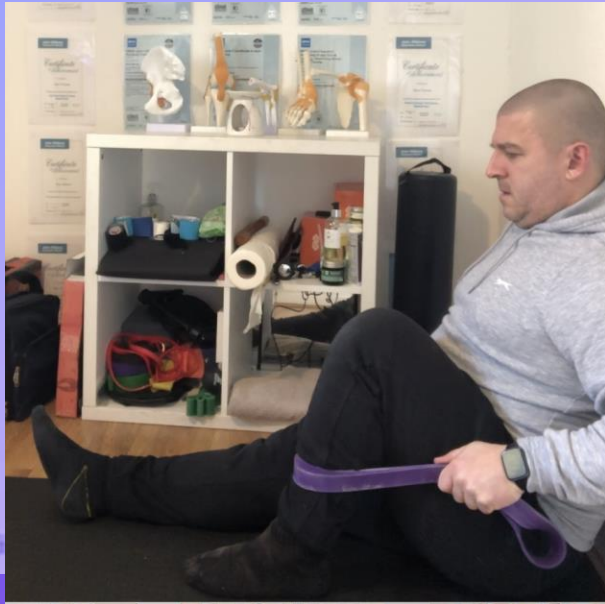


To be performed daily within pain free range

2-4 sets of 15-30 seconds per set

Bandy, W.D. and Irion, J.M., 1994

REHAB EXERCISES – Improve Knee Flexion ROM

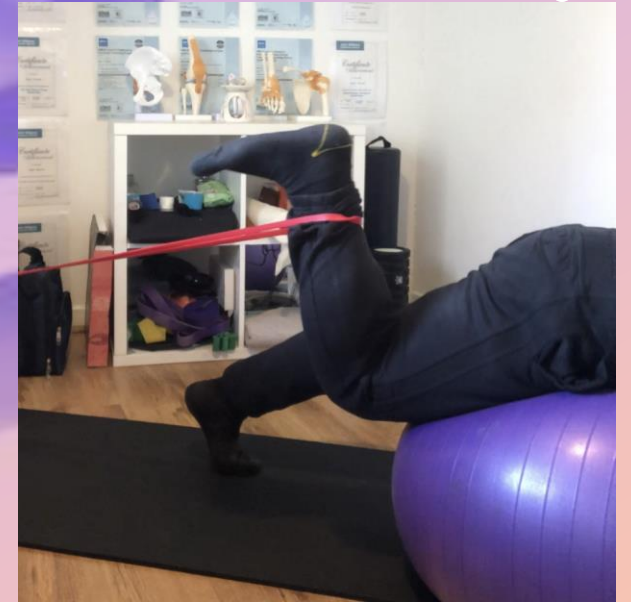
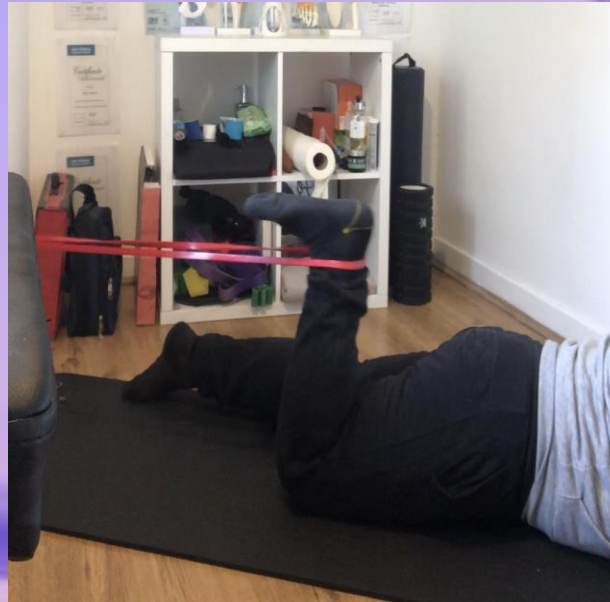


To be performed daily within pain free range

2-4 sets of 15-30 seconds

Ensuring maintenance of CV capacity

REHAB EXERCISES – Isometric Strength and Endurance



Pain-free 5 to 10 second holds with 10 repetitions, at various angles, graded to maximal contraction and repeated several times per day with progression as indicated (Houglum 2005)

REHAB EXERCISES – PROPRIOCEPTION AND MOTOR CONTROL



Advance from eyes open, to eyes closed, then foot placed on wobble board
Can be performed at each stage of rehabilitation
Held for as long as possible to improve proprioception
3 sets done daily

REHAB EXERCISES – CONCENTRIC RESISTANCE (BUILD FUNCTIONAL STRENGTH)



Perform 3 sets of between 10-15 reps 4-5 days per week with 45-60 seconds rest in between sets

When able to perform more than the prescribed reps, progress to more complex variation

As injury improves, rest times may be reduced

REHAB EXERCISES – ECCENTRIC STRENGTH



Additional mechanical stress, lower volume required 2-4 sets of 4-10 reps

Increase angle and ROM as strength progresses

Can reduce the risk of future hamstring injury

Ribeiro-Alvares, J.B., et al (2018)

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