PT Management of a Female NSGA Slowpitch Shortstop

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By the end of this session participants will be able to:

1. Discuss normal age-related LE biomechanical changes impacting physical fitness & performance in older athletes
2. Identify age-related LE biomechanical changes in videos of the case subject engaged in objective/functional testing
3. Describe 2-3 therapeutic exercises appropriate for addressing age-related biomechanical changes in older athletes
4. Discuss general guidelines on sequencing of exercise/recovery & nutritional intake appropriate for older athletes

image courtesy: Universal Studios

The challenge of the Older Athlete

Thank you to Nancy,
an extremely talented and gracious lady who gave me permission to use her as a subject for this presentation!

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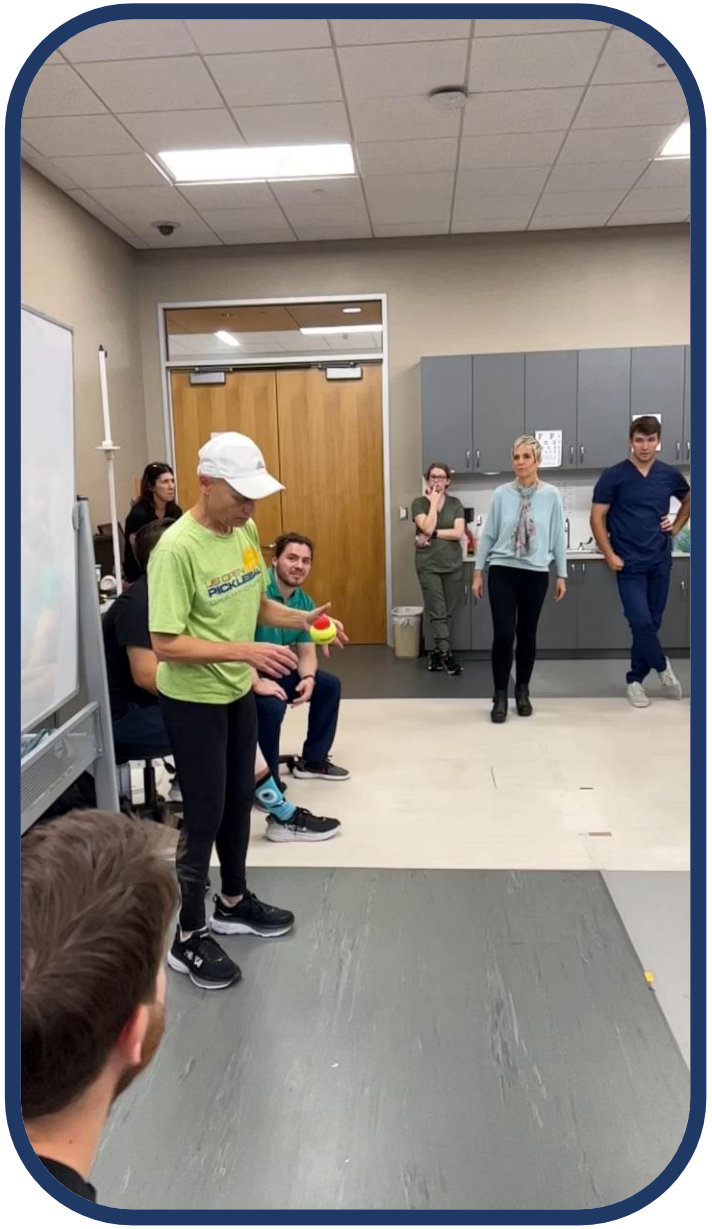
Nancy - National-level Shortstop (67-years-old)

Screen



1 **Screen:** Campbell University

2 **Evaluation:** 5 wks s/p screen

3 **Follow-up:** 11 wks s/p screen

Complains of:

- R hallux MTPJ stiffness/pain (P_1 = 3-7/10)
- Painful plantar callous R 5th MTPJ (P_2 = 0-3/10)
- R AKP with ↑'d exercise intensity (P_3 = 0-7/10)
- ↑'ing Inflexibility over past 2 yrs (esp. LEs)

image courtesy: Universal Studios

Pt goals:

- ↑ LE Strength to be a stronger hitter & a faster base runner
- ↑ Flexibility & power to ↑ fielding range & accuracy of throws
- Maximize stability in the L knee

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PMH - L ACL ‘Coper’[1] + R ACL repair

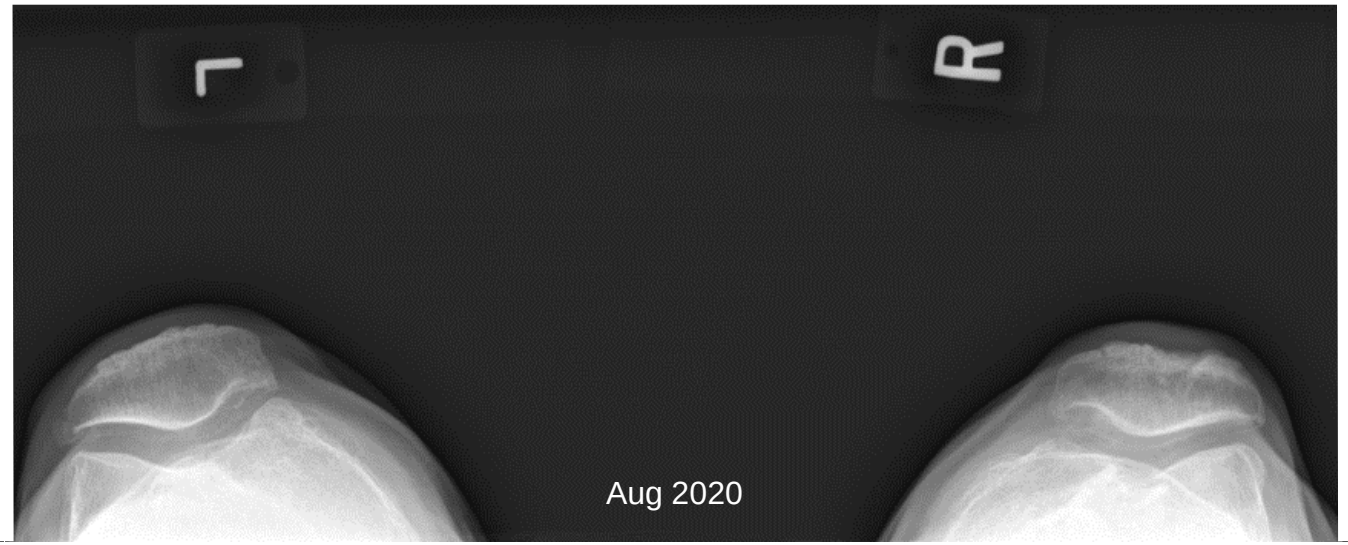
Aug 2009

Chronic L ACL-deficiency (ruptured 1985)

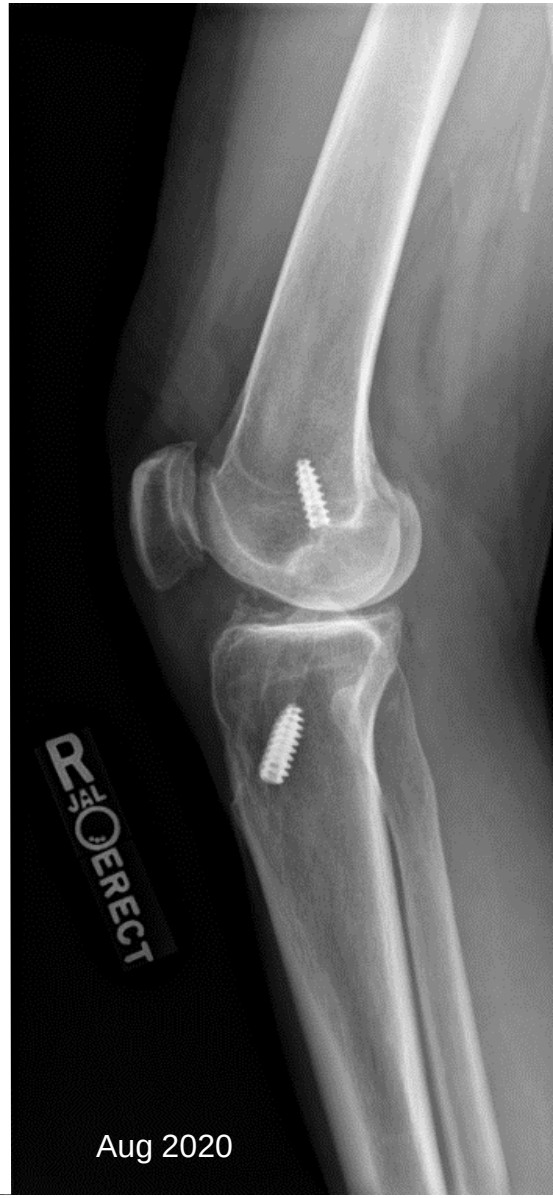
- **NO** subjective complaints of L knee instability
- Partial medial + lateral meniscectomy
- 4 x MUA (significant post-operative scarring Hs)
- MRI (Feb 2018) = Diffuse fissuring + chondral loss in medial, lateral, & patellofemoral compartments

R ACL repair (1990 - Patellar tendon graft)

- Intermittent R AKP with high-intensity activity
- X-ray (Aug 2020) = Primary knee OA



Aug 2020



Aug 2020

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R Hallux pain (7-yr Hs) + Bilateral Functional Hallux Limitus (FHL)

FHL[2]

↓ Ability to transfer body forward over the stance foot

= ↓ hip EXT + ↓ push-off in terminal stance

Barefoot gait pattern + Athletic shoe wear-pattern

Nancy's preferred athletic shoe (past 2 yrs)

Changes shoes approx. every 3 mths based on R Hallux symptoms

Curved carbon-fiber plate[3] **embedded in the highly compliant midsole**

↓

↑'s longitudinal bending stiffness = ↑ lever arm for propulsion

↓

↑ PUSH-OFF

HOKA Bondi 8

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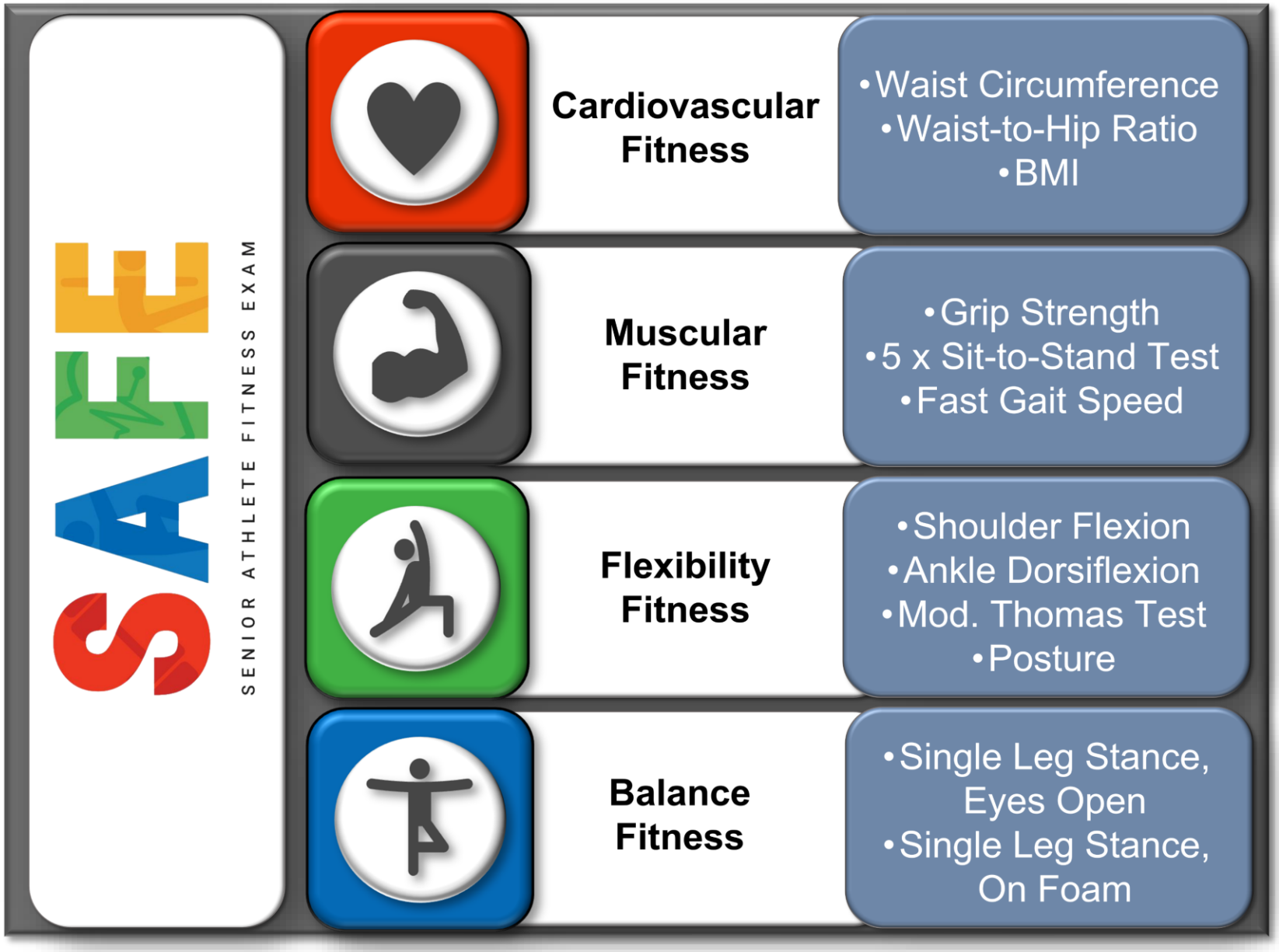
The SAFE Screen - Campbell University



Additional Tests/Measures

Muscular Endurance Tests
- Plank
- Scapular Plank
- GMAX

LE Motor Control Tests
- Forward Step-ups
- 'Fairy-Jumps'

Slow-motion Video Analysis

- Jumping
- Forward step-ups
- Fast Gait Speed **(FGS)**
- 5 x Sit-to-Stand **(FTSTS)**

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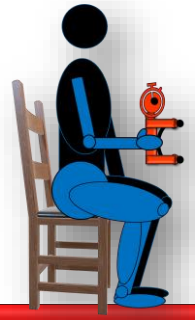
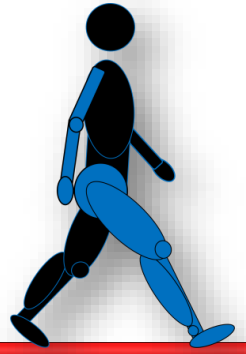
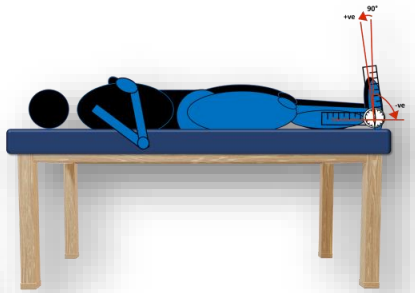
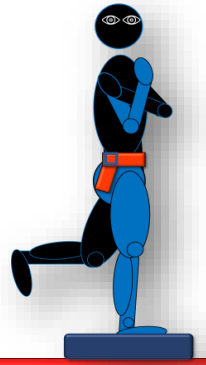
Screen Results VS SAFE & Community Dwelling norms

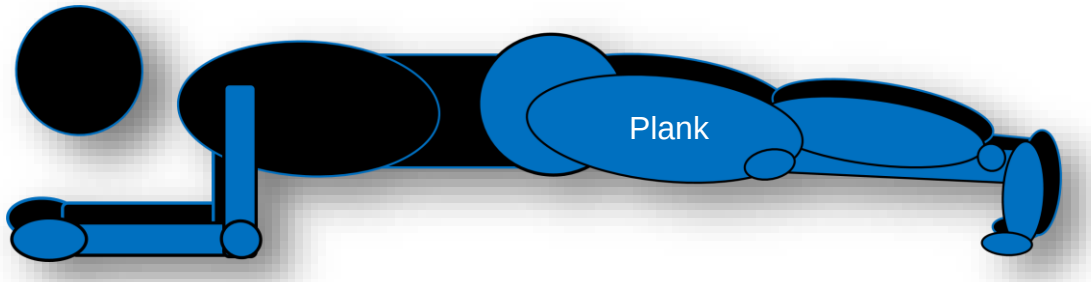


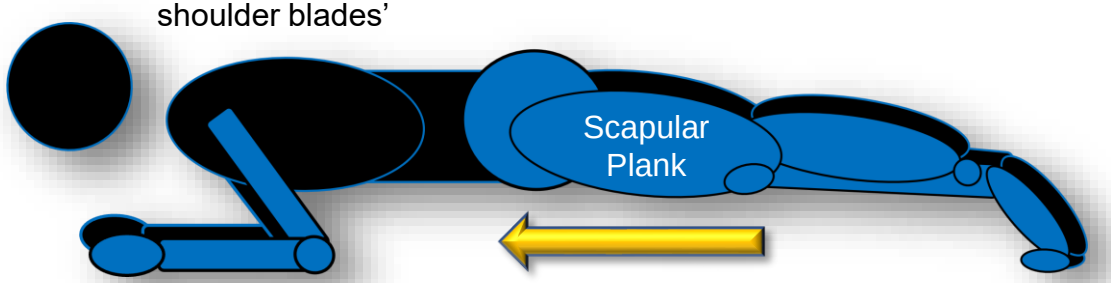

Calculation[10]

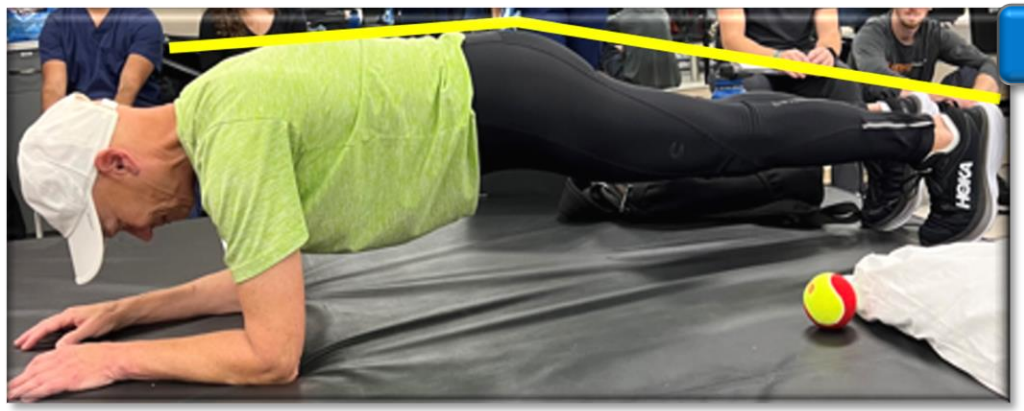

Grip Strength	FTSTS	FGS	Ankle DF ROM	SLS Eyes Closed	SLS Foam Eyes Open	Ave Relative Power
(♀ 65-69 yrs)	(60-69 yrs)	(60-69 yrs)	(60-69 yrs)	(60-69 yrs)	(60-69 yrs)	(♀ 60-69 yrs)
32 kg (R) 33 kg (L)	5.38 sec	2.2 m/sec	7° (R) 0° (L)	5.5 sec (R) 7.8 sec (L)	19.0 sec (R) 12.8 sec (L)	6.5 W/kg
SAFE norms						
31 kg (N = 286)[4]	6.89 sec (N = 1400)[6]	2.2 m/sec (N = 1277)[6]	7° (N = 1417)[6]	9.4 sec (N = 1393)[6]	18.5 sec (N = 1445)[6]	6.7 W/kg (N = 134)[11]
Community Dwelling Older Adult norms						
21 kg (N = 29)[5]	11.4 sec (N = 4184)[7]	1.84 m/s (N = 6)[8]	- *Viviers, 2023*	2.8 sec (N = 101)[9]	-	5.3 W/Kg (N = 39)[12]

Screen - Scapular / Plank Muscular Endurance (sec)



‘Proud btw shoulder blades’





Screen

- Dropping btw the shoulder blades
- Using isometric shoulder IR
- Forward Cx ‘give’

Follow-up

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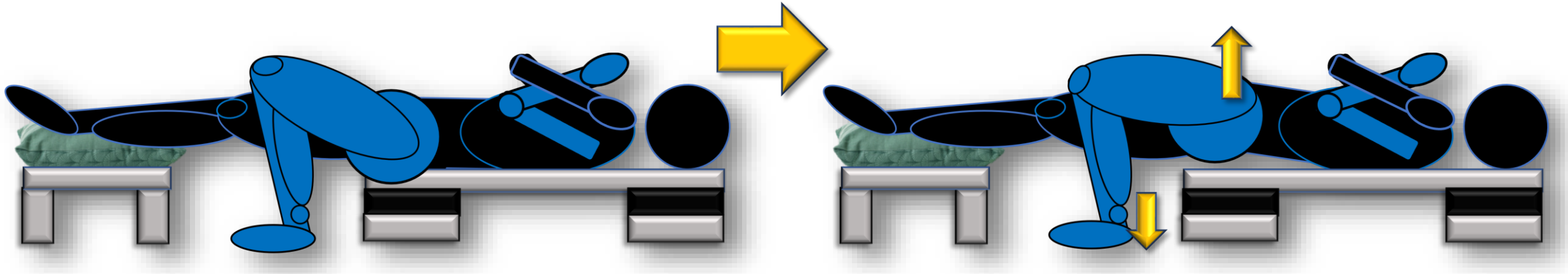
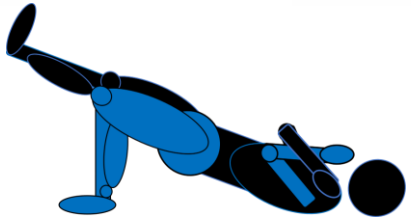
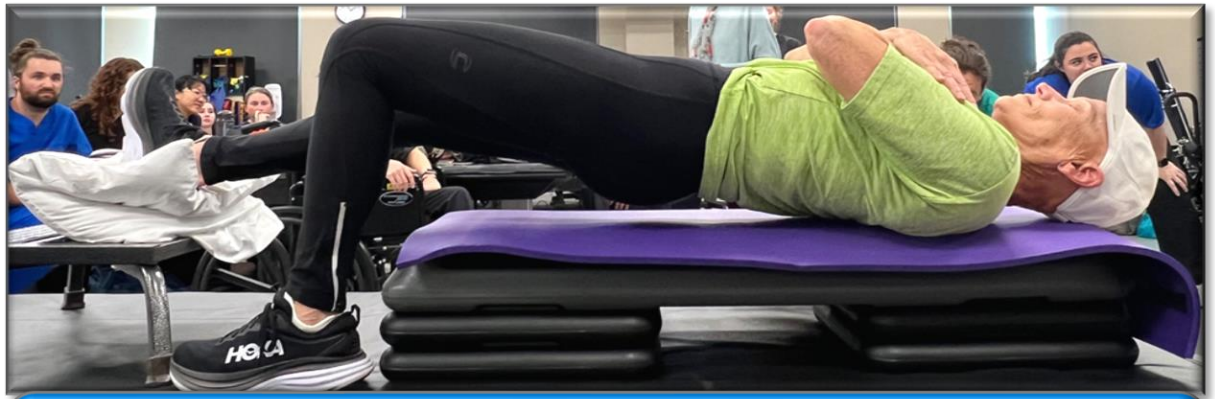
Screen - GMAX Muscular Endurance (sec)

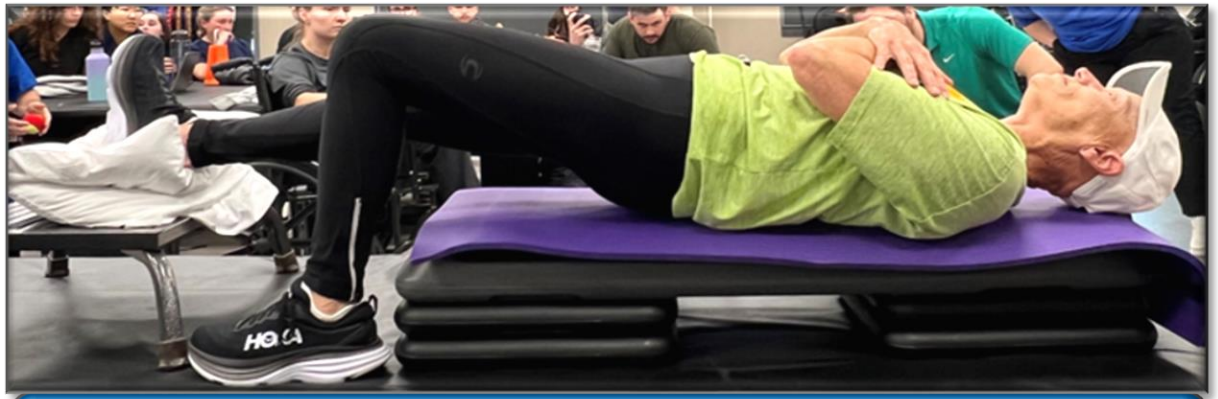




Difficult testing position for older athletes to sustain



- Using non-test hamstring to extend trunk
- Using test quad to extend hip (static foot slide)



Compensatory strategies expose multiplanar GMAX / posterior chain weaknesses

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LE Motor Control Screen - Jump for height / distance

Single-leg

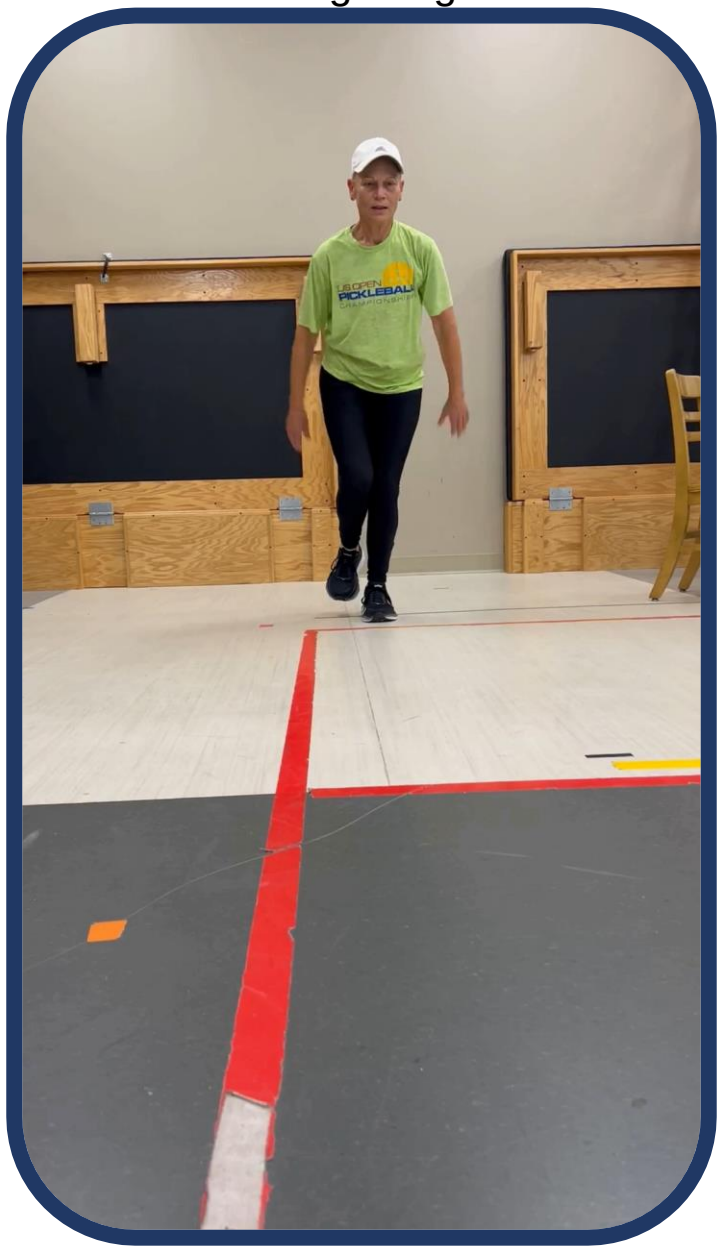
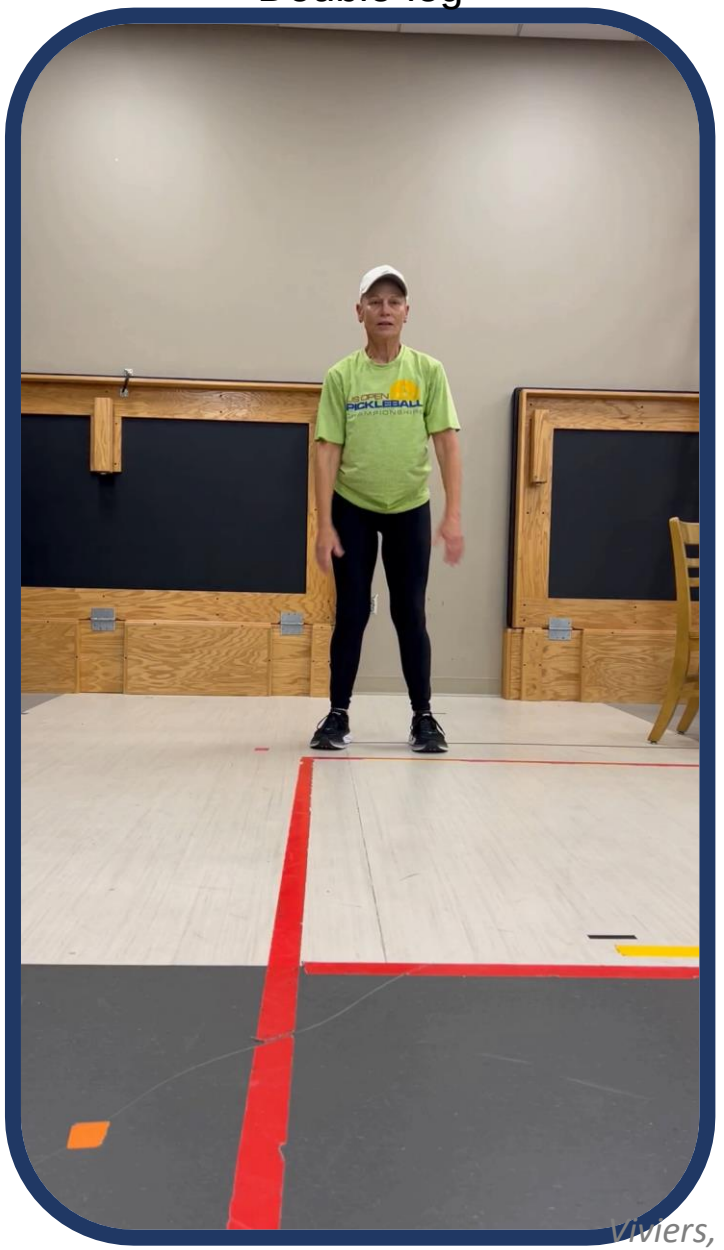


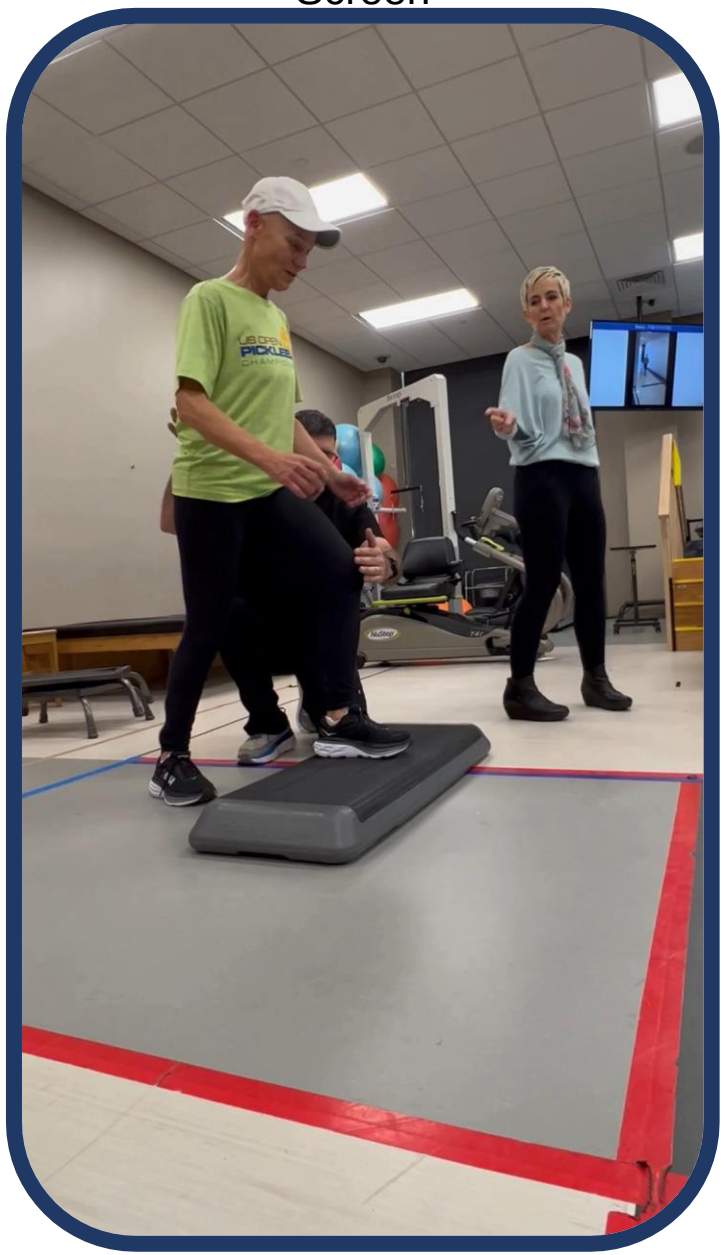
image courtesy: Universal Studios

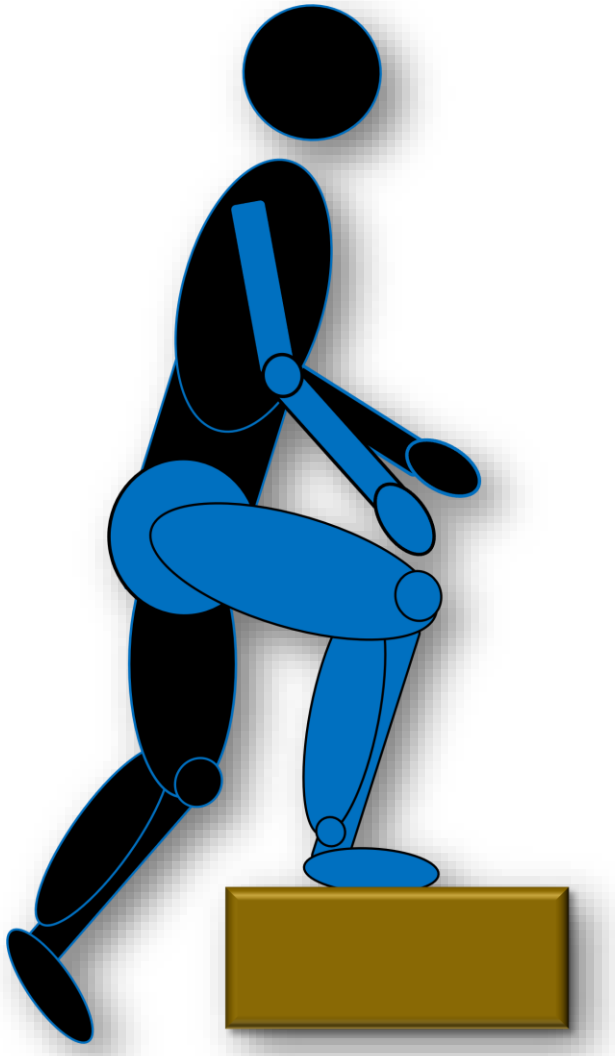
Double-leg



Forward Step-ups - Screen VS Follow-up (11 wks)

Screen

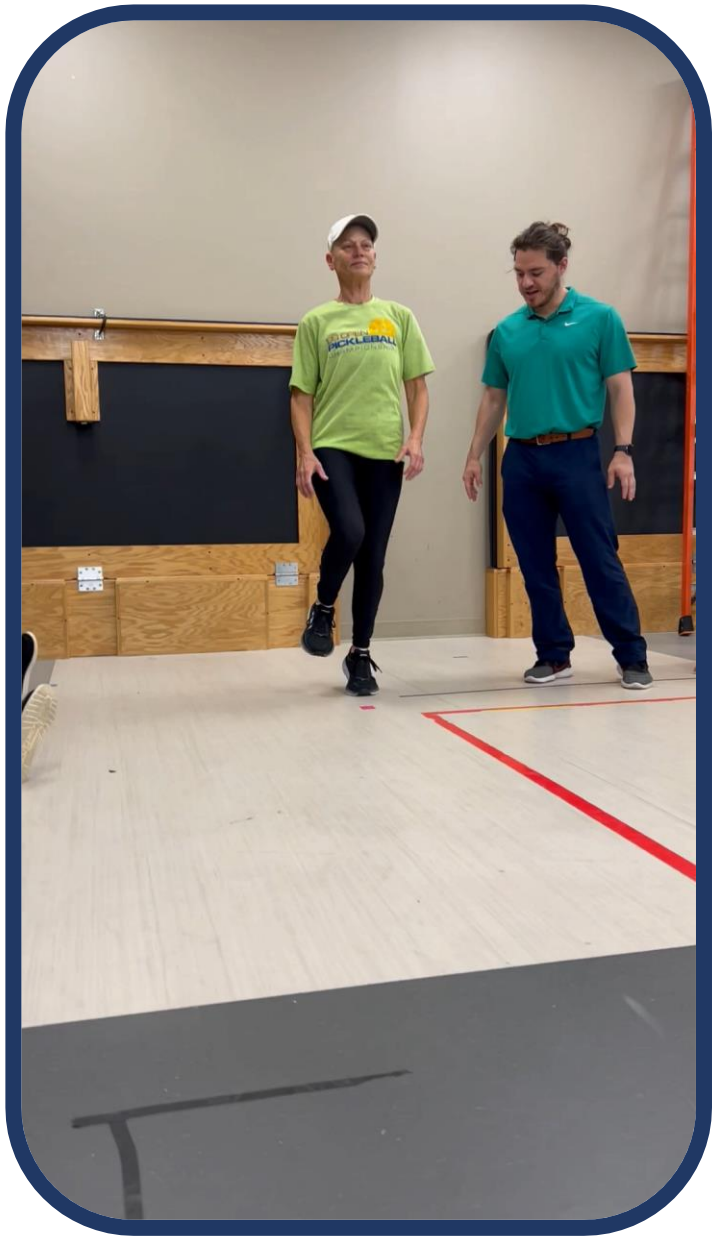




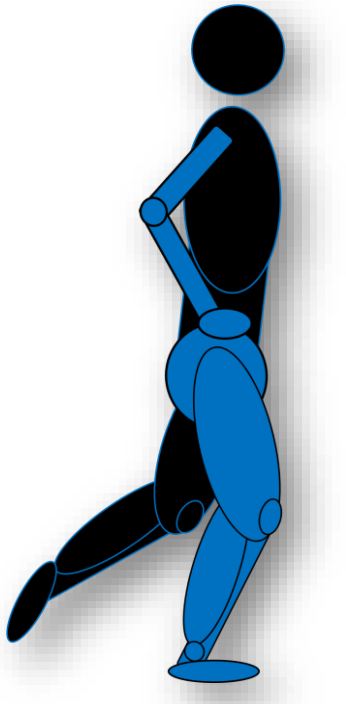
Follow-up

‘Fairy-Jumps’[13,14] - Screen VS Follow-up (11 wks)

Screen



‘Fairy Jumps’
Small jumps on the spot, landing without a sound



Assessing ‘bounce’ & LE alignment in SLS

Follow-up

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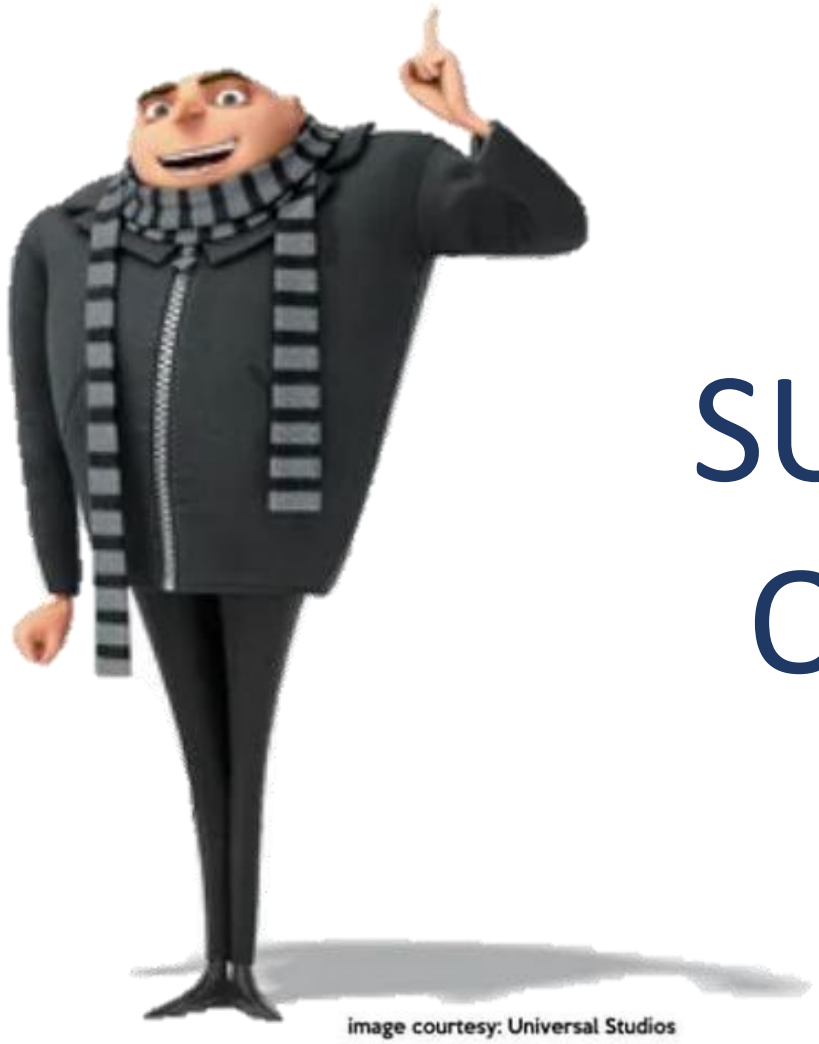
The value of analyzing FGS



GAIT SPEED IS A SUMMED EXPRESSION OF THE UNDERLYING BIOMECHANICS[15]

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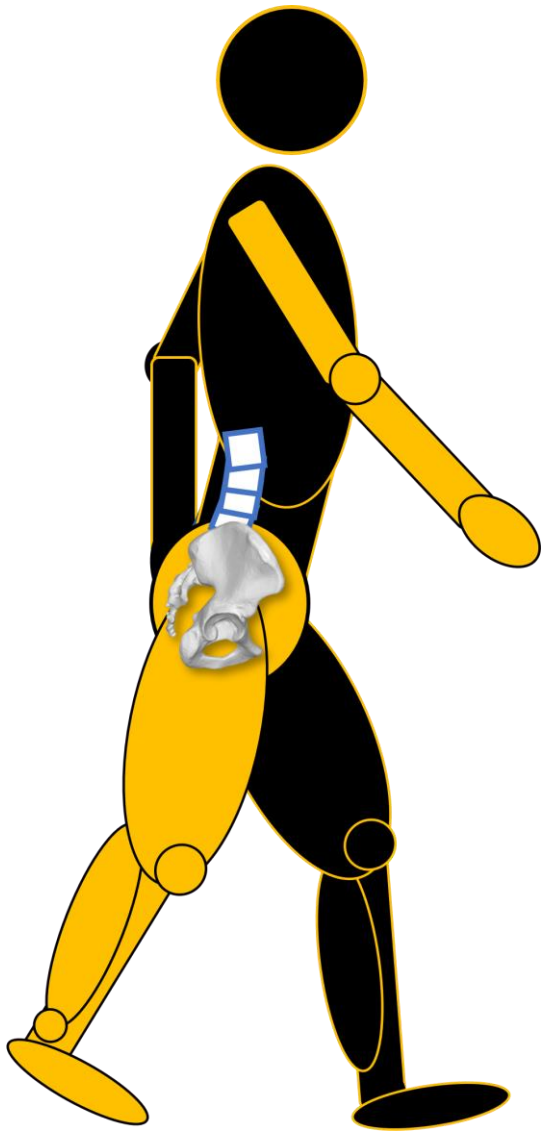
Key age-related changes in gait biomechanics[15-18]

Plantarflexor Power

Distal-to-proximal shift in power generation

Hip Muscle Power



PUSH-OFF

becomes

PULL-OFF

Walking Economy

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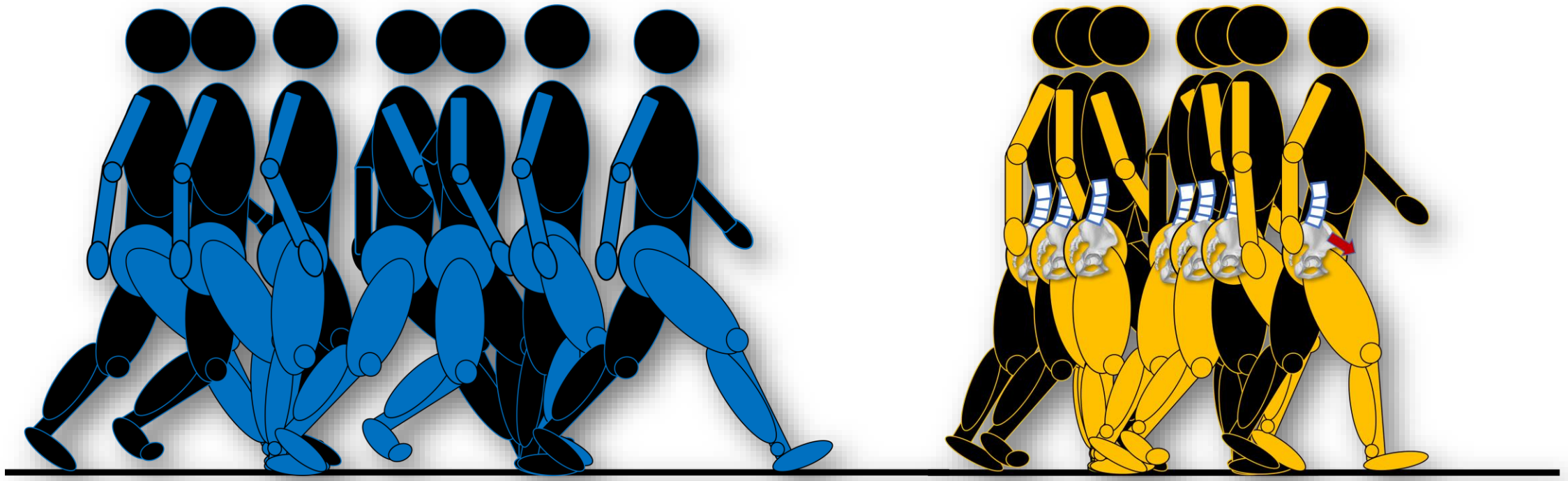
Increased Cadence instead of Step Length[15-16, 20-21]



Compared to younger adults, healthy older adults ↑ **gait speed by**

Ankle mechanical output drives step length

↓ STEP LENGTH

Hip mechanical output drives step frequency

↑ STEP FREQUENCY

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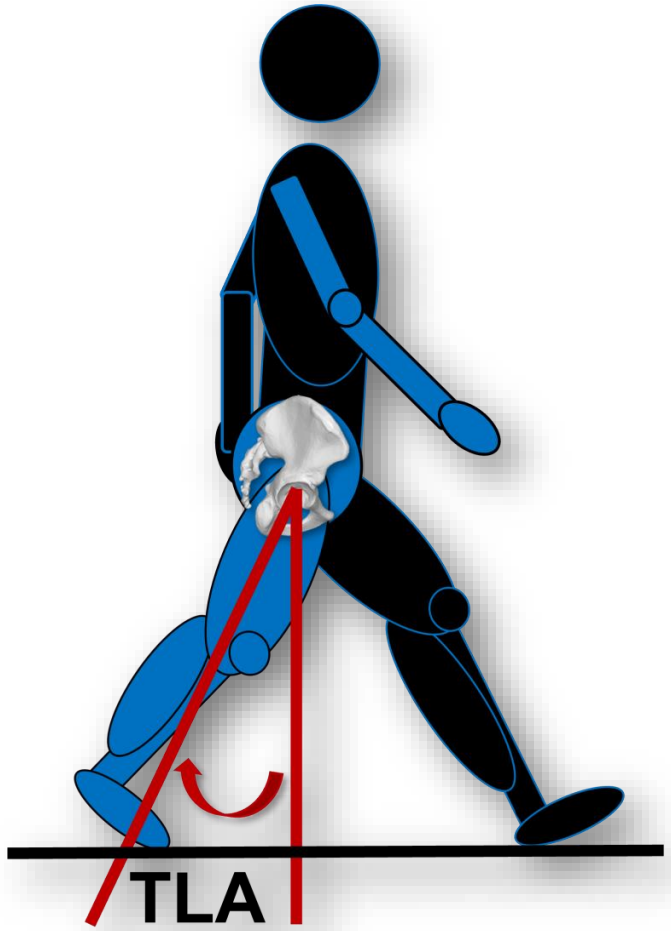
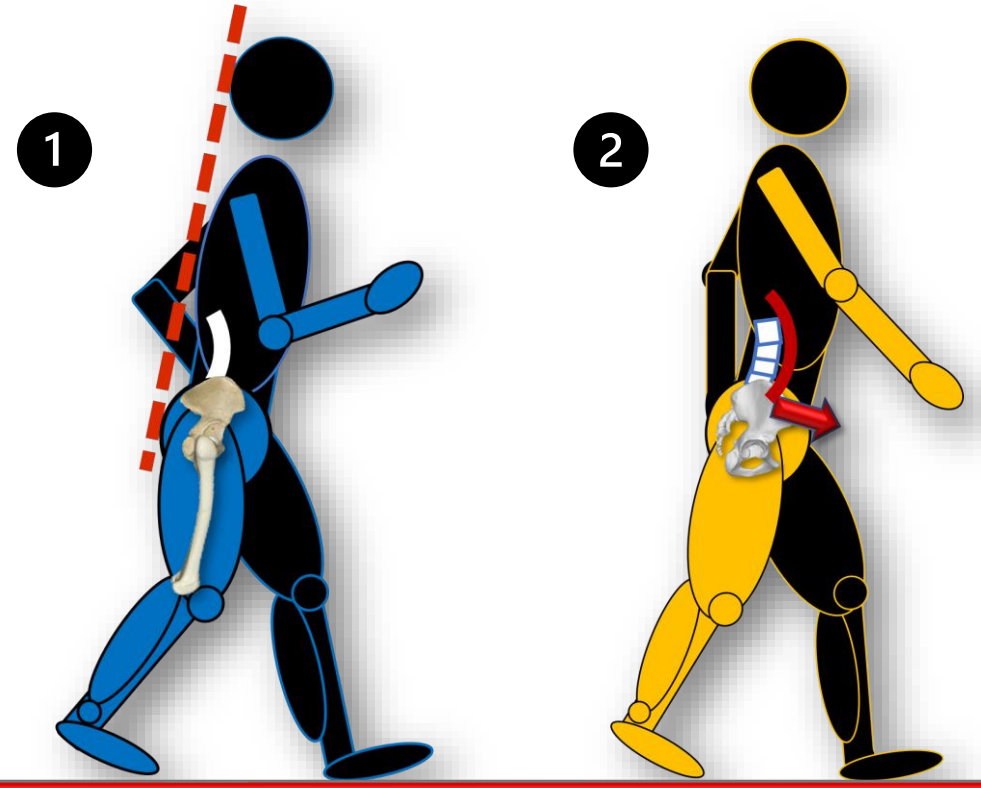
Propulsive Force & Trailing Limb Angle (TLA) during gait[17,22-24]

Contributions to Propulsive Force;

TLA at terminal stance = **65%**

Ankle PF moment during stance = **33.7%**





Athletes with LE inflexibility / weakness increase TLA by:

(1) ↑'ing Trunk FLEX (↑'s GMAX mech. advantage)

(2) ↑'ing Anterior pelvic tilt & therefore Lx EXT ('drive' from Lx extensors instead of stance leg)

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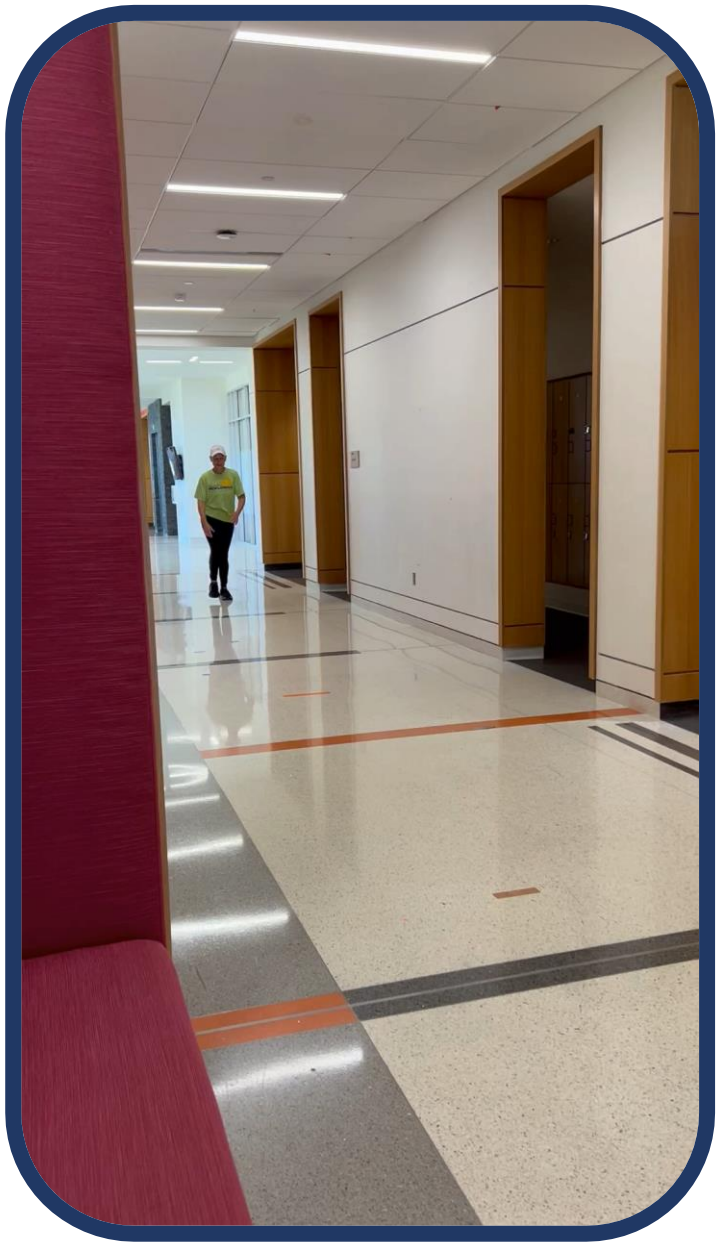
Analysis of FGS at Screen **VS** Follow-up (11 wks)

Screen - 2.2 m/sec



- ☐ **Step length / Cadence**
- ☐ **Trunk FLEX angle**
- ☐ **Anterior pelvic tilt / Lx EXT**
- ☐ **Pelvic motion (frontal plane)**
- ☐ **LE EXT in terminal stance (TLA)**
- ☐ **Push-off in terminal stance**

Follow-up - 3.3 m/sec

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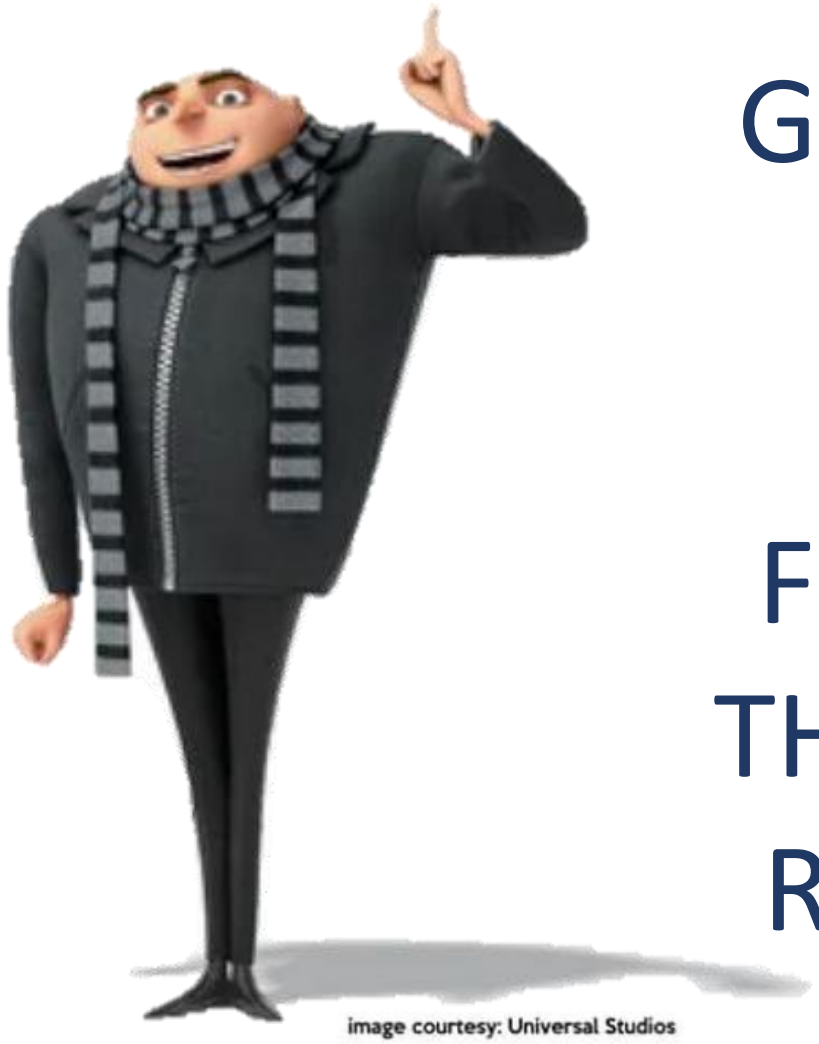
The value of analyzing FTSTS



GMAX, PLANTARFLEXORS, & QUADS ARE PRIMARY CONTRIBUTORS TO THE FORWARD PROPULSION OF THE COM DURING WALKING, RUNNING, & SIT-TO-STAND[25]

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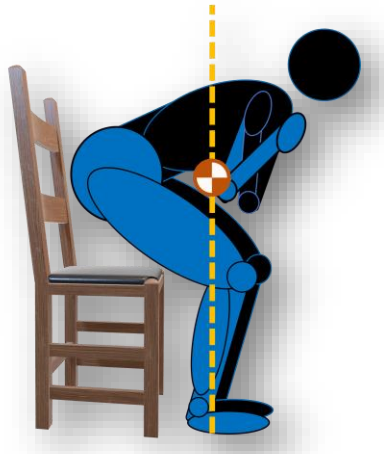
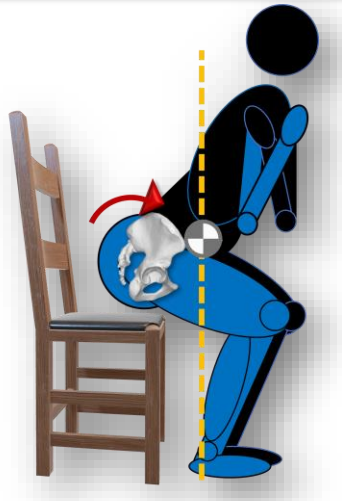
Key age-related biomechanical changes in Sit-to-Stand[25-29]

Hip/knee extensor + abdominal weakness



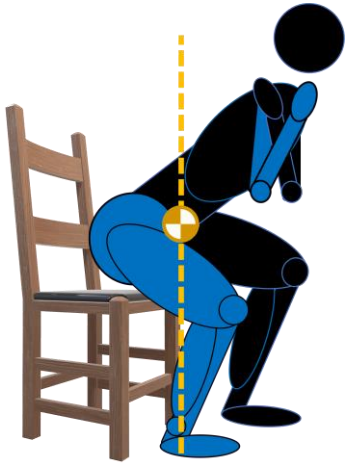
↑ TRUNK FLEXION

GMAX + abdominal weakness / ↓ hip EXT ROM



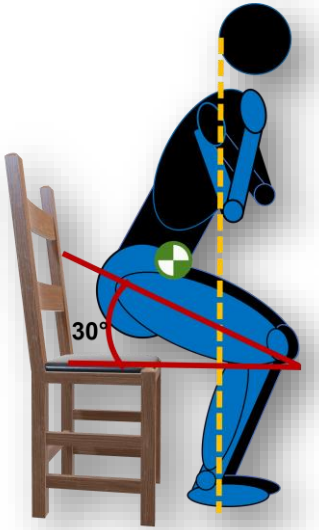
↑ ANTERIOR PELVIC TILT

Hip abductor weakness + postural instability



FEET > HIP DISTANCE APART

Hip extensor weakness (esp. eccentric GMAX)



UNCONTROLLED STAND-TO-SIT

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Analysis of FTSTS at Screen **VS** Follow-up (11 wks)

Screen - 5.38 sec

- ☐ **Trunk position at lift-off**
- ☐ **Sagittal pelvis rotation at lift-off**
- ☐ **LE EXT on Sit-to-Stand**
- ☐ **LE alignment (frontal plane)**
- ☐ **Eccentric LE control on Stand-to-Sit**

Follow-up - 4.68 sec

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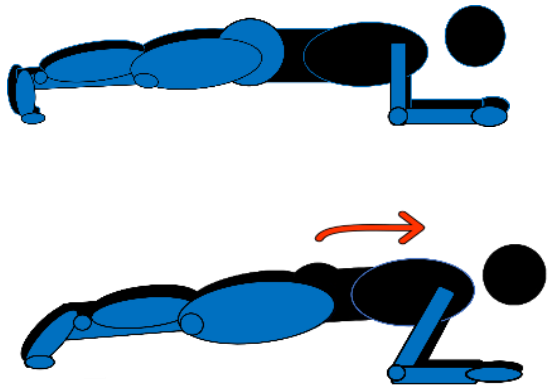
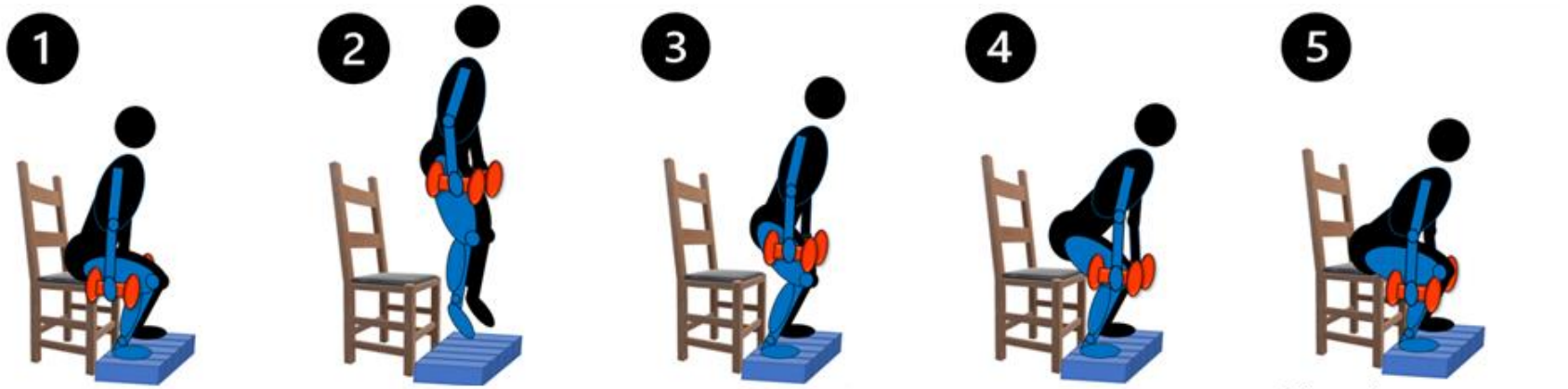
HEP 1 - s/p Screen

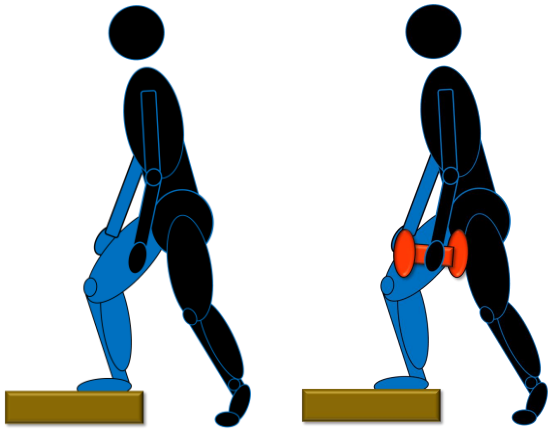
Scapular / Plank



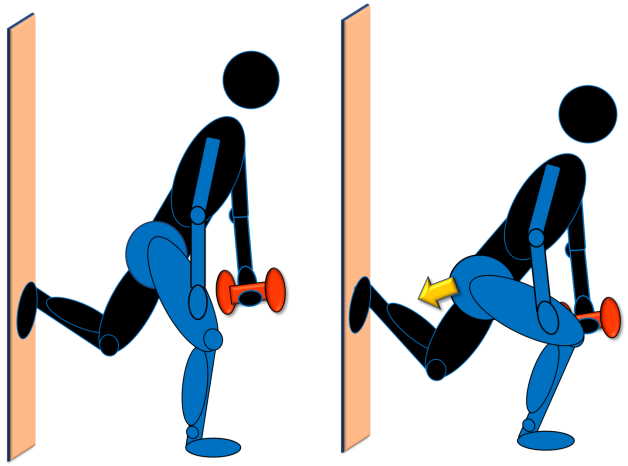
‘All-in-One’



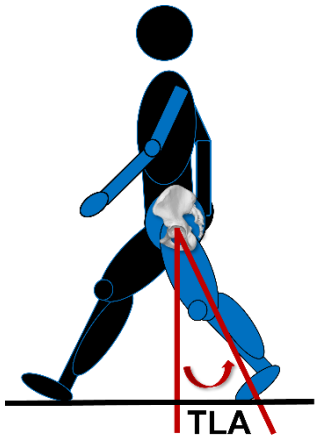
Forward Step-ups



‘Running-man’



Gait retraining



Soleus stretch

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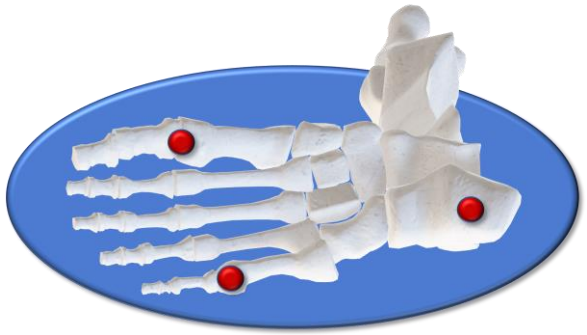
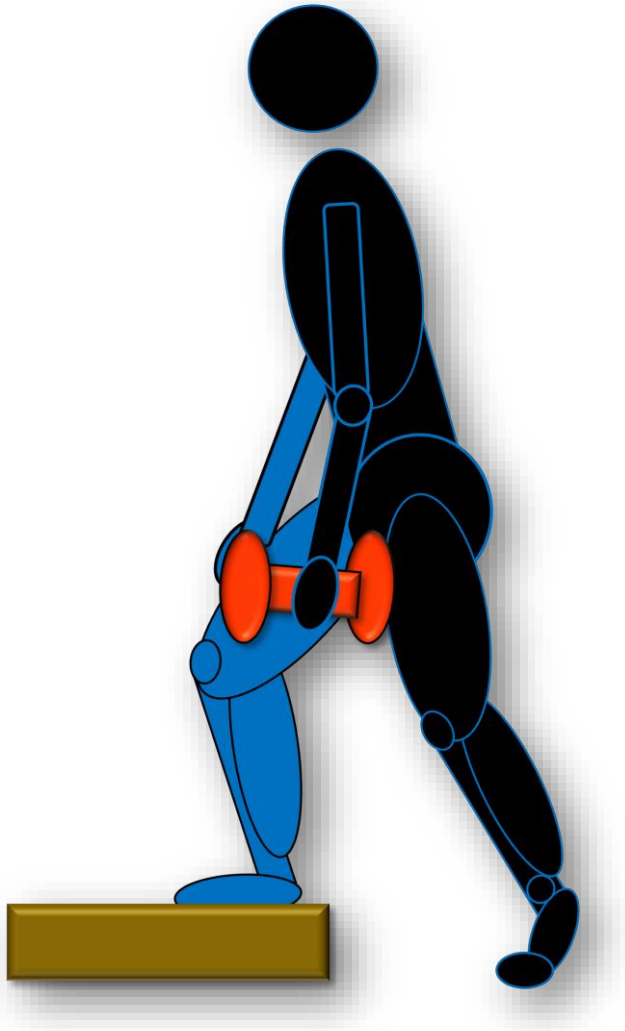
Step-ups for GMAX Rehabilitation[30-32]

Rock body forward as a unit until weight is on front leg. Push up onto step, extending to a 'soft knee'. **DO NOT push off with back leg**.



Keep equal pressure under big toe, little toe, & heel of front leg



3 x 5 reps each side, alternating sides

Actions of GMAX;

- Generates concentric/eccentric hip movement in sagittal plane
- Stabilizes hip in frontal plane (counters hip ADD)
- Stabilizes hip in transverse plane (counters femoral IR)
- Counters trunk rotatory force with a contralateral load
- The step-up exercise = highest levels of GMAX activation

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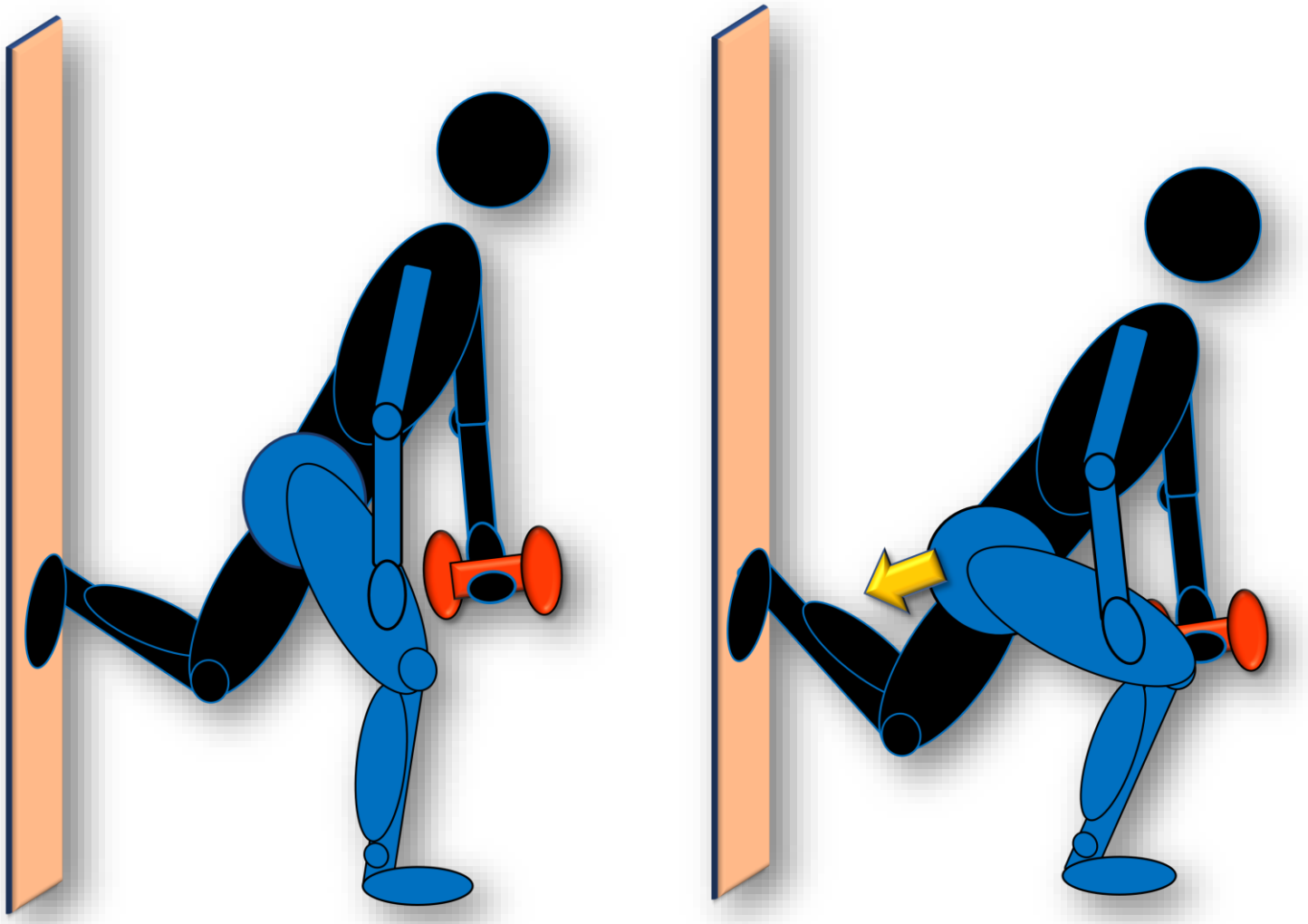
‘Running man’ - Functional Sports Rehabilitation



3 x 8-12 reps each side, alternating sides

<u>Single-leg stance exercises</u>;

Mimic motor control demands on stance leg in multiple planes during gait & sport (high demands on GMAX / GMED / posterior chain).[32]

- Foot of ‘swing’ leg on wall
- With tailbone back, slowly bend/straighten stance knee
- Hand just above the knee resists isometric hip ABD
- Felt in stance leg GMED > GMAX, <u>not</u> Quadriceps

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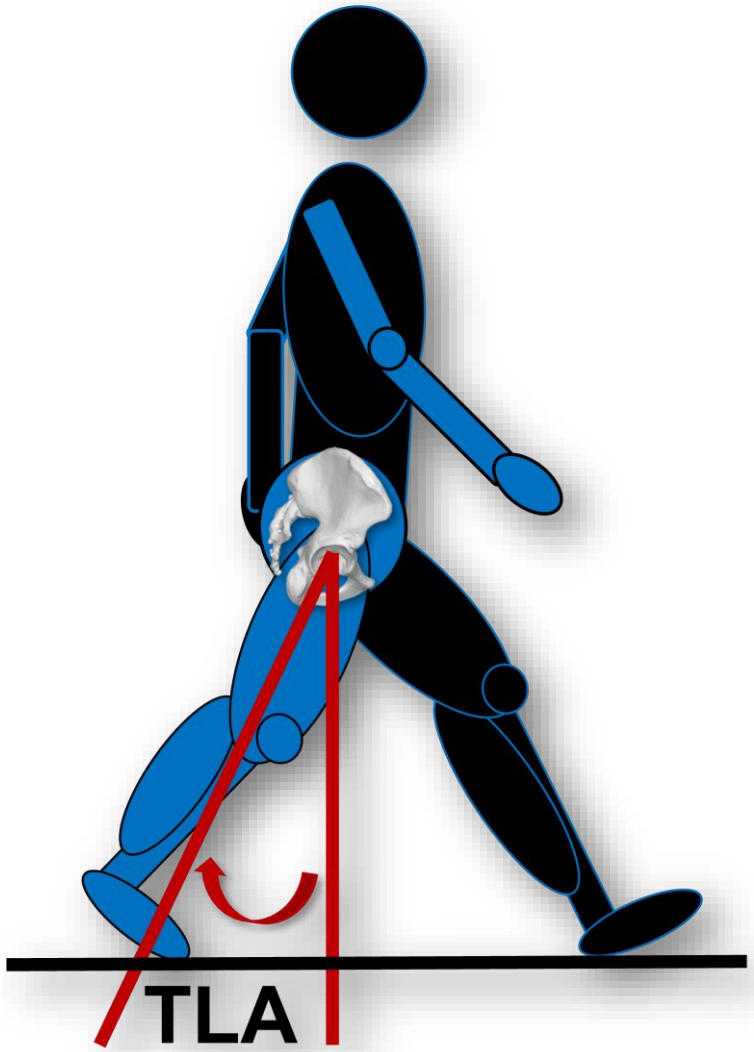
Gait retraining to improve TLA & Push-off

Healthy, active older adults **<u>can walk with as vigorous a push-off as younger adults</u>** but choose not to, to maintain dynamic balance control (modulated by muscle weakness and ↓'d flexibility)[17]

image courtesy: Universal Studios



Gait retraining progression

1. ↑ Hip + knee EXT in terminal stance **without** ↑'ing trunk FLEX or Lx EXT at **USUAL** gait speed
2. As per (1) at **TOP** gait speed
3. As per (2) + push harder into the ground at push-off

Remediate LE ROM deficits & LE/proximal strength deficits concurrently

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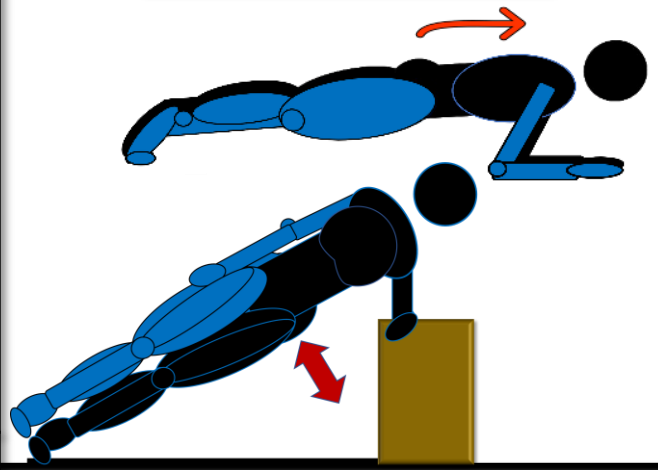
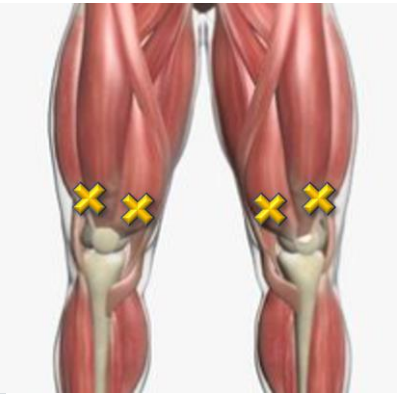
HEP 2 - s/p Evaluation

Scapular / Plank + ‘Side Plank’

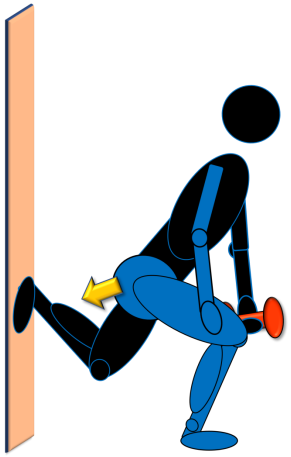


‘All-in-One’ (no jump)

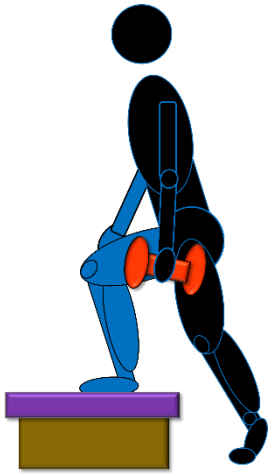
Self-MFR with active knee F/E, R Hallux mobs & taping



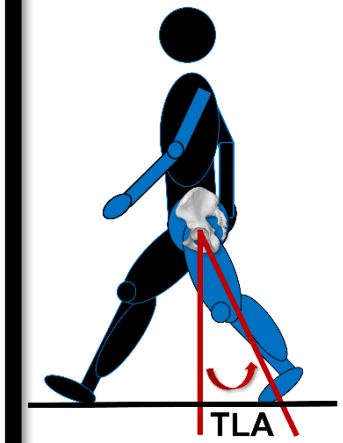
‘Running-man’



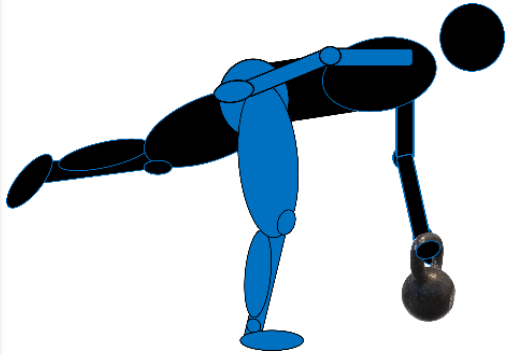
Step-ups



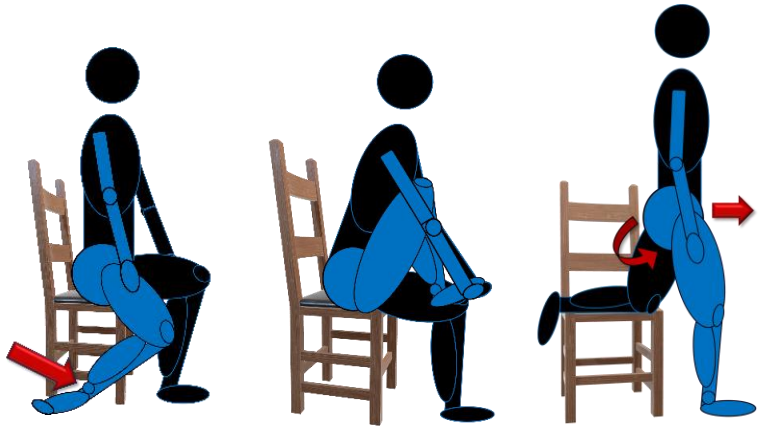
Gait



Romanian Dead-lift



Foot / ankle / hip Stretches



Exercise Intensity, Sequencing, and Recovery

FITT-VP[33]	NANCY - GENERAL EXERCISE PRESCRIPTION PARAMETERS	
FREQUENCY	• Therex - 3 days/wk (no > 2 consecutive days) • Stretching - 7 days/wk • MFR - 7 days/wk	• Gait retraining - 3-4 days/wk (no > 2 consecutive days) • Walking - 5-7 days/wk
INTENSITY	• Heaviest weight you can use to perform 8-12 reps with good form at RPE = 7-8/10 (70%-80% of 1-RM) • High enough to induce muscular fatigue after 1 x 8-12 reps that recovers within 1-2 mins of rest, with inability to recover within 1-2 mins after completing 3 x 8-12 reps • Gait retraining - USUAL-TOP speed with max. TLA + push-off • Walking for 3-4 miles at RPE = 7-8/10 (moderate-vigorous intensity)	
TIME	• Total Plank time - 9 mins max./session • Total stretching time -10 mins max./session	• Total MFR time - 5 mins max./session • Total Gait retraining time - 15 mins max./session)
TYPE	• Loaded Therex, static stretching, MFR, Theract (gait retraining), walking	
REPETITIONS	• General muscular fitness - 8-12 reps bilaterally • Step-ups - 5 reps bilaterally • Plank variations - 3 x 1 min	• Stretching - 3 x 30 sec static holds bilaterally • Gait retraining - 3 x 5 mins
SETS	• Therex/Theract - 3 sets/session	• Rest btw sets - 1-2 mins (unless alternating legs)
VOLUME	• Therex - 9 sets max. of each exercise/wk	• Gait retraining - 60 mins max./wk
PROGRESSION	• ↑ Weight when you can perform > 3 x 12 reps after 1-2 mins of rest **OR** > 12 reps in any exercise set after 1-2 mins rest **OR** 3 x 12 reps with an RPE = <7/10	

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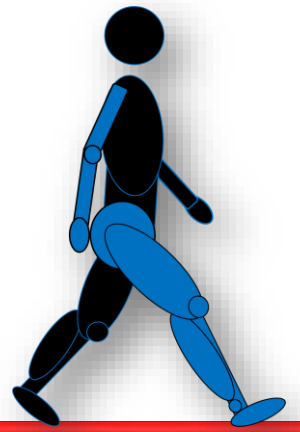
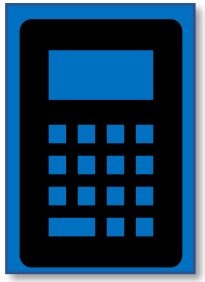
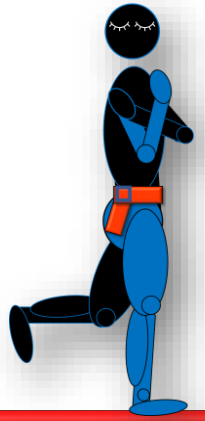
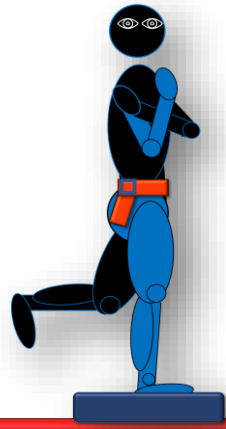
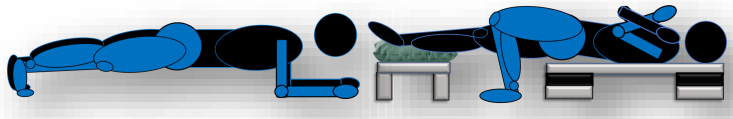
Performance Measures - Screen VS Follow-up (11 wks)



FGS	FTSTS	Ave Relative Power	SLS Eyes Closed	SLS Foam Eyes Open	Plank	GMAX Endurance
Screen						
2.2 m/sec	5.38 sec	6.5 W/kg	5.5 sec (R) 7.8 sec (L)	19.0 sec (R) 12.8 sec (L)	1:04:00	1:01:00 (R) 0:48:10 (L)
Follow-up (11 wks)						
3.3 m/sec	4.68 sec	7.8 W/kg	9.1 sec (R) 14.5 sec (L)	30.0 sec (R) 22.5 sec (L)	2:17:08	1:32:04 (R) 1:07:00 (L)
			(60-69 yrs) 9.4 sec (N = 1393)[6]		(60-79 yrs) 2:04:07 (N = 60)[38]	

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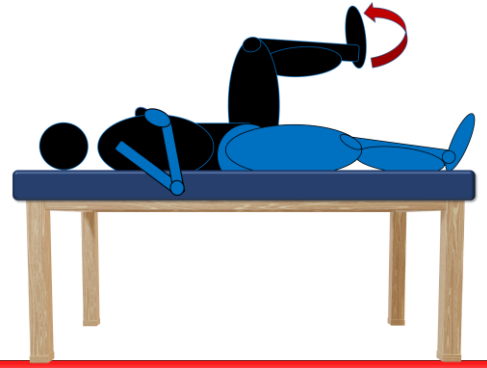
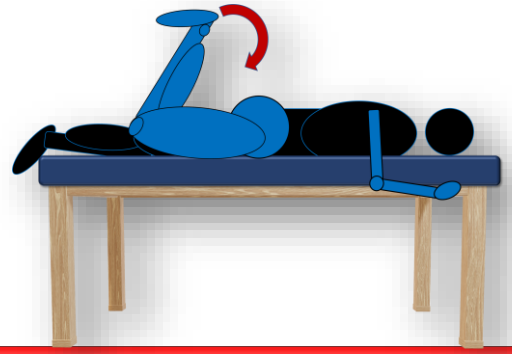
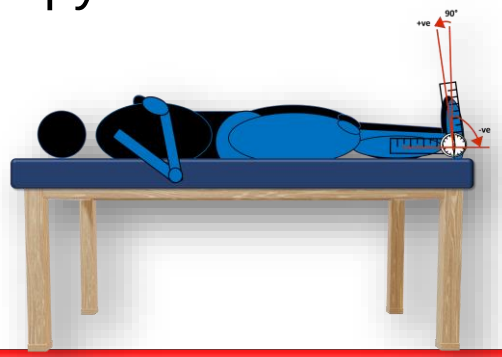
Flexibility measures at Evaluation + Follow-up (5 wks)

* Manual therapy x 1 *







Hip 90/90 IR	PKB Knee FLEX	Ankle DF ROM	WTB Hallux Dorsiflexion
Evaluation			
8° (R) 15° (L)	115° (R) 100° (L)	7° (R) 0° (L)	26° (R) 22° (L)
Follow-up (5 Wks)			
12° (R) 24° (L)	120° (R) 114° (L)	18° (R) 6° (L)	31° (R) 32° (L)
Norms			
35° (60+ yrs, N = 300)[34]	131° (60+ yrs, N = 100)[34]	7° (N = 1417)[6]	48.5° (N = 44)[35]

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Protein requirements for Performance & Recovery in older athletes[36,37]

To optimize strength and power gains during general training
≥ 1.2 g/kg/day

To optimize lean muscle mass gains during resistance training
1.5 - 1.6 g/kg/day

(0.4 g/kg post-training + 0.3 - 0.4 g/kg, 3-4 x during the day)

Postmenopausal female endurance athletes
1.6 - 1.8 g/kg/day

Consume **high-quality protein** (e.g., soy, lean chicken, fish, egg white) / refer athletes who are vegetarian to a dietician for a sport-specific diet containing optimal amino acid balance

Chronic dietary protein insufficiency may lead to **NET muscle protein catabolism**, slower recovery, and ↑ injury risk

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How much protein is that??!!

1 = 6 g protein

For strength & power gains
≥ 1.2 g/kg/day

73 g = **12**

For lean muscle mass gains
1.5 - 1.6 g/kg/day

91 - 97 g = **15 - 16**

For chronic endurance training
1.6 - 1.8 g/kg/day

97 - 109 g = **16 - 18**

For recovery post-exercise
0.4 g/kg

24 g = **4**

Nancy = 60.6 kg (134 lb)

BMI = 22.7 kg/m^2

Breakfast
1 Large egg = 6 g protein

Lunch
½ Can tuna in water (69 g) = 13 g protein

Snack
3 Tbsp peanut butter (48 g) = 11 g protein

Dinner
1 Cup chicken breast (140 g) = 43 g protein

Average daily protein intake = 73 g

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QUESTIONS?

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