Common fencing injuries

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What am I here to do?

- Describe the literature on fencing
  - What data is out there?
- Give coaches an idea of some the sport science research related to fencing
- Describe common injuries in fencing
  - Preventative strategies
- Fencing biomechanics & physiology
- What strength coaches should add to their program

What I am not here to do

- Tell coaches what to do, and how to do it
- Tell athletes how to train

WHY DOES AN INJURY HAPPEN?

Kobe Bryant
April 13, 2013 ·

This is such BS! All the training and sacrifice just flew out the window with one step that I've done millions of times! The frustration is unbearable. The anger is rage. Why the hell did this happen ?!? Makes no damn sense. Now I'm supposed to come back from this and be the same player Or better at 35?!? How in the world am I supposed to do that??
I have NO CLUE. Do I have the consistent will to overcome this thing? Maybe I should break out the rocking chair and reminisce on the career that was. Maybe this is how my book
ends. Maybe Father Time has defeated me...Then again maybe not! It's 3:30am, my foot feels like dead weight, my head is spinning from the pain meds and I'm wide awake. Forgive my Venting but what's the purpose of social media if I won't bring it to you Real No Image?? Feels good to vent, let it out. To feel as if THIS is the WORST thing EVER! Because After ALL the venting, a real perspective sets in. There are far greater issues/challenges in the world then a torn achilles. Stop feeling sorry for yourself, find the silver lining and get to work with the same belief, same drive and same conviction as ever.
One day, the beginning of a new career journey will commence. Today is NOT that day.
"If you see me in a fight with a bear, prey for the bear". Ive always loved that quote. Thats "mamba mentality" we don't quit, we don't cower, we don't run. We endure and conquer.
I know it's a long post but I'm Facebook Venting LOL. Maybe now I can actually get some sleep and be excited for surgery tomorrow. First step of a new challenge.
Guess I will be Coach Vino the rest of this season. I have faith in my teammates. They will come thru.
Thank you for all your prayers and support. Much Love Always.
Mamba Out

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Why does an injury happen?

- Your body is able to do what you **demand** from it because it has the **capacity** to do it
  - (Capacity is your physical and mental ability)
- In other words, what you demand from your body better equal your capacity
- If the demand exceeds the capacity, this is when injuries happen…

When does an injury happen?

- If the **demand** exceeds the **capacity** you are most likely dealing with an injury
- Injuries could vary in severities…some that you could merely "walk-off", and some that could hold you back from training
- Injuries could be rolled ankles, muscle strains, meniscal irritation, ACL tear, back pain, shoulder impingement, etc.

Capacity

<<Demand

Injury reduction…

- Enhancing or increasing your capacity, means you could take on more demand.
- More **capacity**, allows more **demand**, which consequently means better performance
  - This goes for physical capacity, psychological capacity, and physiological capacity

Demand

<<Capacity

Easy solution?

- Ok, great! Increase my "capacity" and I'll be golden, right?
  - The problem is capacity is comprised of more than just strength…It's also muscle asymmetry, muscle imbalance, muscle and mental fatigue, coordination, mobility, muscle control, etc., etc., and the list goes on…

Injury recognition, prediction, & prevention

Reality behind injury prediction…

- Even with all these screens, and the data out there, the scientific findings are still not conclusive
- Not as simple as once thought
- Risk factors are limited in its ability to successfully identify predictive factors

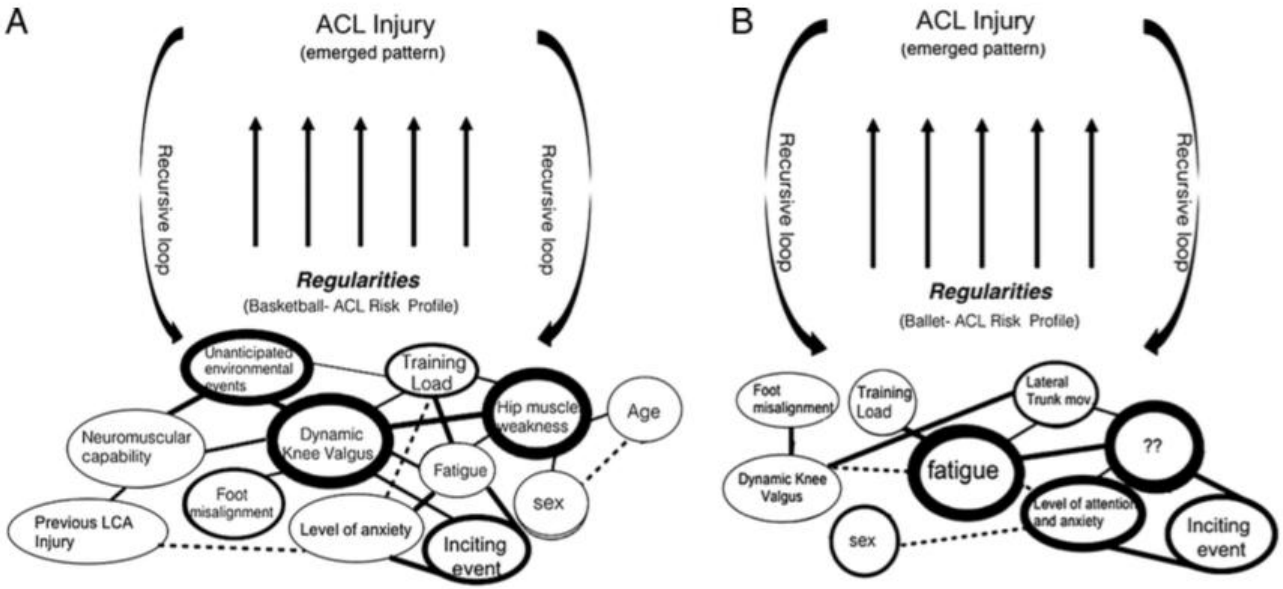


Figure 2 (A) Web of determinants for an ACL injury in basketball athletes and (B) web of determinants for an ACL injury in ballet dancer.

Injury pattern recognition

- Instead of looking for the units (first level risk factors), we should look for the existing pattern of interactions among the units (regularities).
- The complex nature of sports injuries arises not from the linear interaction between isolated and predictive factors, but from the complex interaction among a web of factors which may produce regularities that prompt the emerging pattern (injury)

Common fencing injuries

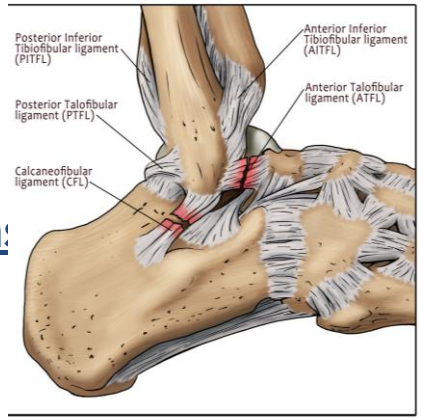
Fencing injuries in the literature

- The reports of fencing injuries are very scarce in the literature
- Epidemiological large-scale and prospective studies are lacking
- Therefore, objective data is lacking for reliable panorama of fencing injures and their prevention

What are the injuries?

- During competition…
  - The injuries caused by the opponent's weapon (wounds and bruises)
    - 48% in regional competitions
    - 66% in Junior International Championships

- In all recorded injuries…
  - ~25% contusions only..
  - **non-contact injuries, such as ligament sprains and muscle strains = pre-dominant types of injury**



Specific injury sites

Table VIII. Location and frequency of fencing injuries

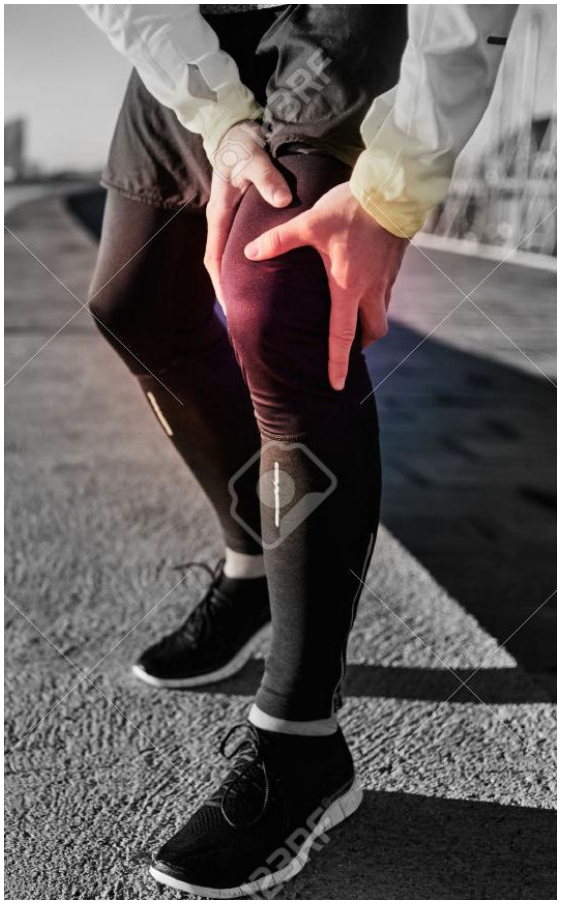
	Participants (n)	Injuries (n)	Head	Spine/trunk	Upper extremity	Lower extremity	Other
Roi and Fascì[69]	1365	58	10.3	3.4	55.2	27.6	3.4
Muller-Strum and Biener[75]	105	148	2.0	23.0	20.0	55.0	0.0
Moyer and Konin[76]	NS	322	5.9	9.0	32.9	40.7	1.6
Carter et al.[77]	1603	842	0.6	13.8	30.4	54.6	0.6
Zemper and Harmer[68]	1031	107	2.8	9.3	41.1	46.7	0.0

NS = not stated.

Specific injury sites

- **The lower extremity was the most frequent location for fencing injuries** followed by the upper extremity

- Ligament sprains and muscle strains are the predominant injuries



% of time lost injury

- **20% knee** = most common site of injury
  - Meniscal lesions
  - Anterior cruciate ligament (ACL) rupture
  - Medial collateral ligament (MCL) rupture
  - Patellar tendon pain/Patellar Femoral Pain (PFP)
  - Patellar subluxation/dislocation
- **14% thigh** strains
- **13% ankle** sprain
- **9% low back** pathologies (sprain, strain, spasm)
- **8% finger** injuries = most common upper extremity injury
  - sprains, contusions, fracture, subluxation/dislocation
- **3% hand**
- **3% shoulder**

Who's getting hurt?

- **Women** are in greater risk than men
- **Sabre** fencers had a significantly greater risk than foil and epee fencers
- Reason for these differences is currently under investigation…limited data…

Severity of Injury

- Rarely are fencers unable to complete the competition (about 5% withdraw from the tournaments)
- Despite the low rate of acute time-loss injuries in competitive fencing, the rate of minor (non-time loss) injuries is high!
  - blisters, abrasions, lacerations

Figure 2. Typical rear foot friction blister.

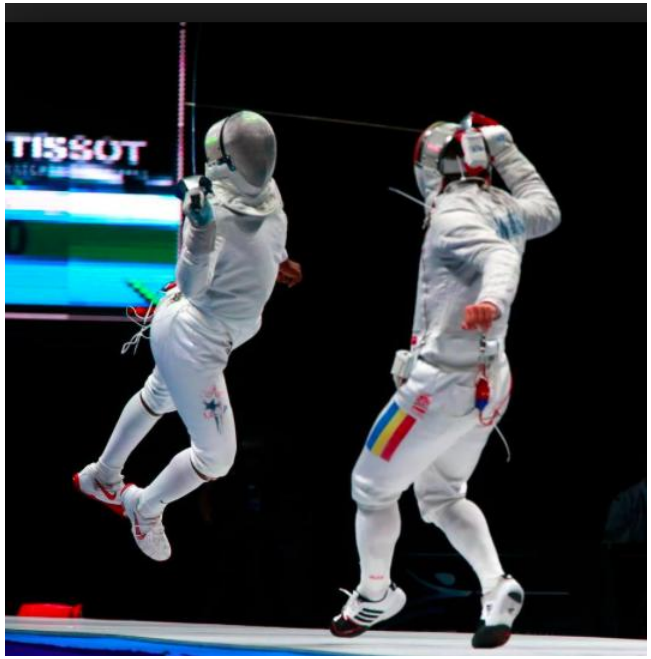
What about chronic & overuse injury?

- No studies on incidence of chronic/overuse injuries have been conducted
- Prevalence studies indicate that these injuries account for ~30% of injuries that interfere with training
  - impingement syndromes in the shoulder
  - Ethesopathies of the lateral epicondyle of the humerus
  - Patellar tendon (front leg)
  - Tibia (medial tibial stress syndrome; MTSS)
  - Achilles tendon (rear leg)
  - Plantar fascia

Prevention

- Half of the factors contributing to the fencing injuries were personal (intrinsic) factors under direct control of the fencer, therefore implying that **these injuries are preventable**
  - These factors are: inadequate warm- up, poor fencing technique, dangerous tactics, lack of adequate general conditioning, fatigue, overtraining and repetitive movements leading to overuse injuries
- Because fencing is an asymmetrical sport, **overuse injuries are more common** in the shoulder, the back and the pelvic girdle
- Successful **prevention must involve several steps and several people** who carry out specific interventions in terms of structural and educational measures
  - Athletes, coaches, parents, strength coaches, health practitioners

Fencing under the microscope



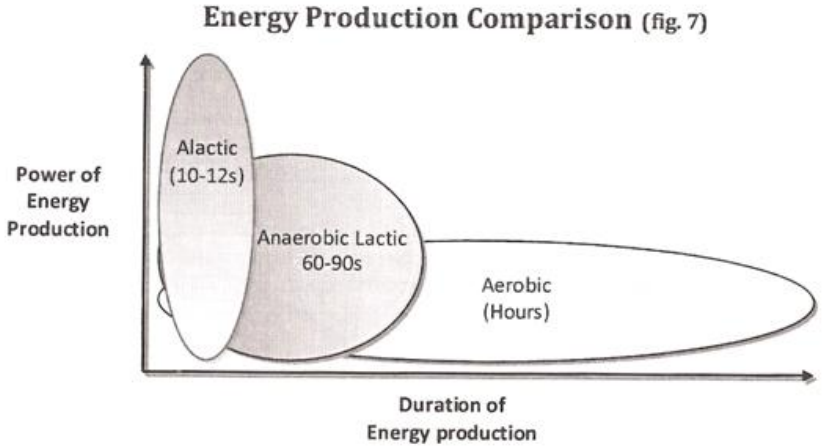
Physiology

- MISCONCEPTION: HIGH AEROBIC CAPACITY WILL FEND OFF FATIGUE ACROSS THE LONG DAYS THAT MAKE UP FENCING COMPETITIONS
  - Milia et al.
    - **Fencers moderately recruited aerobic energy sources**
    - Concluded that **athletes need to use specific training programs**
- Fencing only imposed moderate respiratory and metabolic stress
- Data support an HIIT approach for fencers, as in addition to being specific to the "stop-start" and explosive nature of fencing, these can be manipulated **to evoke high blood lactate responses, while challenging and thus adapting the recovery process, including decreasing the accumulation of, and increasing the tolerance to, hydrogen ions**

Physiology

- Data reveal fencing's anaerobic dominance but specifically, identify that the **pools (5 hits) predominately derive energy from the alactic system, whereas the elimination rounds (15 hits) from the lactic acid system**

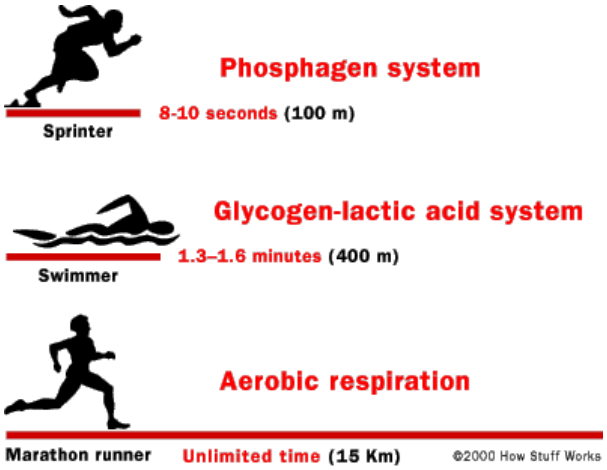
- Suggestion that primary energy system used is the phosphogen system, followed by anaerobic glycolysis (lactic system)



Physiology

- Elliott et al. (10) has described how traditional aerobic training (i.e., long, slow-distance running) is detrimental to strength and power output

- Pool bouts rely more on the alactic system (and therefore PCr as fuel), whereas the elimination bouts rely more on the lactate system (and therefore glucose as fuel)



Biomechanics - Kinematics

- Gutierrez-Davila examined **elite vs. medium-level fencers** while lunging:
  - movement time of **601 vs. 585 milliseconds**
  - greater distance of **1.4 vs. 1.13 m**
  - Elite level executed a **temporal arm-foot sequence**.
    - the elite was quicker to reach maximum velocity in the initial extension of the arm (31 vs. 45%)
    - **The results highlight the importance of starting the advance with a rapid thrust of the arm, followed by a lunge forward with the lead foot. *(see next slide)***
  - The temporal arm-foot sequence is required for correct technique and also determines the right of way (priority) in foil and saber.

Biomechanics - Kinematics

According to the FIE the rules state that: "*the attack is the initial offensive action made by extending the arm and continuously threatening the opponents target, preceding the launching of the lunge or fleche.*"

- Although the arm-foot sequence contradicts the well accepted "ground up" based kinematics of most sports, for example, baseball, javelin, and tennis, priority ruling dictates this

As such, fencers must be trained to quickly extend their arms independent of force generated at the legs, and thus supports the use of strength and power training targeting the upper body***

Important for strength coaches***

Eccentric control

- **Flight phase**: Lead leg **knee flexors** (namely the hamstrings) must then control rapid knee extension during the flight phase to enable high angular velocities at the knee and reduce the likelihood of injury; the high incidence of hamstring strains in these athletes may be indicative of the need to target these muscles.

- **Landing:** the front **knee extensors** must exert high braking forces at landing; the eccentric forces experienced by the lead leg are likely to be high.
  - The ability to quickly arrest this forward momentum, that is, reducing the required knee flexion, may reduce the transition time to change direction and return to on-guard position. This would decrease the time the opponent has to counter attack should the lunge be unsuccessful.****
    - **The faster you stop your momentum, the faster you could recover, the less chance for your opponent to take over**

Strength training & conditioning

- **Change-of-direction speed (CODS)**
- Fencing is a predominately anaerobic sport and that "explosive" movements define the performance…
- **HIIT** for strength and power
- **Recommended that fencers be subjected to high eccentric loads as part of their strength and conditioning program**
- The need for prophylactic **strengthening and proprioceptive training** of the musculature of the knee (hamstring and quadriceps) and ankle

Strength training & conditioning

- **Squats and deadlifts** → target the knee and hip extensors/flexors
  - Single legged squats/deadlifts
  - Lunges

Strength training & conditioning

- **Split squat exercises** → target the gluteal musc and collectively train a fast recovery from the lunge back to on guard

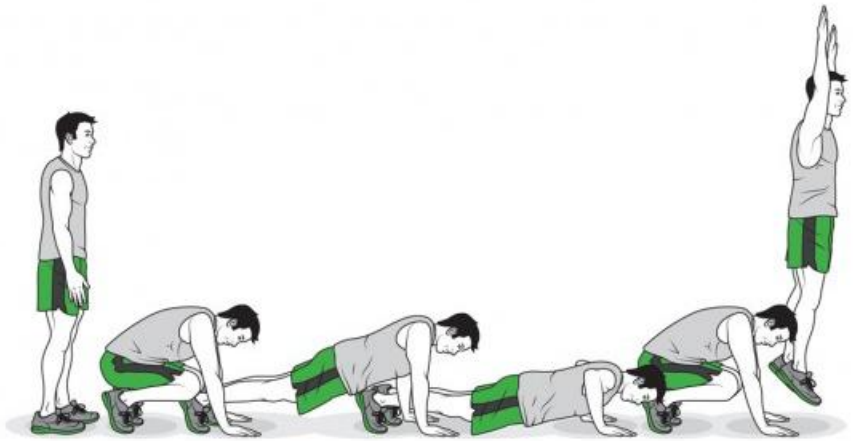
- **Nordics** and stiff-leg deadlifts can help reduce the high incidence of hamstring strains

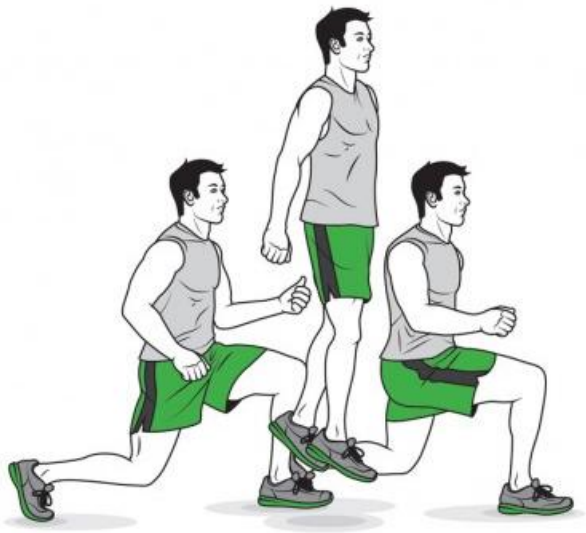
Strength training & conditioning

- **Bench press** and seated medicine ball throws → target upper-body strength and power development, respectively.
  - Important to dissociate upper body strength from lower body in fencing.

Strength training & conditioning

- Reactive strength (and thus reduced ground contact times) coupled with “deep” squats (below parallel)





Strength training & conditioning

- CORE!!!! (not crunches)

Suggested solution…

Sport psychologists

nutritionist

coach

Chiro/Physio/therapists

Strength coach

parents

- A *team* approach, involving **coaches and medical personnel** (physicians, chiropractors, athletic trainers, physiotherapists, strength coaches) is recommended.

- Fencing is a unilateral sport, thus, bilateral and whole body strengthening programs are recommended, particularly for children and adolescent fencers, to avoid incapacities due to muscle imbalances on their growing musculoskeletal systems

PERFORMANCE CUEING FOR COACHES

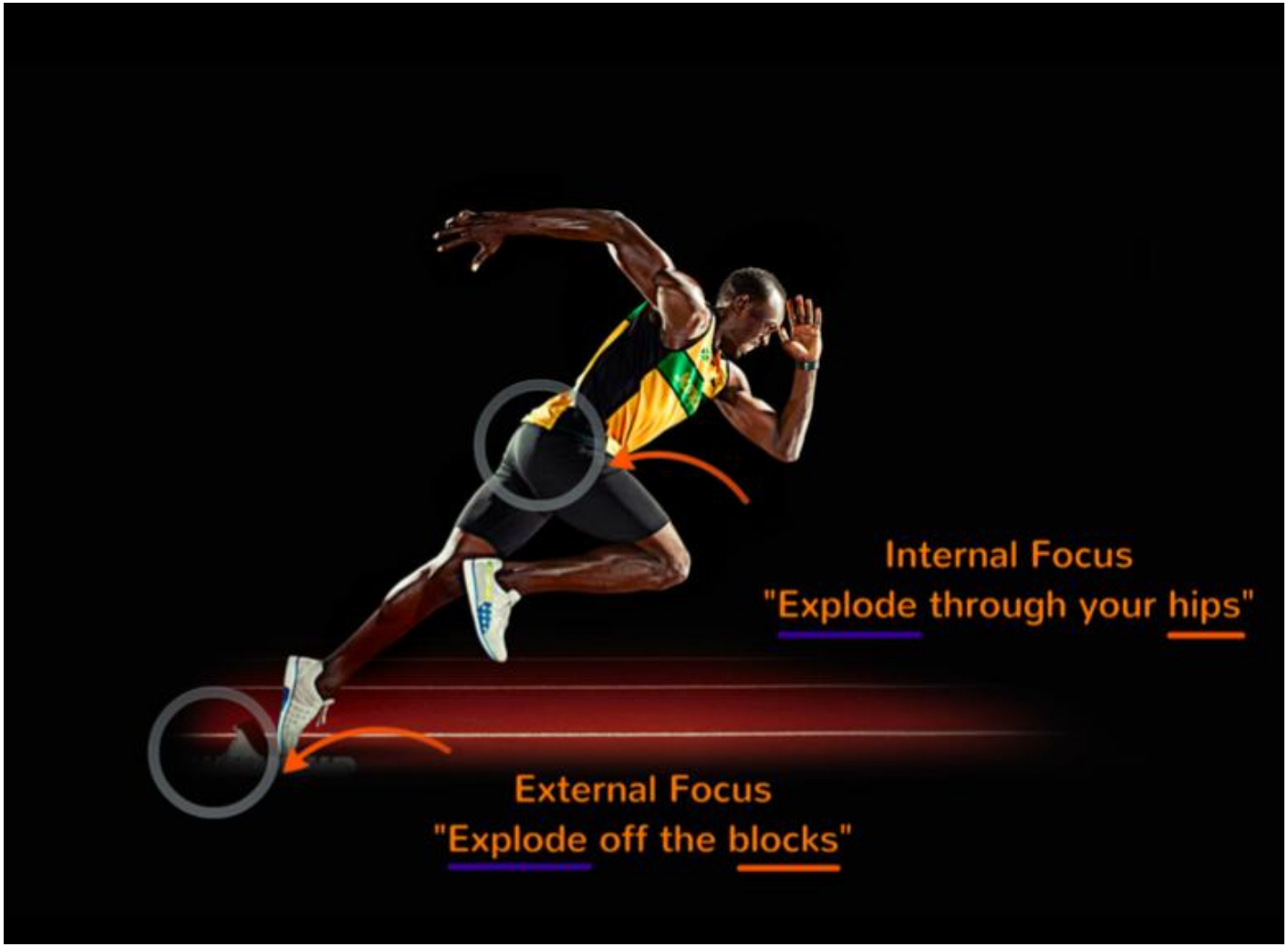
Cueing

- What we say matters…
- When coaching movements, the words you use is key….
  - It impacts technique, reaction time, speed, accuracy
  - Internal focus vs. external focus

Internal vs. external

- **Internal focus**: primary focus of the body (quad muscle) and its movement process (knee extension)

- **External focus:** primary focus on movement outcome (ex. jump high) and its environment (push the ground)


Internal Focus
"Explode through your hips"
External Focus
"Explode off the blocks"


Internal: "Drive off your front foot"
External: "Reach far with your sabre"
Internal: "Reach far with your arms"
External: "Drive the ground away"
11
1:50
ROU
МОСКОМСПОРТ
FIE

What does the research say is better cueing?

External knocks internal out the park

Wulf et al. (1999)

- External focus superior during practice retention in novice golfers

Wulf et al. (2001)

- External focus improves reaction time during balance tasks

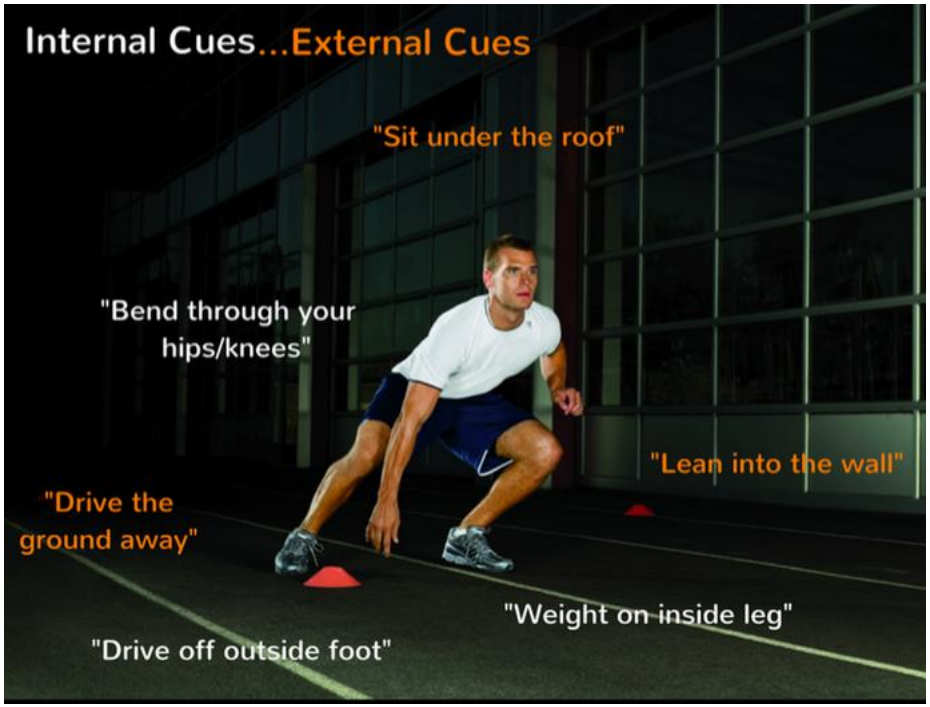
- External focus increases speed during bicep curl
- External focus increases free throw accuracy
- External focus increases shot accuracy in expert golfers
- External focus increases balance in those with Parkinson's disease

Why is external so much better?

- Wulf et al. suggests that….
  - …internal…"constrains the motor system by interfering with autonomic control process that would normally regulate the movement"
  - …external…"allows the motor system to more naturally self organize, unconstrained by the interference caused by conscious control attempts"

How could this apply to coaching?

- If you want to instruct speed…



How could this apply to coaching?

- If you want explosiveness….

External:
"Fire off like an arrow"

Internal:
"extend you arm straight"

Internal:
"straighten your back leg"

Internal:
"lean your body weight forward"

External:
"Drive off like a jet taking off"

External:
"Accelerate towards your target"

Use action words that create images

Quick

Snap

Sharp

Bounce

Spin

Drive

Explode

Fluid

STRETCHING

Stretching

- ROM may be limited by 2 anatomical entities: joints and muscles
  - Muscles could be tight because of from an increase in tension from active or passive mechanisms
    - Passively; shortened through postural adaptation or scarring
    - Actively; can become shorter due to spasm or contraction (neurological)

Stretching

- Stretching techniques are **Static**, **Dynamic**, and **Pre-Contraction stretches**

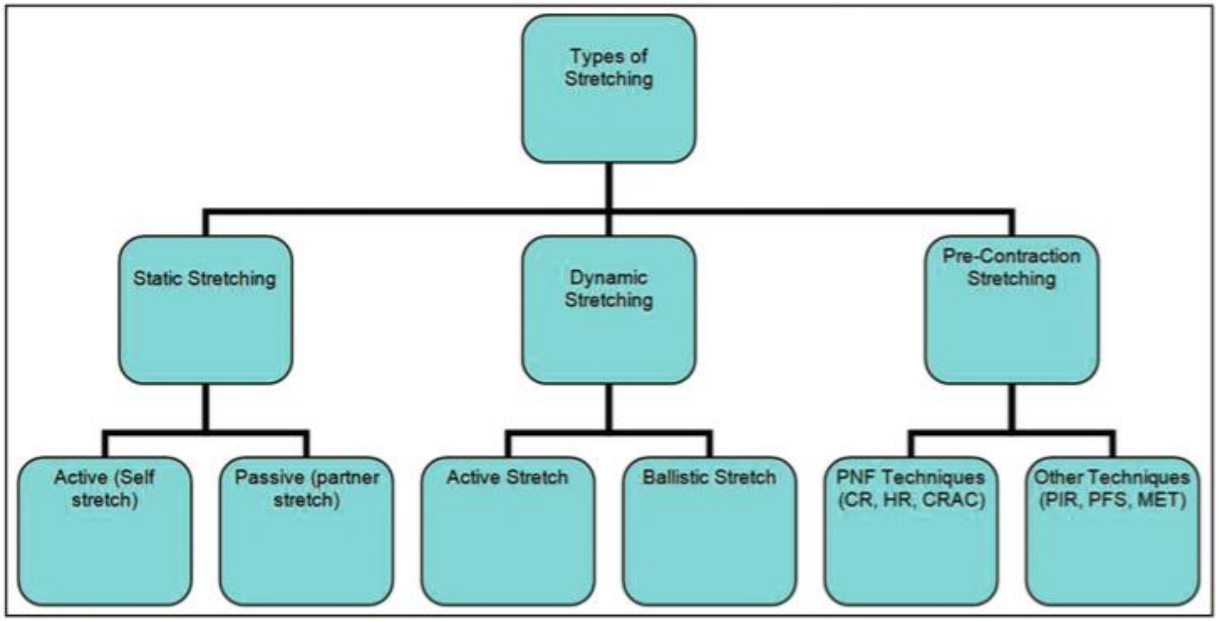


Figure 2. *Techniques of Muscle Stretching. HR = Hold relax; CR = Contract relax; CRAC = Contract relax, agonist contract; PIR = Post-isometric relaxation; PFS = Post-facilitation stretching, MET = Medical exercise therapy.*

Static stretching

- Traditional and most common type
- A specific position is held with the muscle on tension to a point of a stretching sensation and repeated
- Can be performed passively by a partner, or actively by the subject

Dynamic Stretching

- 2 types of dynamic stretching: active and ballistic stretching.
  - **Active stretching generally involves moving a limb through its full range of motion to the end ranges and repeating several times**
  - Ballistic stretching includes rapid, alternating movements or 'bouncing' at end-range of motion
    - because of increased risk for injury, ballistic stretching is no longer recommended

Pre-contraction stretching

- Pre-contraction stretching involves a contraction of the muscle being stretched or its antagonist before stretching
- The most common type of pre-contraction stretching is **proprioceptive neuromuscular facilitation (PNF)** stretching
  - 75 to 100% of maximal contraction
  - provided by a partner
- Other types: **post-isometric relaxation" (PIR)**
  - uses a much smaller amount of muscle contraction (25%) followed by a stretch
- **Post-facilitation stretch (PFS)**
  - Technique developed by Dr. Vladimir Janda
  - involves a maximal contraction of the muscle at mid-range with a rapid movement to maximal length followed by a 15-second static stretch

Effects of static-stretching…

- Static stretching often results in <u>increases in joint ROM</u>
- Interestingly, the increase in ROM *may* not be caused by increased length (decreased tension) of the muscle; rather, an increased tolerance to stretching
- **<u>static stretching as part of a warm-up immediately prior to exercise has been shown detrimental to muscle strength performance in running and jumping</u>**
- The loss of strength resulting from acute static stretching has been termed, "**stretch-induced strength loss**"
  - specific causes for this type of stretch induced loss in strength is not clear
    - some suggest neural factors while others suggest mechanical factors

Recommendations

- Static and dynamic warm-ups are equally effective at increasing ROM prior to exercise
- **Warm-up for Sports and Exercise:**
  - Stretching performed as part of a warm-up prior to exercise is thought to reduce passive stiffness and increase range of movement during exercise.
  - Static stretching is most beneficial for athletes requiring flexibility for their sports (e.g. gymnastics, dance, etc.)
  - **Dynamic stretching may be better suited for athletes requiring running or jumping performance during their sport such as basketball players or sprinters**
- Stretching has not been shown to be effective at reducing the incidence of overall injuries.

Take home message

- Most common acute injuries in fencing are sprains and strains, and most of the time it's in the lower extremity
- Aerobic training will NOT fend off fatigue during long fencing days. Train HIIT
- **Strength training is <u>essential</u>** in correcting muscle imbalance, increase power, muscle-control, and preventing injuries
- Coaching with **external cues** is more superior to internal cues in increasing performance
- **Dynamic stretch** prior to exercise, and static stretch post exercise

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Questions or concerns?

Please don't ever hesitate to contact me with regards to sports injuries, strength training, etc…

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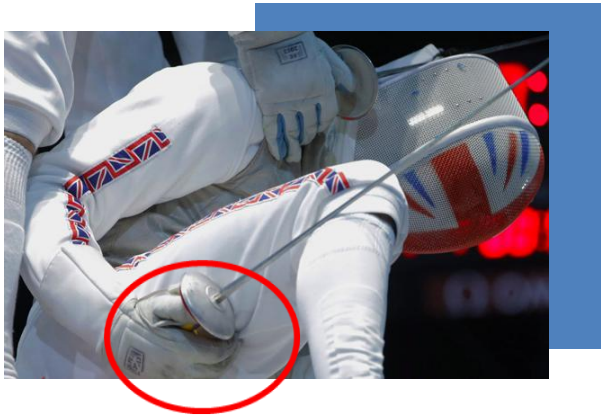
THANK YOU!!

For Health Practitioners

For Health Practitioners

- few well-designed epidemiological studies
- Despite limitations, the existing literature indicates that the rate of significant (i.e., time loss) injuries is low. A time loss injury is defined as one that forces the athlete from competition

Acute injury



- the majority of acute time loss injuries in fencing are related to the dynamic movement of fencing actions (i.e., strains, sprains) rather than injuries associated with the use of fencing equipment (i.e., puncture, lacerations)
  - Strains & sprains, 26.1% and 25.5%, respectively (Harmer 2008)
  - Knee was the most common site of injury, accounting for 19.6% of all time loss injuries. However, a wide variety of pathologies including: ACL & MCL rupture, patellar tendon pain, patellar subluxation/dislocation and non-specific knee pain (perhaps patellar-femoral pain syndrome?)
  - Thigh strains and ankle sprains (14% and 12.5% of all reportable injuries, respectively)

Acute injury

- Finger injuries (sprains, contusions, fracture, subluxation/dislocation) were the most common upper extremity injury (7.6% of total)
- Hand and shoulder (3% each)
- Low back pathologies (sprain, strain, spasm) accounted for 9% of time loss injuries.

Acute injury

- Despite the low rate of acute time loss injuries in competitive fencing, the rate of minor (non-time loss) injuries is high
- Majority of these injuries are friction blisters and abrasions on the fencing hand from the grip of the weapon, or small lacerations on either hand from the opponent's blade
- Readily addressed with standard antiseptic cleaning and cloth bandaids, usually lightweight adhesive flexible tape to prevent the wound coverings from being displaced by sweating
- Penetrating injuries is very low. However, non-broken blade penetrating injuries to the hand in sabre have recently been detected
  - ranges in severity from minor cutaneous damage (1-3 cm) to penetration from the wrist to the elbow (~30 cm)
  - none have resulted in significant permanent damage

Acute Injury

- In the lower extremity, friction blisters are common, especially on the Achilles tendon and under the head of the first metatarsal of the rear foot
  - Rear-foot blisters develop from loaded plantar-flexed stance in the rear foot that is used to facilitate lunging placing a lot of body weight on the metatarsal head.
  - treatment of the acute blister: check insole wear and advise the athlete of to maintain good quality insoles. The use of SecondSkinTM or similar for protection and pain relief
- Subungual hematoma is also a common minor injury that interferes with participation
  - occur in the fingers from being hit by an opponent's blade and in the toes from being stepped on by an opponent or from ill-fitting shoes (either too small or too large)
  - Draining with a scalpel, if the hematoma is located in the distal third of the nail bed, or with a fine-tip cauterizer, if it is located in the proximal two-thirds, with standard antibiotic packing and covering is recommended

Chronic & overuse injury

- Chronic injuries account for ~30% of injuries that interfere with training
- 14.5% of respondents self-identified ‘‘tendinitis’’ as the worst in their fencing career (Carter et al.1993)
  - Outdated…?
  - Tendinitis vs. tendinosis…
- Common chronic/overuse problems include impingement syndromes in the shoulder, enthesopathies of the lateral epicondyle of the humerus, patellar tendon (typically in the ‘‘front’’ leg), tibia (medial tibial stress syndrome), Achilles tendon (in the rear leg), and plantar fascia

Recommendations

- **For Rehab (therapist, chiro's, physio's, physicians, etc.):**
  - Stretching is effective for the treatment of orthopedic conditions or injury
  - Static stretching has been shown to be more effective than dynamic stretching for those recovering from hamstring strains
  - Patients with knee osteoarthritis can benefit from static stretching to increase knee ROM; however, PNF stretching may be more effective.

PROPHYLATIC TAPING AND BRACING

- Due to the significant friction and torsional stresses on the body during fencing, fencers habitually tape in hopes of preventing injury
- Foil fencers tape the fingers, hand, and wrist of the weapon side
- Epee fencers are more likely to only tape the wrist)
- Ankle taping (or lace-up braces) is common
- Specialized taping is also frequently used during acute phases of overuse conditions of the Achilles tendon, MTSS, plantar fascia and lateral epicondyle of the humerus
- Particular attention needs to be paid to athletes with unstable knees who wish to use an external brace