Materiales docentes para el alumnado

Clases teóricas

Lesiones ligamentosas – Lesiones de rodilla (Parte 1)

Asignatura: Readaptación deportiva y reentrenamiento físico-deportivo

Docentes

D.ª Alba Aparicio Sarmiento	alba.aparicio@um.es
Dr. Francisco Javier Robles Palazón	franciscojavier.robles1@um.es
Dr. Francisco Ayala	francisco.ayala@um.es
Prof. Pilar Sainz de Baranda	psainzdebaranda@um.es

Facultad de Ciencias del Deporte
Universidad de Murcia - Campus de San Javier

Imaginad que sois preparadorxs/readaptadorxs físico-deportivos de un equipo:

¿CÓMO ACTUARÍAIS ANTE UNA LESIÓN DE RODILLA?

PASOS A SEGUIR PARA LA READAPTACIÓN DE UNA LESIÓN DE RODILLA

1. ¿QUÉ? Conoce la anatomía y función de la estructura lesionada

LESIONES DE RODILLA MÁS COMUNES: Lesión del LCA en el deporte femenino

2. ¿CÓMO? Conoce cómo se ha producido la lesión al detalle para intentar entender las causas

3. ¿POR QUÉ? Estudia las posibles causas de la lesión para saber qué factores de riesgo abordar en la readaptación

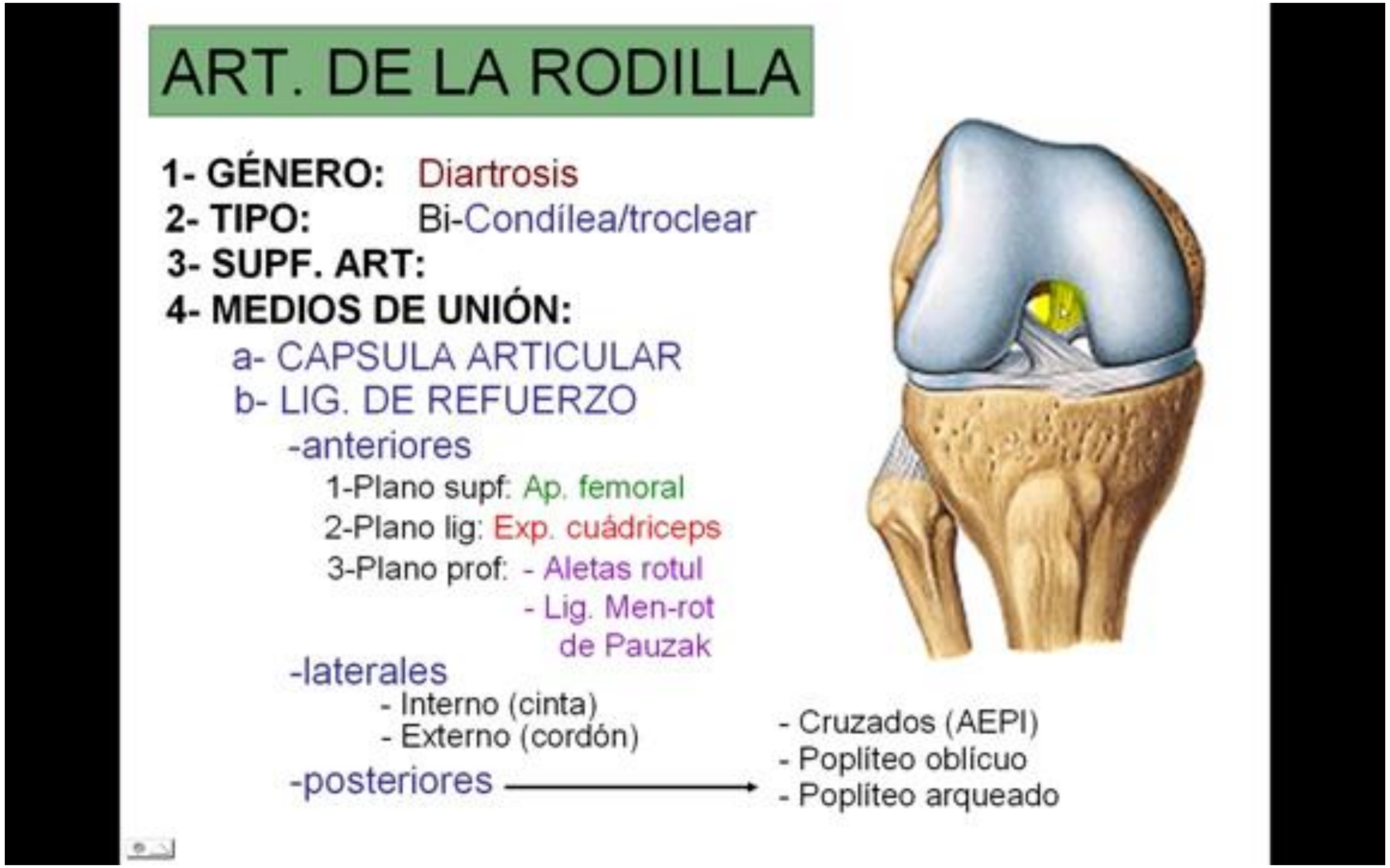
MANOS A LA OBRA: Claves para la prevención de lesiones de rodilla

4. MANOS A LA OBRA: Periodiza la readaptación en fases y establece criterios de progresión en cada fase

5. TRABAJA EN EQUIPO: Mantén contacto con fisio, entrenador/a, psicólogo/a y con el/la deportista

¿QUÉ?
Conoce la anatomía y función de la estructura lesionada

1. ANATOMÍA DE LA RODILLA



https://www.youtube.com/watch?v=jTKaBdpgjpc&t=276s

1. ANATOMÍA DE LA RODILLA

https://www.youtube.com/watch?v=_q-Jxj5sT0g

1. ANATOMÍA DE LA RODILLA

Knee Flexion and Extension

Flexion of the knee occurs primarily by the hamstring muscles—biceps femoris, semitendinosus, and semimembranosus. Gastrocnemius in the lower leg also helps flex the knee, and sartorius, gracilis, and popliteus help flex and rotate the joint.

Extension of the knee occurs primarily by the quadriceps femoris muscles—rectus femoris, vastus lateralis, vastus intermedius, and vastus medialis.

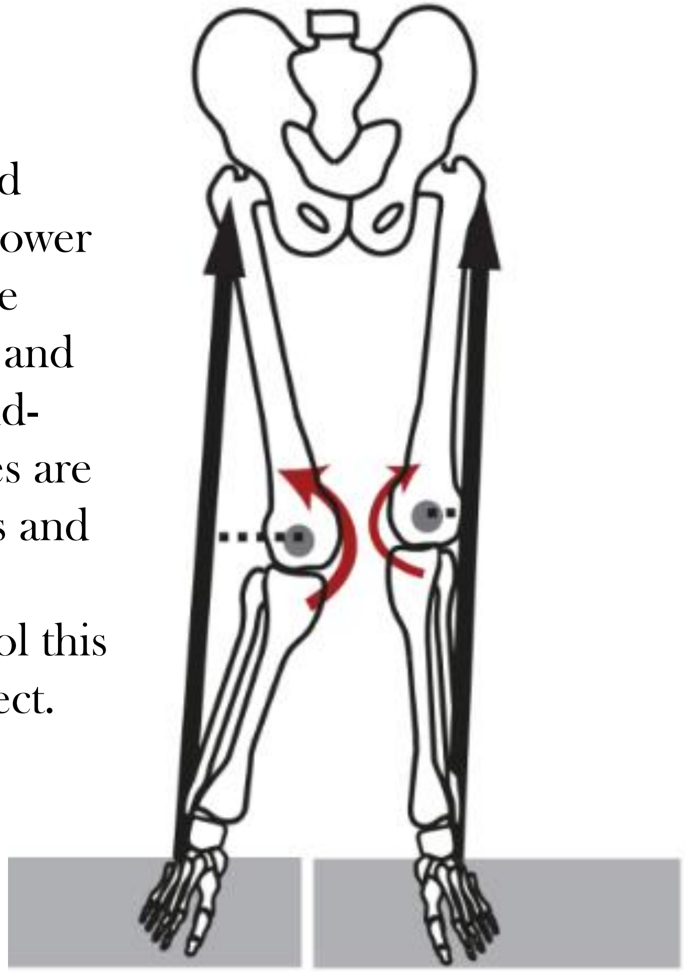
Several ligaments around the knee help stabilize the joint during flexion and extension. When the knee is flexed, the medial and lateral collateral ligaments are relaxed, and the posterior cruciate ligament is taut, preventing hyperflexion of the knee.

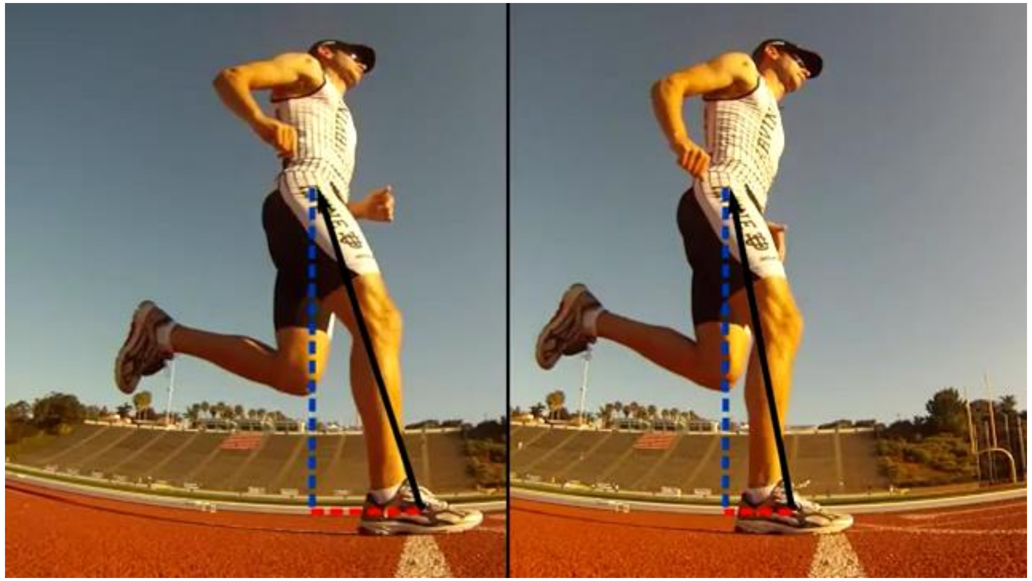
When the knee is extended, the medial and lateral collateral ligaments are taut. The anterior cruciate ligament is also taught, preventing hyperextension of the knee.

https://human.biodigital.com/index.html

2. The knee as a force-absorber and force-generator

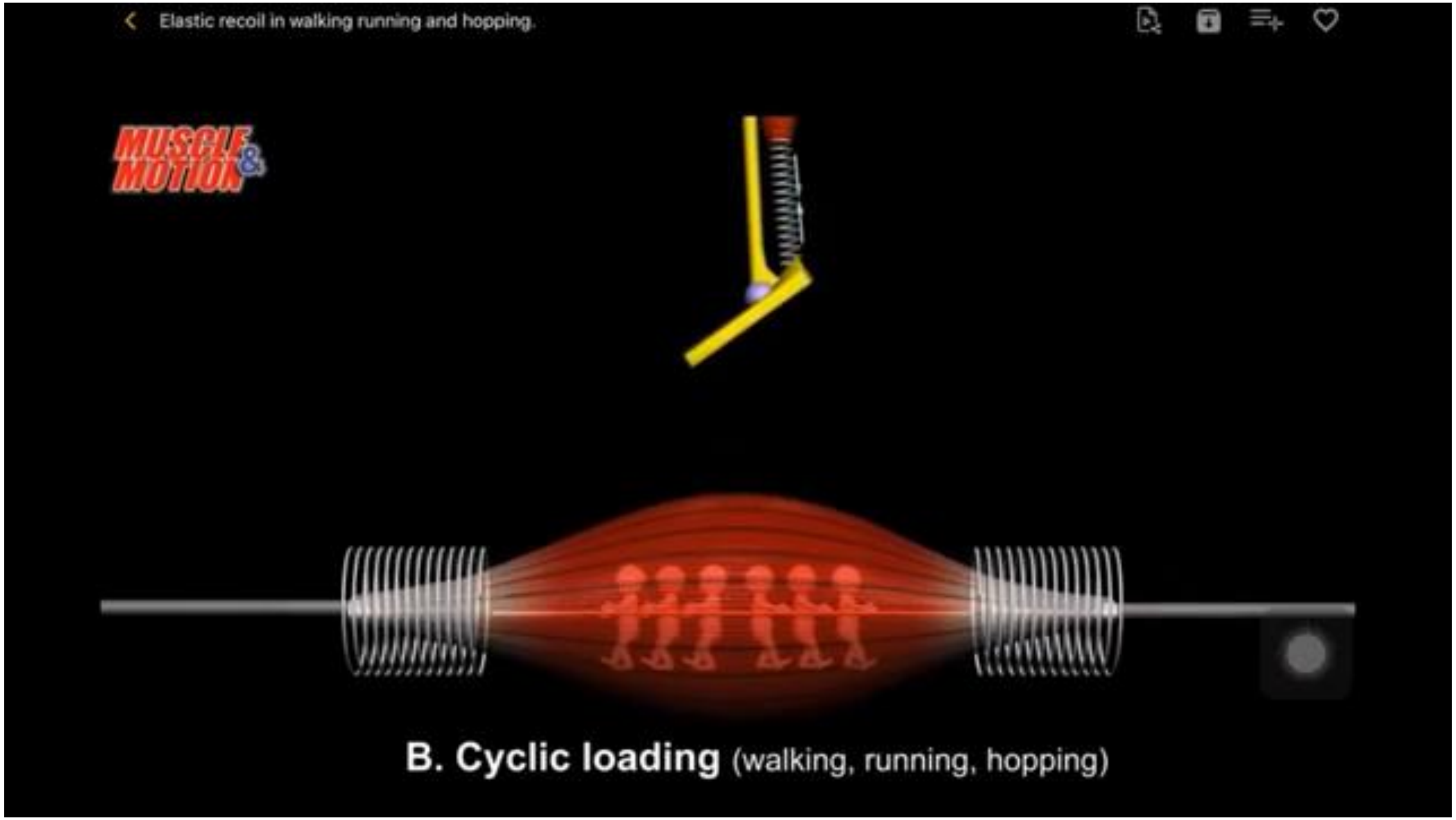
When walking, running and jumping, the joints of the lower limb flex to absorb both the downward force of gravity and the resultant upward ground-reaction force. These forces are worn by the joint structures and the muscle structures that eccentrically work to control this absorbing (dampening) effect.





2. The knee as a force-absorber and force-generator

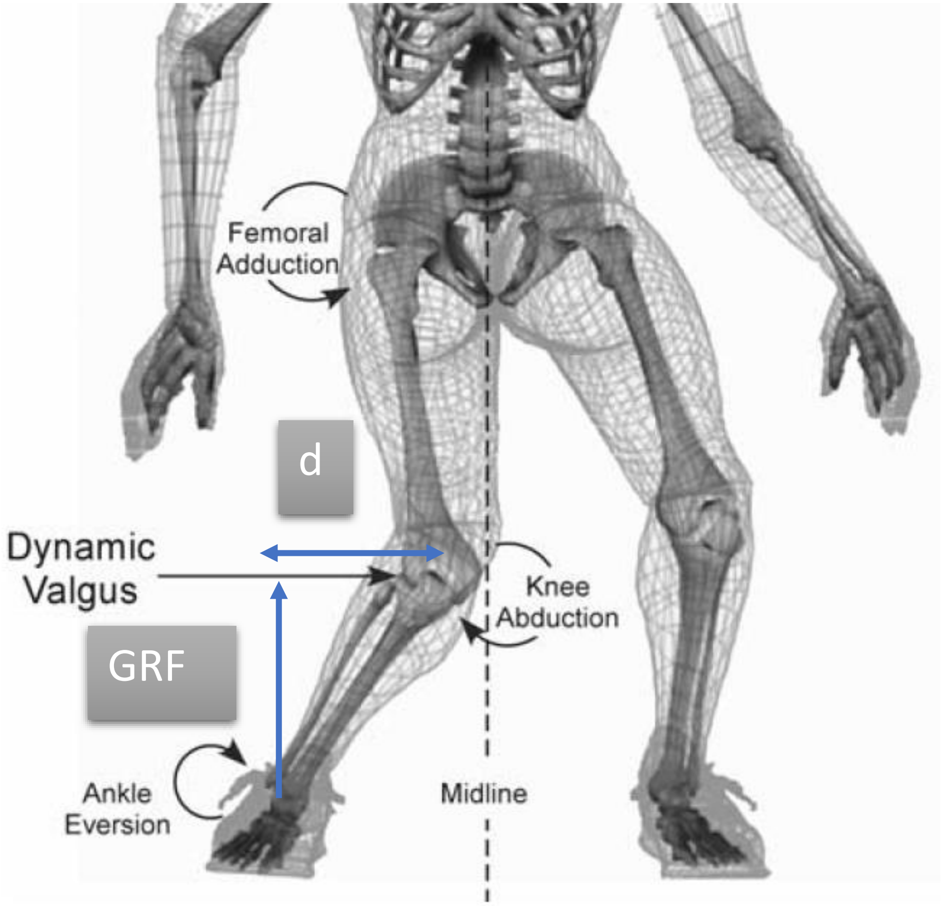
Muscle-tendon-fascial complexes **absorb these forces and use the stored elastic energy to recoil (like a spring)** into the propulsion or acceleration force of locomotion where the joints are extending.



https://www.youtube.com/watch?v=bLCRPStXbsI

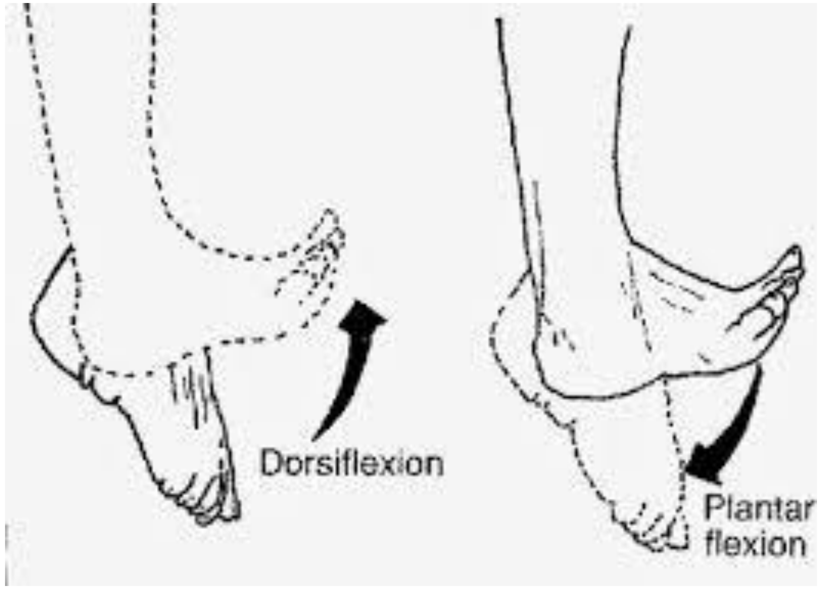
2. The knee as a force-absorber and force-generator

Abnormal or excessive stresses, or the inability to absorb these stresses due to inefficient neuromuscular patterns or muscle weakness at one joint, may have an effect on the lower-extremity kinetic chain.



$$KAM = GRF \ x \ d$$

2. The knee as a force-absorber and force-generator



3. Kinetic chain control and alignment: implications for the knee

Table 24.1 Muscles required to function eccentrically to absorb ground reaction forces

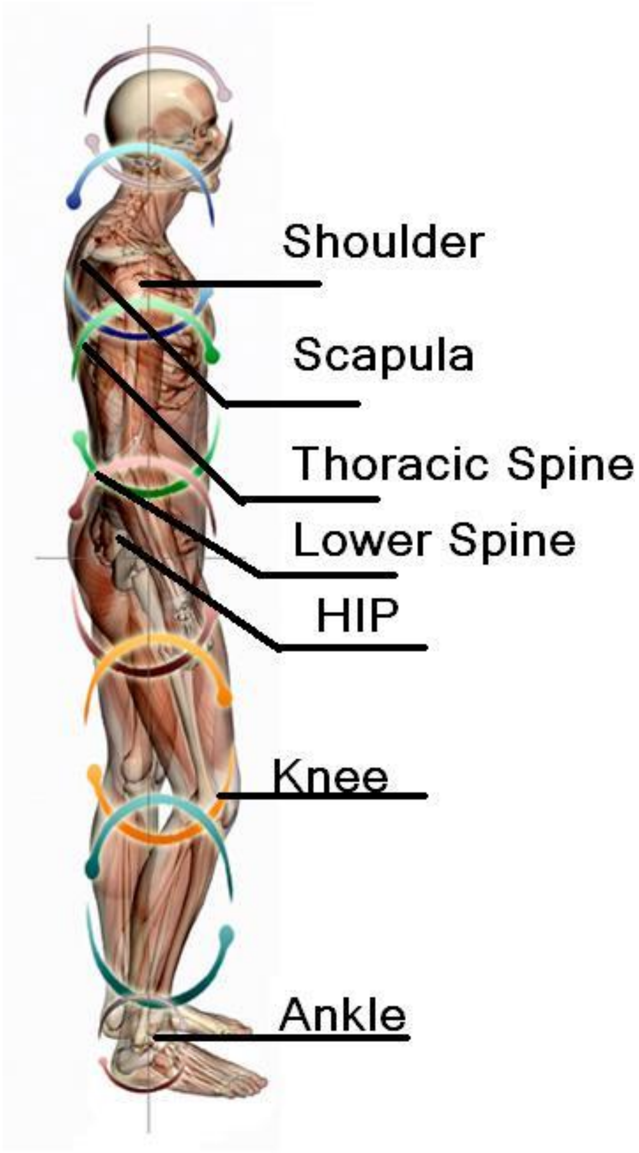
Joint	*Muscles*
Hip	Gluteals and deep hip rotators
Knee	Quadriceps, gluteals, popliteus
Ankle	Soleus, peroneals
Subtalar	Tibialis posterior, long toe flexors

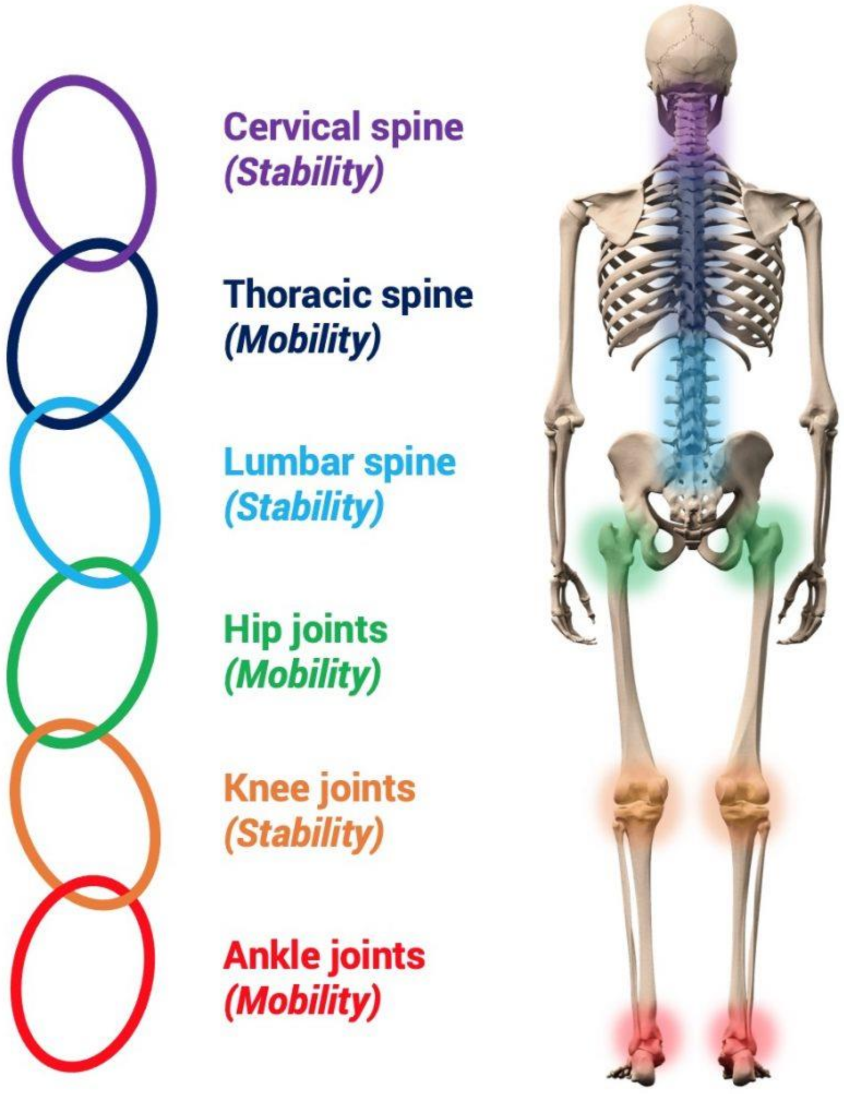
3. Kinetic chain control and alignment: implications for the knee

All lower-limb joints involved in the 'absorption' of downward force are then involved in the 'propulsion' or acceleration phase of locomotion and thus need specific reconditioning to correctly execute the kinetic chain extension movements. We can see, therefore, that **we cannot just think of the knee in isolation**.

3. Kinetic chain control and alignment: implications for the knee

We cannot just think of the knee in isolation.





3. Kinetic chain control and alignment: implications for the knee

The effective and ineffective **kinetic chain and performance**

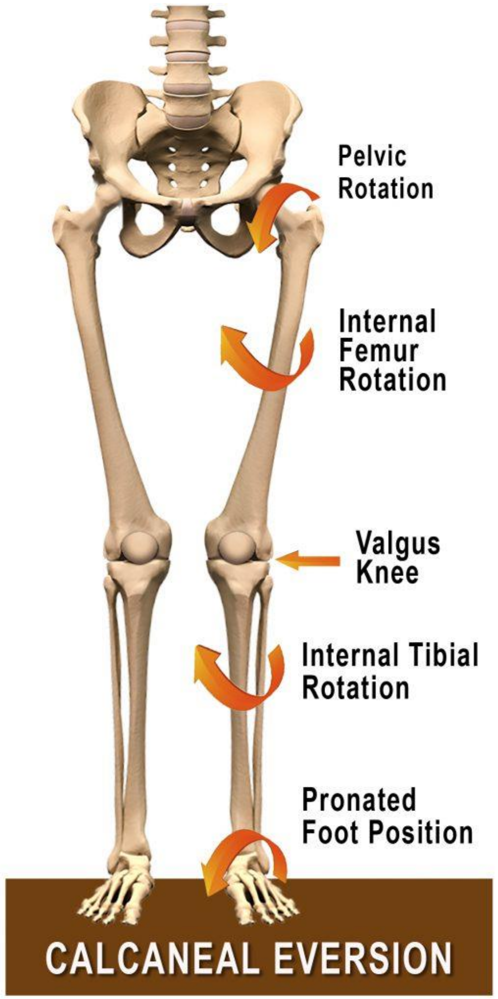
$$Eficiencia = \frac{Energía\ generada}{Energía\ consumida}$$

Energía perdida

When a significant 'energy leak' is present, the movement speed is compromised, and for the athlete to increase their power and speed, other muscles must be recruited to a greater extent in order to make up for the energy leak in the system.

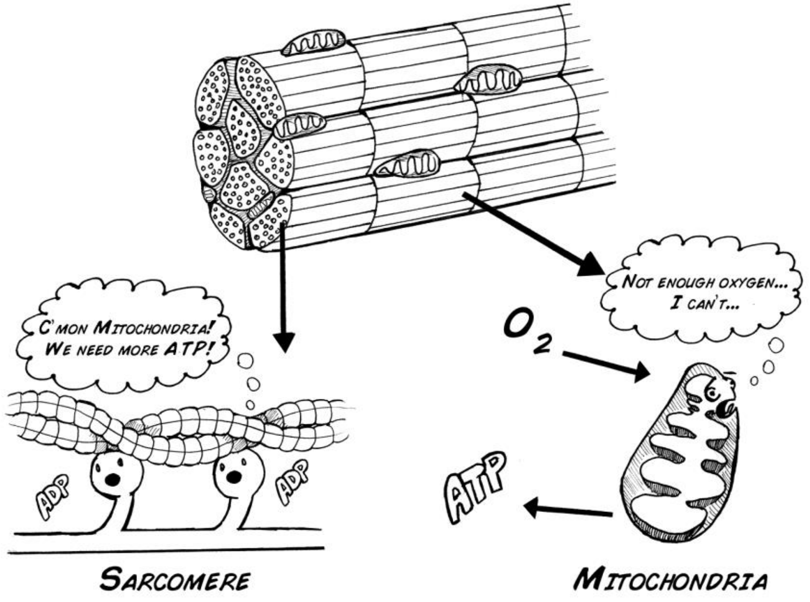
3. Kinetic chain control and alignment: implications for the knee

The effective and ineffective **kinetic chain and injury**



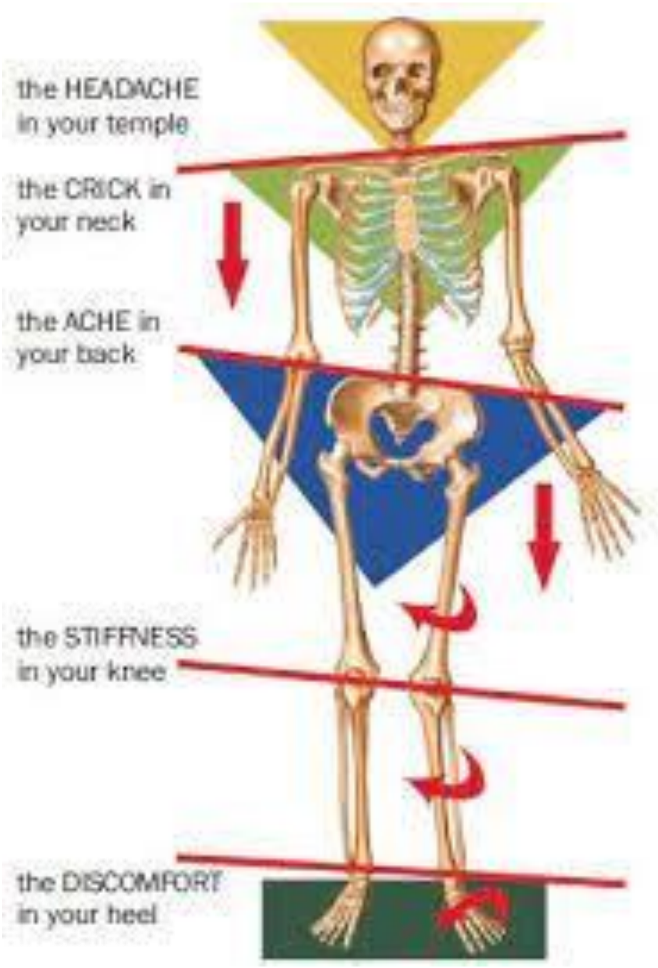
Inefficient movement mechanics lead to injury in the following ways:

- Accelerated muscle fatigue
- Excess stress on links (joints) in the chain



3. Kinetic chain control and alignment: implications for the knee

The effective and ineffective **kinetic chain and injury**

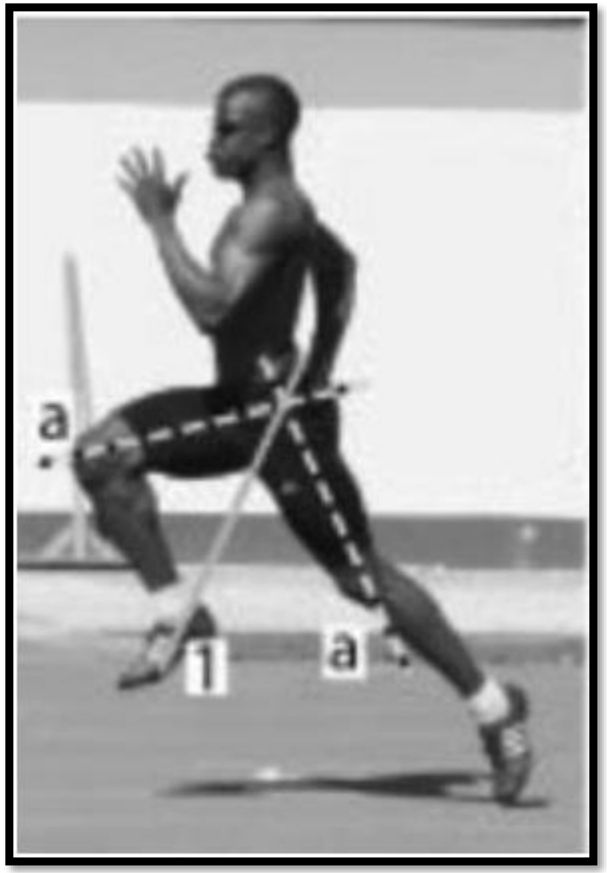


Inefficient movement mechanics

Excess stress on links (joints) in the chain

Accelerated muscle fatigue

4. Assessing the kinetic chain: biomechanical analysis



Cuanto más adelante apunte la línea bisectriz, mejor será la técnica de carrera

Toe-off is also the point at which the quality of the motion can be measured within a model that is based on posture – the 'positive running' posture. Positive running can be measured by drawing a line through each of the athlete's thighs in a side-on video still at toe-off. The angle between the two lines is then bisected. **The further forward the bisecting line points, the better the running technique**

4. Assessing the kinetic chain: biomechanical analysis

El muslo debería estar relativamente en la vertical en la fase de “toe-off”

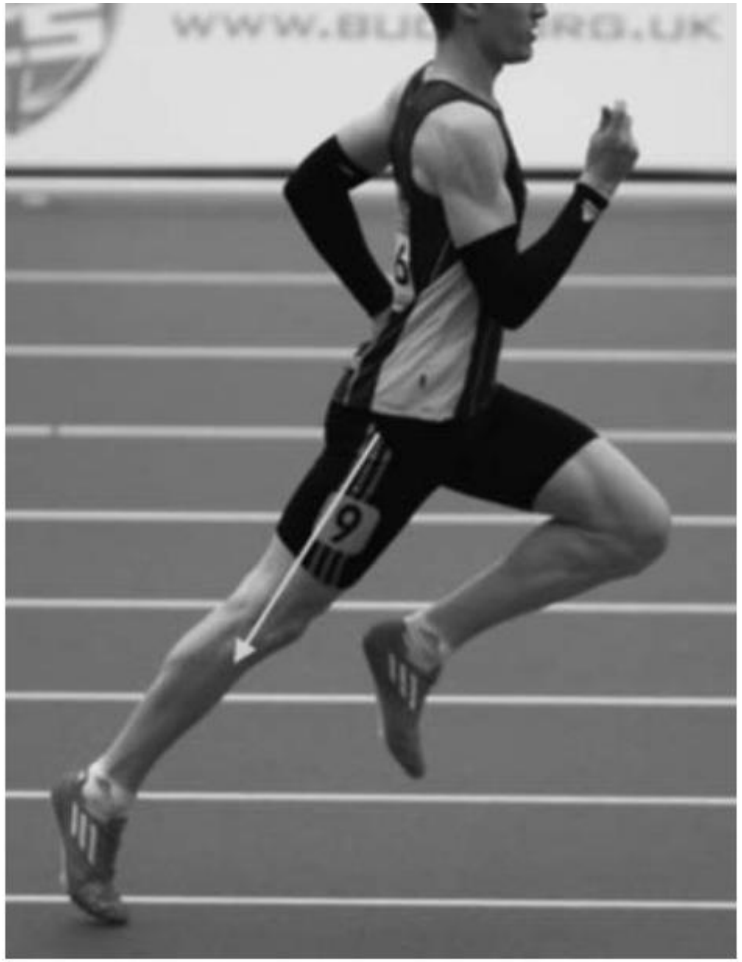


Figure 9.6 Excessive thigh extension at toe-off (combination of hip extension and anterior pelvic tilt)

4. Assessing the kinetic chain: biomechanical analysis

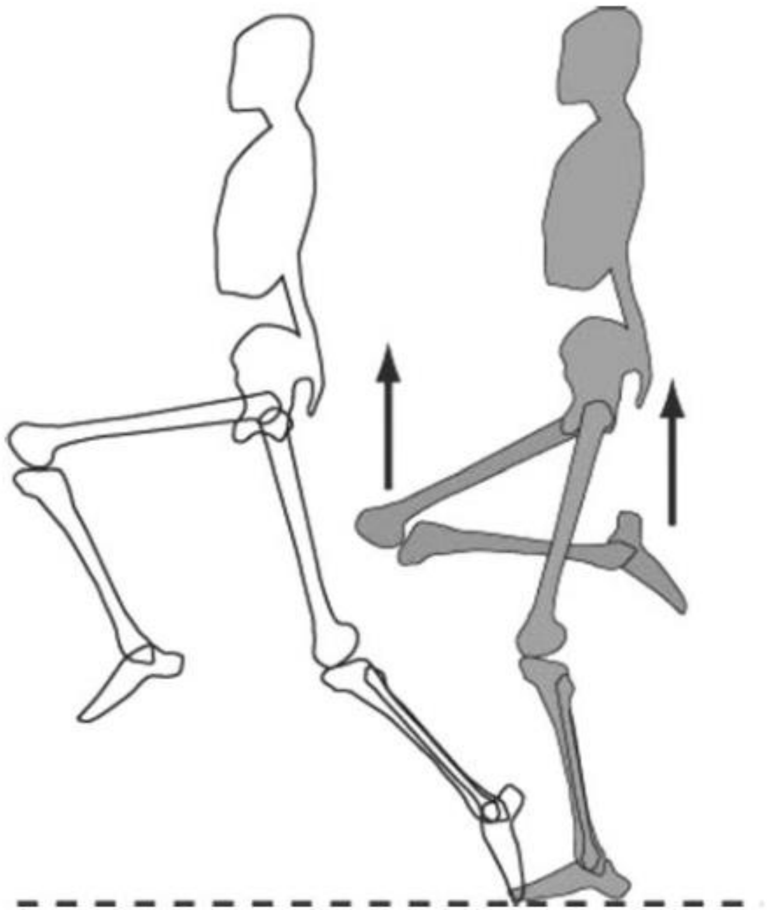


Figure 9.9 In positive running the knee of the swing leg at mid-stance must have clearly moved past the knee of the stance leg

4. Assessing the kinetic chain: biomechanical analysis

OVER-STRIDING

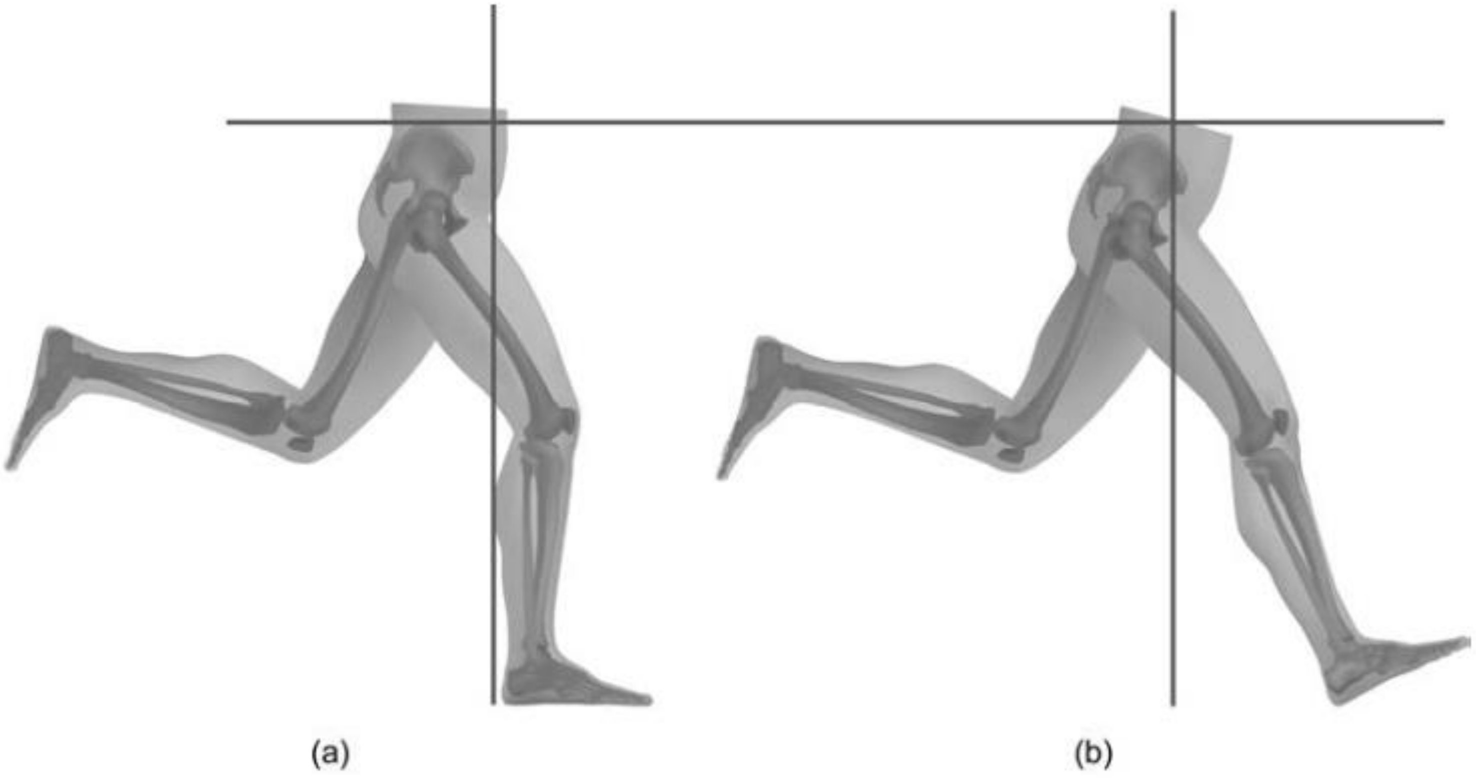
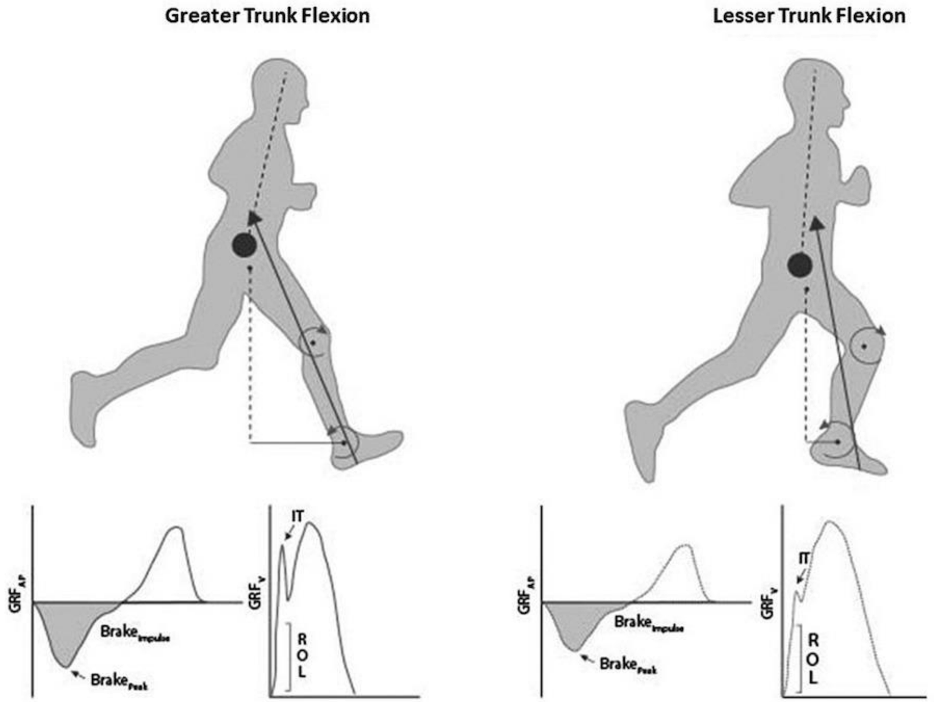


Figure 25.1 (a): A level pelvis, with vertical tibia at initial contact and mid-foot landing reduces load on the anterior compartment and is the optimal position for those with anterior shin pain (b): The usual position at foot strike in those with ABOS

- ✓ Tibia vertical en el contacto inicial
- ✓ Aterrizaje con el mediopié

4. Assessing the kinetic chain: biomechanical analysis



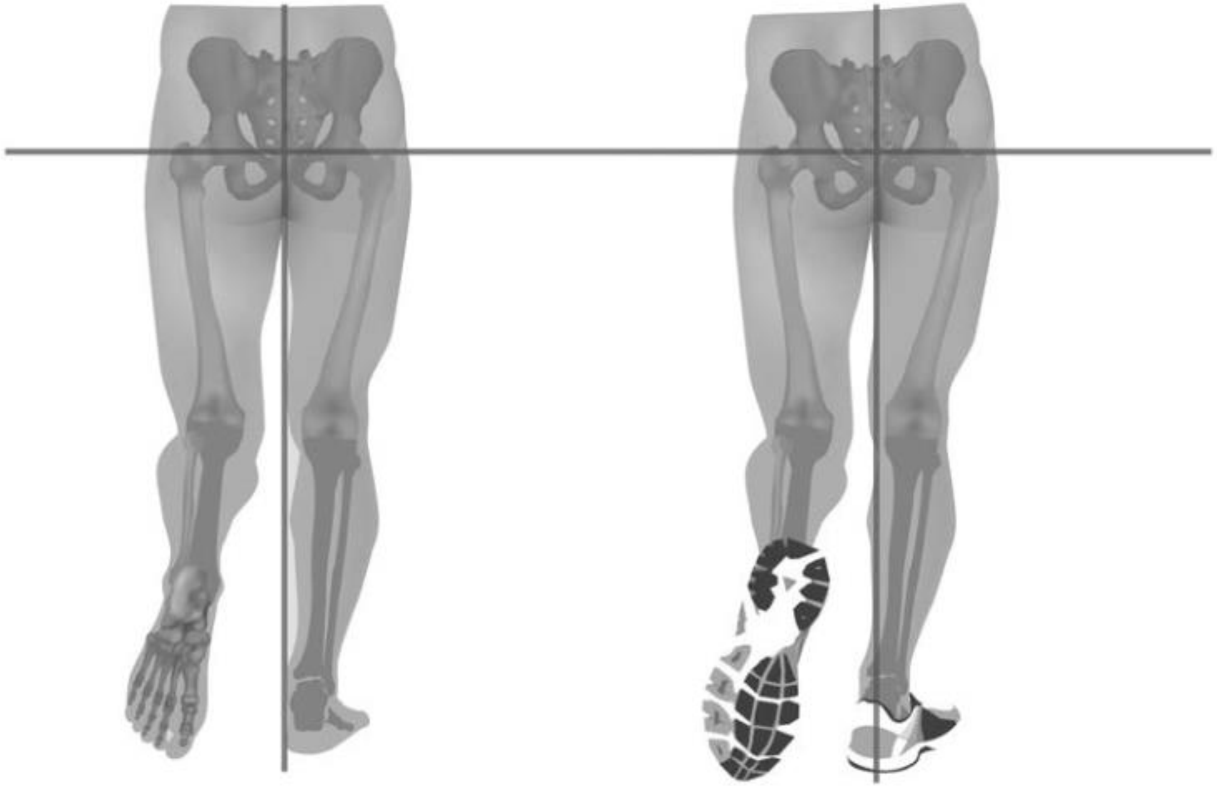
TRUNK – centre of mass

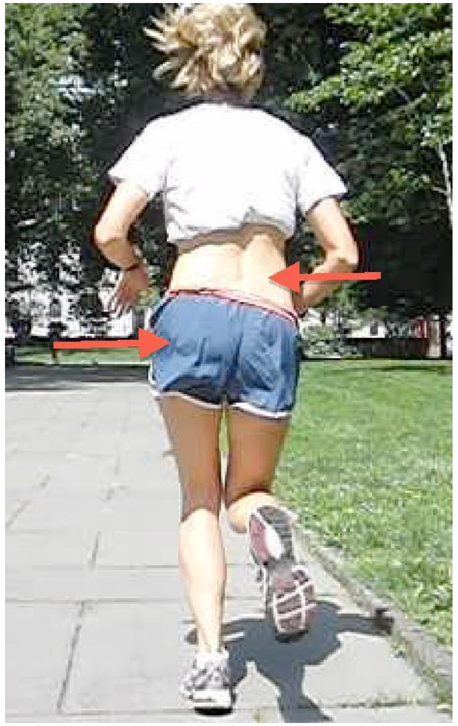
A near vertical torso is the most effective position to allow proximal muscle control of the running gait and prevent the overload of the shank muscles.

Running with a forward trunk lean can lead to the ankle being too greatly dorsiflexed in midstance, increasing the demand on the plantar flexors to propel the athlete forward in an attempt to chase their centre of mass (COM).

4. Assessing the kinetic chain: biomechanical analysis

PELVIC DROP

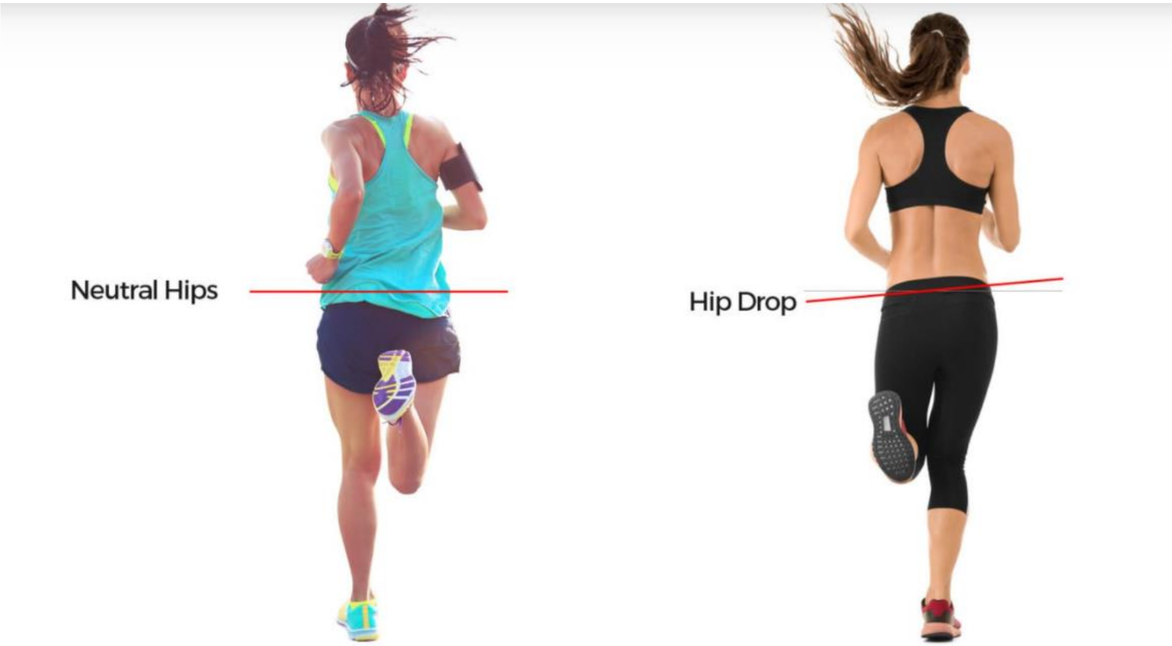


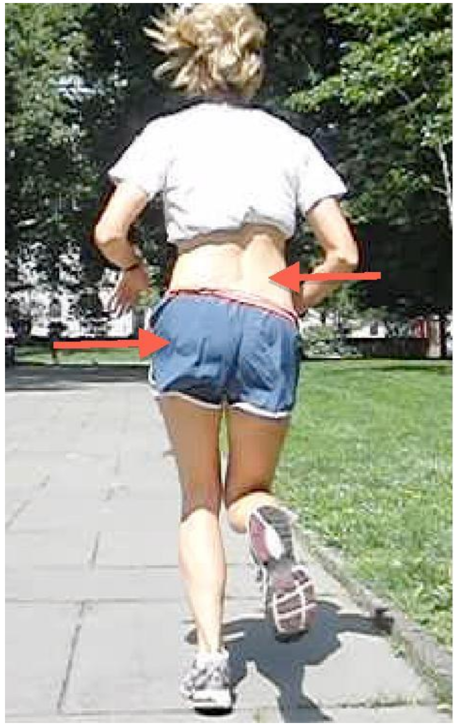


A rule for proper timing of the movement of the free side of the pelvis is that the free (swing leg) side must be higher than the stance leg side when the heel has clearly left the ground.

4. Assessing the kinetic chain: biomechanical analysis

PELVIC DROP



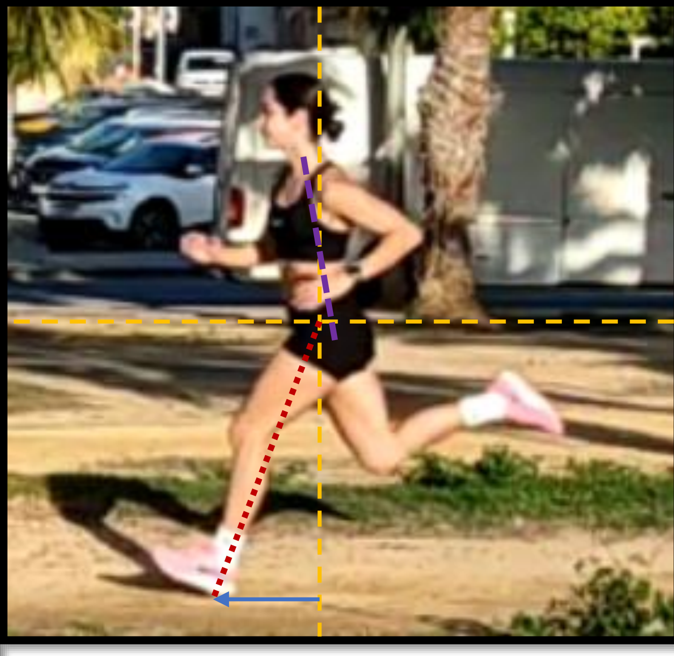


A rule for proper timing of the movement of the free side of the pelvis is that the free (swing leg) side must be higher than the stance leg side when the heel has clearly left the ground.

¿Presenta caída pélvica en momento de “Heel-off”?

¿Debe mejorar posición de “Toe-off”?

¿Rodilla libre sobrepasa claramente a la rodilla de apoyo?

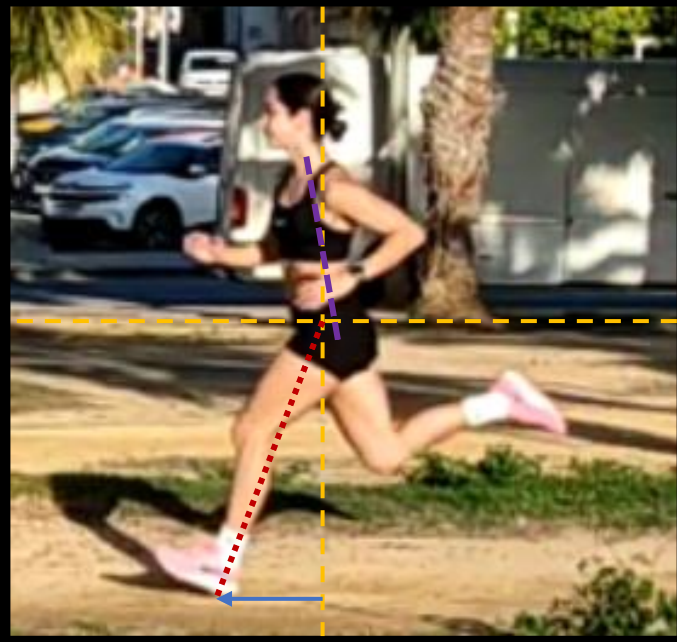


- Tibia vertical?
- Aterrizaje de talón?
- Tronco vertical?
- COM-BOS?

¿Presenta caída pélvica en momento de “Heel-off”? → SÍ

¿Debe mejorar posición de “Toe-off”? → SÍ

¿Rodilla libre sobrepasa claramente a la rodilla de apoyo? → NO



- Tibia vertical= no
- Aterrizaje de talón
- Tronco vertical= no
- CI lejos del COM

¿Presenta caída pélvica en momento de "Heel-off"?

¿Debe mejorar posición de "Toe-off"?

¿Rodilla libre sobrepasa claramente a la rodilla de apoyo?

- Tibia vertical?
- Aterrizaje de talón?
- Tronco vertical?
- COM-BOS?

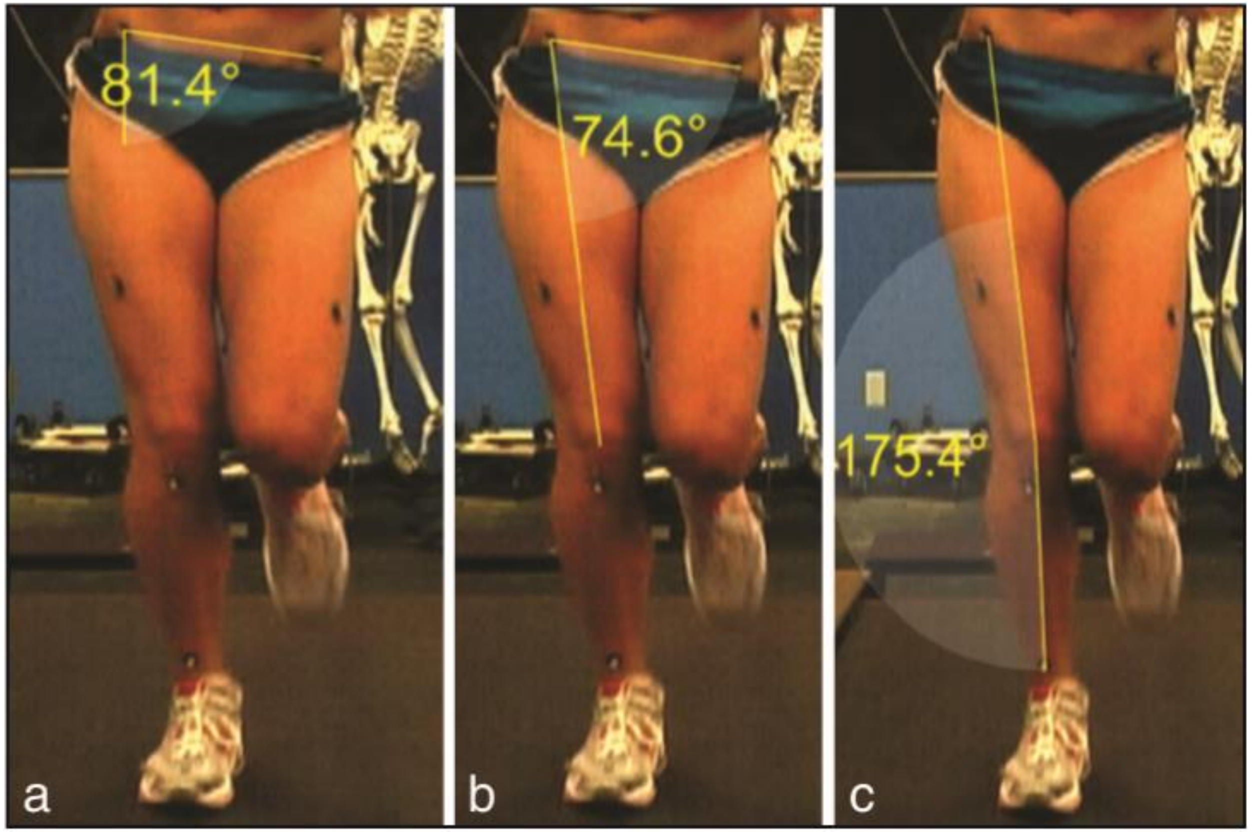
¿Presenta caída pélvica en momento de “Heel-off”? → NO ✓

¿Debe mejorar posición de “Toe-off”? → Es buena, pero puede mejorarla

¿Rodilla libre sobrepasa claramente a la rodilla de apoyo? → NO

- Tibia vertical= Sí ✓
- Aterrizaje con mediopié ✓
- Tronco vertical= no ✗
- CI cerca del COM ✓

4. Assessing the kinetic chain: biomechanical analysis

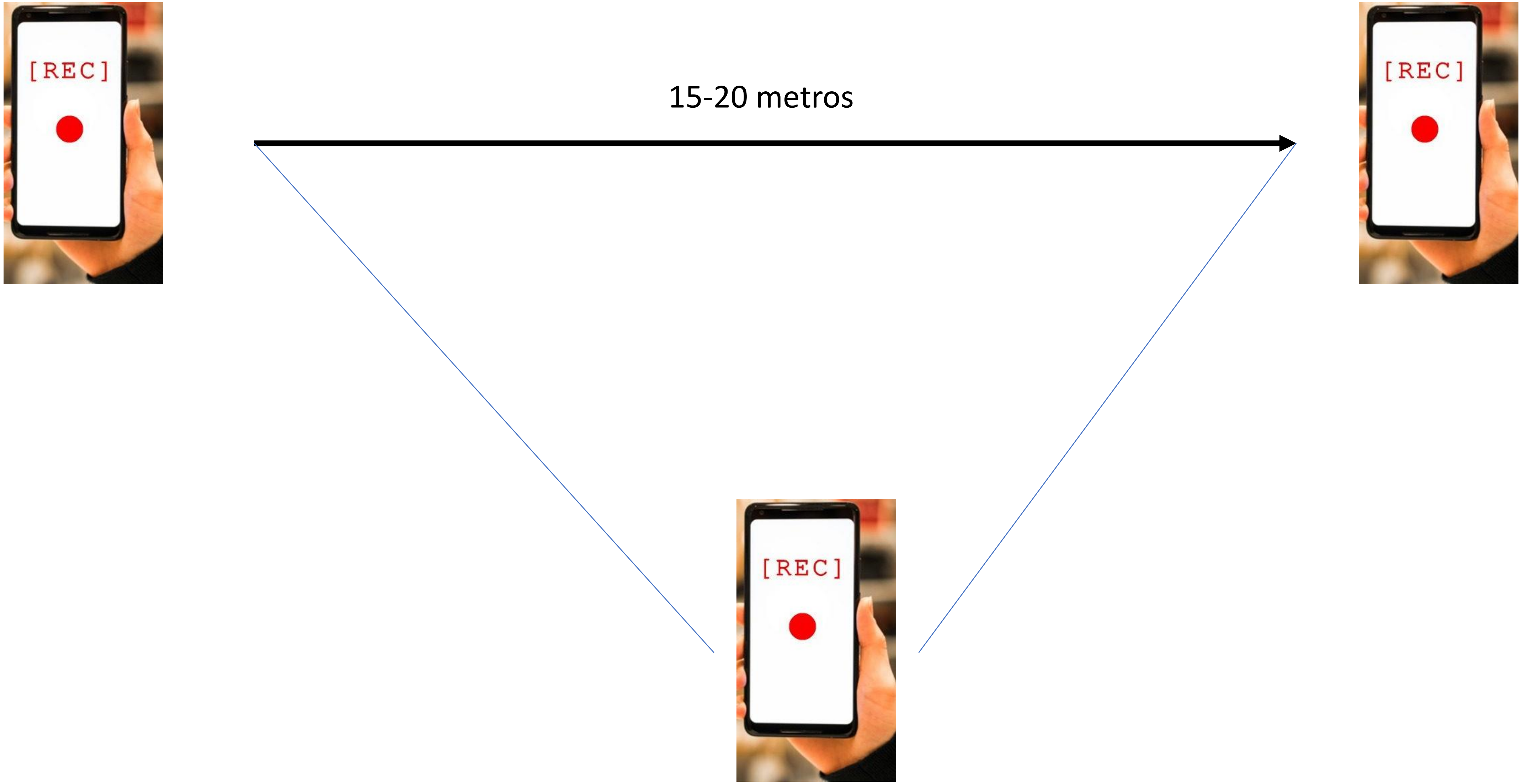


El **ángulo de caída pélvica** fue el formado por una línea desde la espina ilíaca anterosuperior (ASIS) de la pierna de apoyo hasta la ASIS de la pierna en fase de balanceo, y una segunda línea perpendicular a las ASIS de la pierna de apoyo. Esta medida se restaba a un ángulo de 90º para obtener el valor de caída pélvica (Maykut et al., 2015).

El **ángulo de adducción de cadera** fue el formado entre la línea que unía las ASIS y una línea desde la ASIS de la pierna de apoyo hasta el punto medio de la articulación tibiofemoral. El **ángulo de abducción de rodilla** estuvo conformado por una línea desde la ASIS de la pierna de apoyo hasta el centro de la rodilla y otra línea desde el centro de la rodilla hasta el punto medio entre los maléolos medial y lateral del tobillo (Maykut et al., 2015).

Figura. Videoanálisis 2D del ángulo de caída de la pelvis contralateral (a), el ángulo de adducción de cadera (b) y el ángulo de abducción de rodilla (c) durante la fase de apoyo en la carrera. Tomado de Maykut et al. (2015).

Grabación de la mecánica de carrera

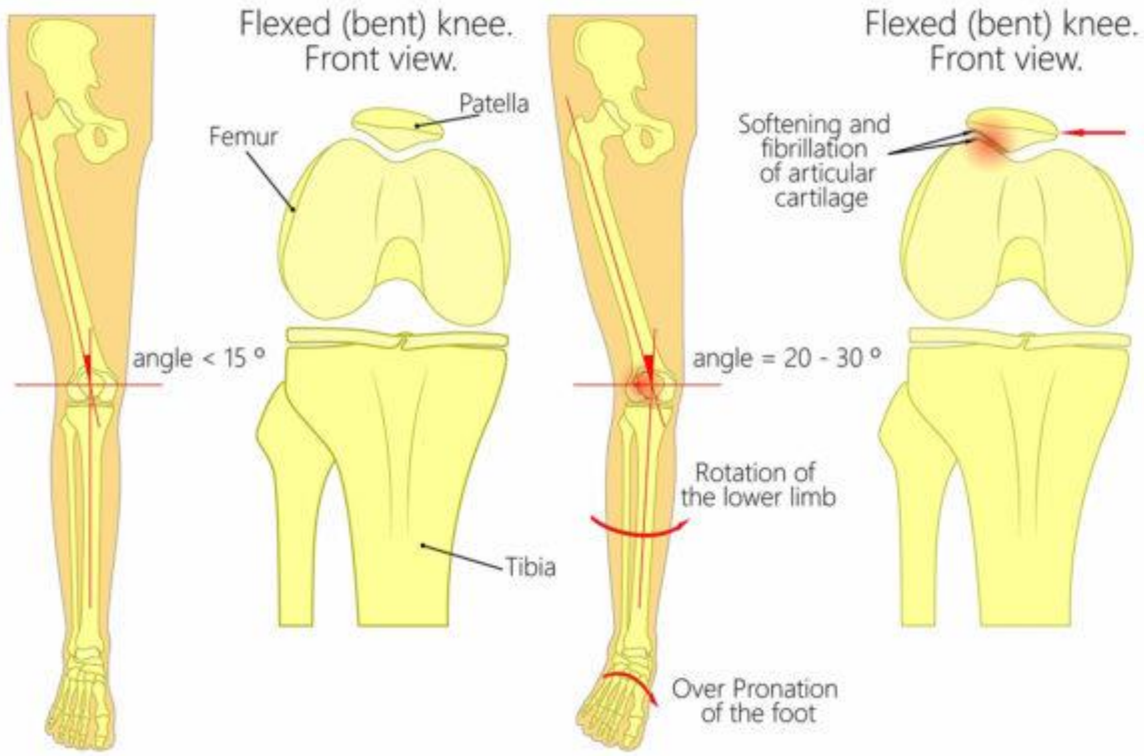


LESIONES DE RODILLA MÁS COMUNES: Lesión del LCA en el deporte femenino

3. Kinetic chain control and alignment: implications for the knee

Knee injuries in sports

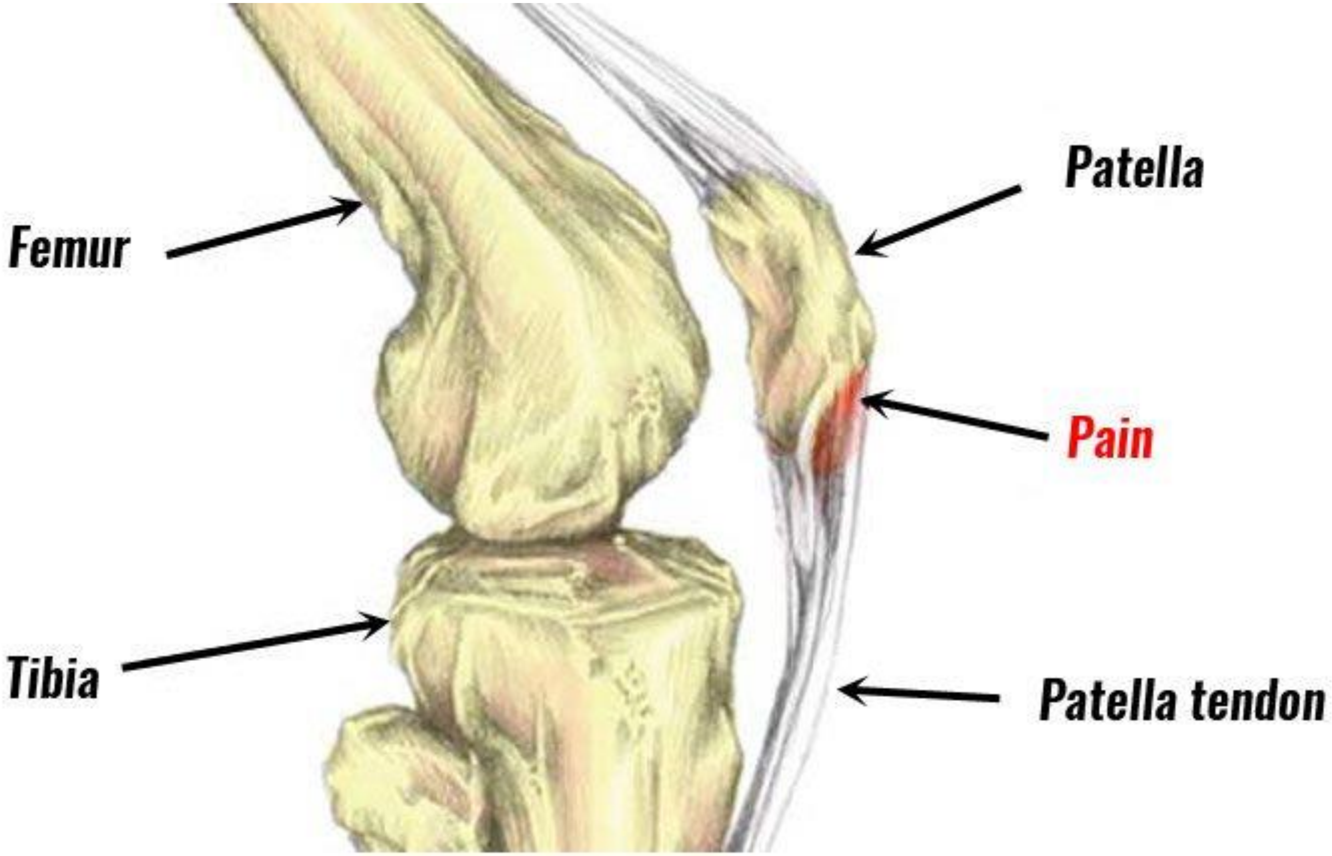
Excessive rear foot eversion and hip adduction has been shown to be a risk factor in people with **patellofemoral joint pain**



3. Kinetic chain control and alignment: implications for the knee

Knee injuries in sports

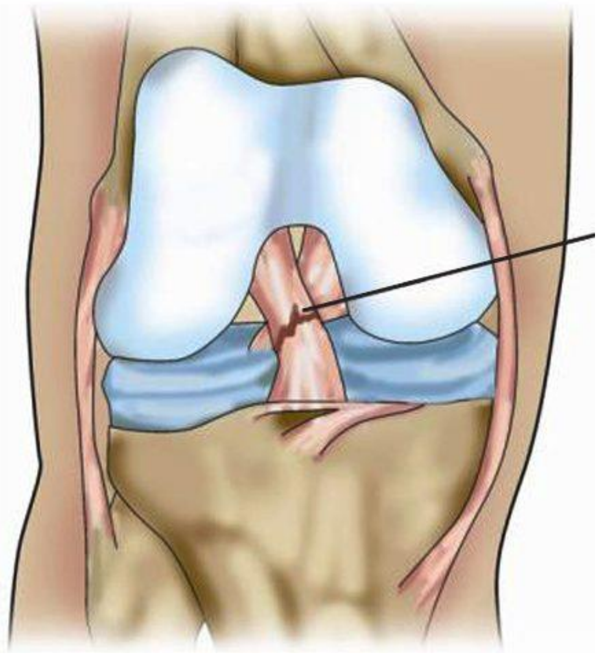
Stiff landing strategies and altered hip sequencing upon landing have been shown to be more present in athletes with **patella tendinopathy**.



3. Kinetic chain control and alignment: implications for the knee

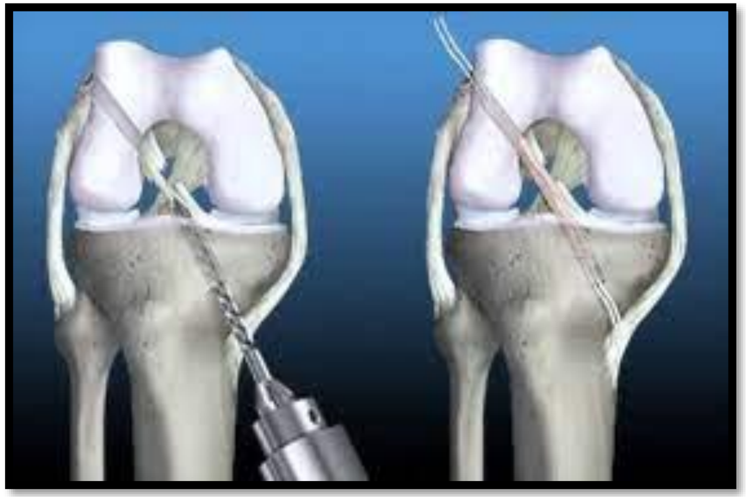
Knee injuries in sports

Knee ligament injuries: Lateral collateral ligament (LCL); Medial colateral ligament (MCL); Anterior cruciate ligament (ACL); Posterior cruciate ligament (PCL)



3. Kinetic chain control and alignment: implications for the knee

sports medicine. In general, ACL ruptures account for over 50% of all knee injuries and most commonly require surgical treatment, resulting in high healthcare costs and great impact on the individual both physically and mentally (1). The



Joseph AM, Collins CL, Henke NM, et al. A Multisport Epidemiologic Comparison of Anterior Cruciate Ligament Injuries in High School Athletics. J Athl Train 2013;48:810-7.

3. Kinetic chain control and alignment: implications for the knee

Knee ligament injuries in sports: the **female athlete**

INCIDENCIA LESIÓN LCA EN EL DEPORTE

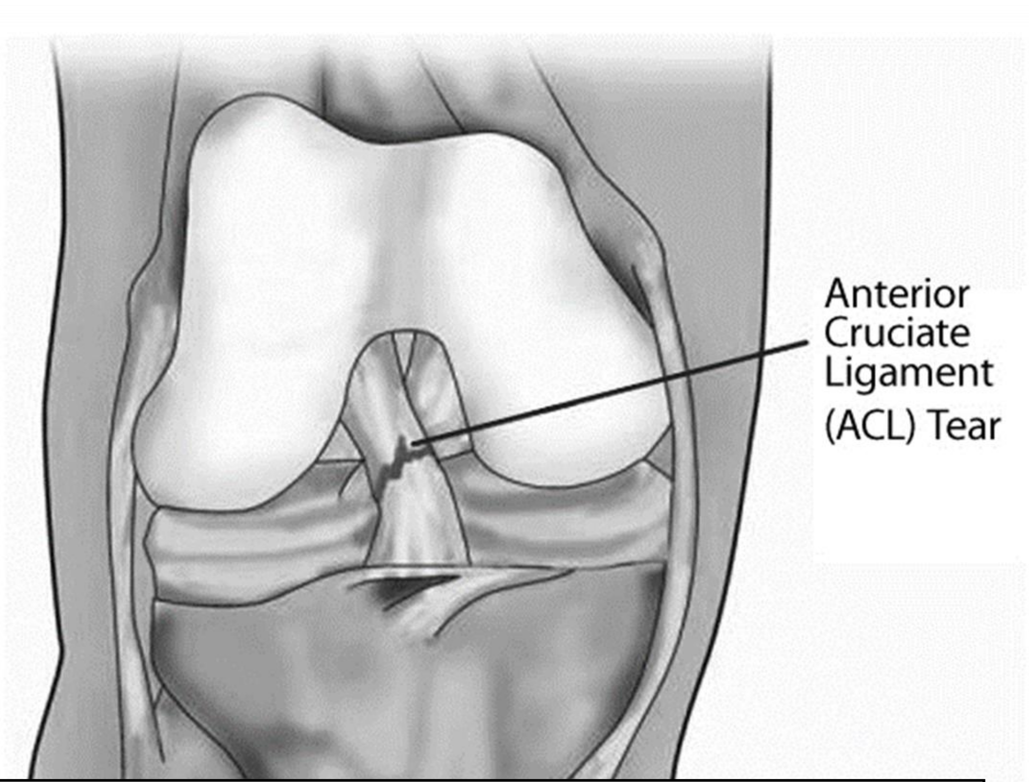
♀♂

Incidence Rate (IR)

Masculino	Femenino
0.9 ACL per 10000 AEs	1.5 ACL per 10000 AEs

Incidence Proportion (IP)

Masculino	Femenino
2.0%	3.5%



IR among all athletes was **1.5/10000** Athlete exposures (AEs); **IP** for all football athletes was **2.8%**

(Montalvo et al., 2019)

INCIDENCIA LESIÓN LCA EN EL DEPORTE

ACL injury compared to males (5). Within each sport, the injury rate per 1,000 athlete-exposures (AEs) in females compared to males was higher in all cases (0.22 versus 0.08 in basketball, 0.23 versus 0.13 in lacrosse, and 0.10 versus 0.04 in soccer). These general patterns in rate differences

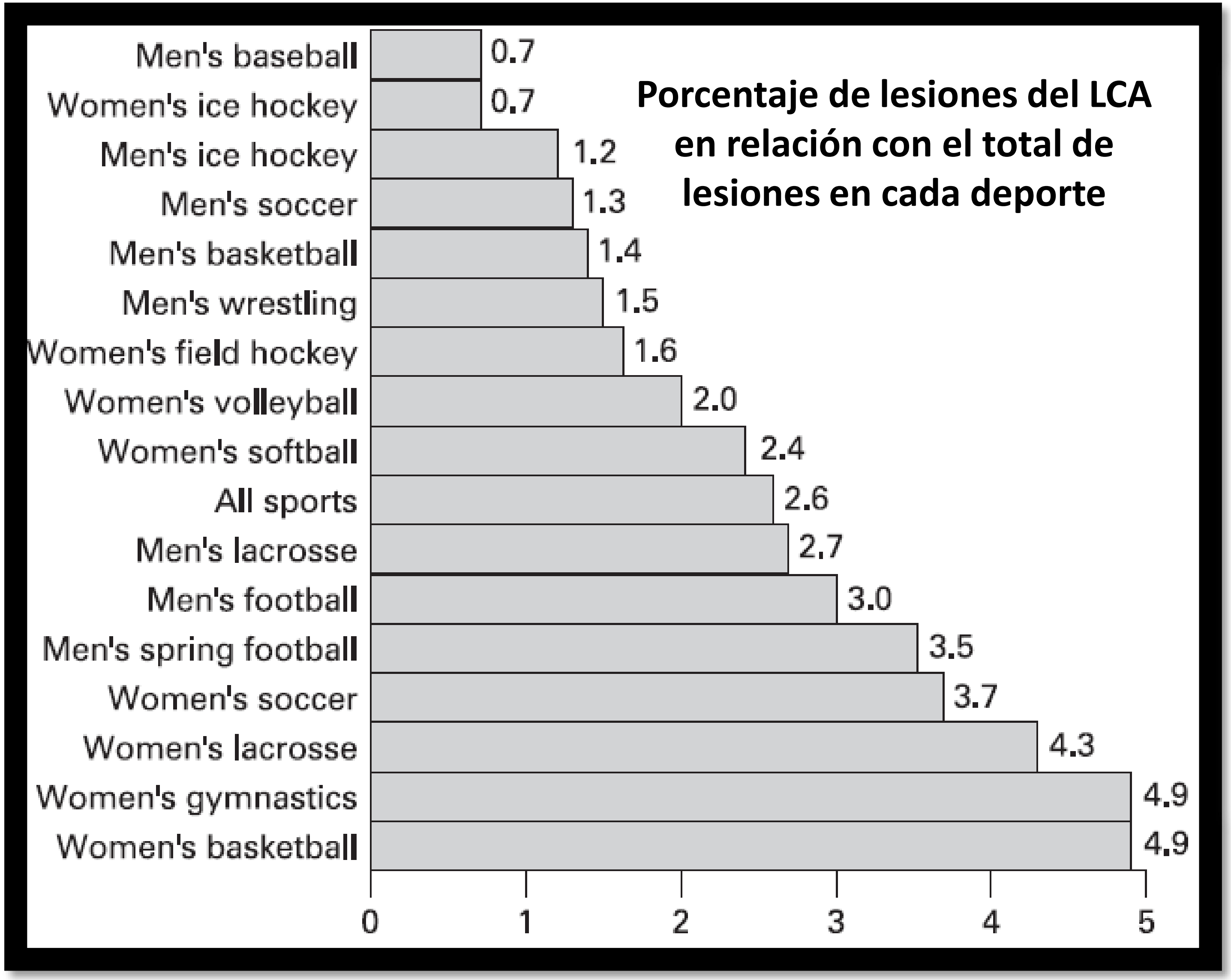
Agel J, Rockwood T, Klossner D. Collegiate ACL Injury Rates Across 15 Sports: National Collegiate Athletic Association Injury Surveillance System Data Update (2004-2005 Through 2012-2013). Clin J Sport Med 2016;26:518-23.

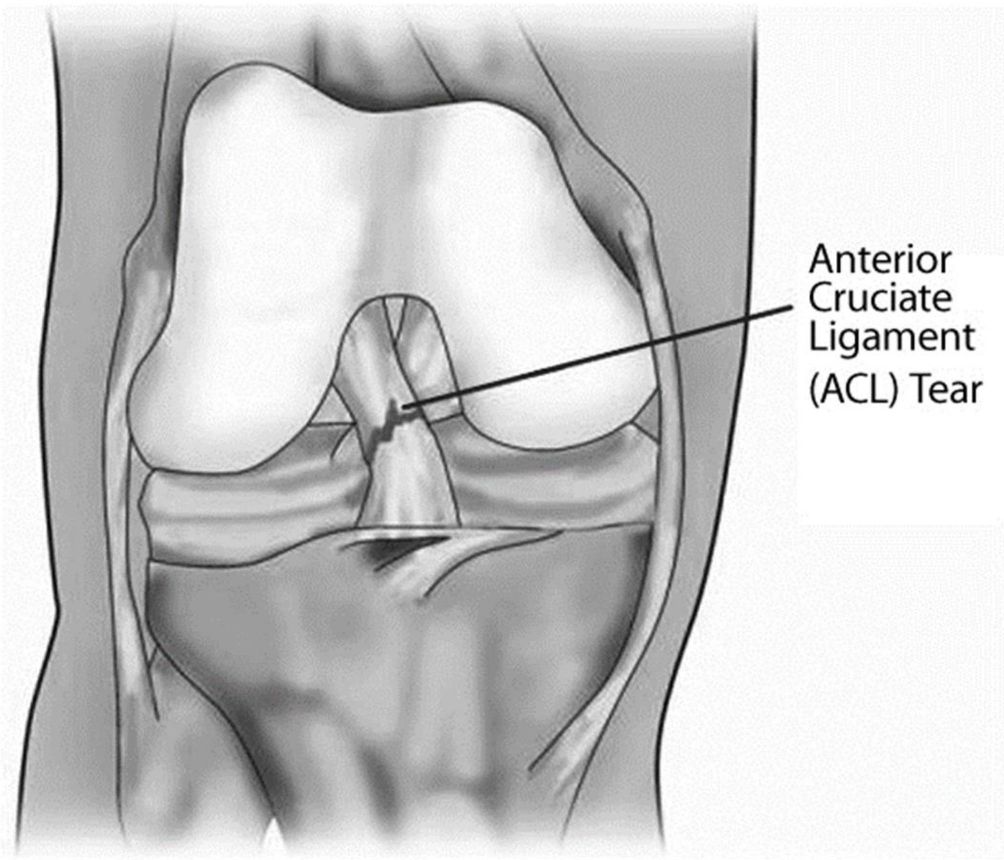
INCIDENCIA LESIÓN LCA EN EL DEPORTE

counterparts, female athletes consistently suffer ACL injuries at a significantly higher rate, with some reports of incidence rates as high as 8 times greater, and have a greater risk of further ACL injury post-reconstruction (1-4). Noncontact

1. Joseph AM, Collins CL, Henke NM, et al. A Multisport Epidemiologic Comparison of Anterior Cruciate Ligament Injuries in High School Athletics. J Athl Train 2013;48:810-7.
2. Fältström A, Kvist J, Gauffin H, et al. Female Soccer Players with Anterior Cruciate Ligament Reconstruction Have a Higher Risk of New Knee Injuries and Quit Soccer to a Higher Degree Than Knee-Healthy Controls. Am J Sports Med 2019;47:31-40.
3. Lin CY, Casey E, Herman DC, et al. Sex Differences in Common Sports Injuries. PM R 2018;10:1073-82.
4. Sandon A, Engström B, Forssblad M. High Risk of Further Anterior Cruciate Ligament Injury in a 10-Year Follow-up Study of Anterior Cruciate Ligament-Reconstructed Soccer Players in the Swedish National Knee Ligament Registry. Arthroscopy 2020;36:189-95.

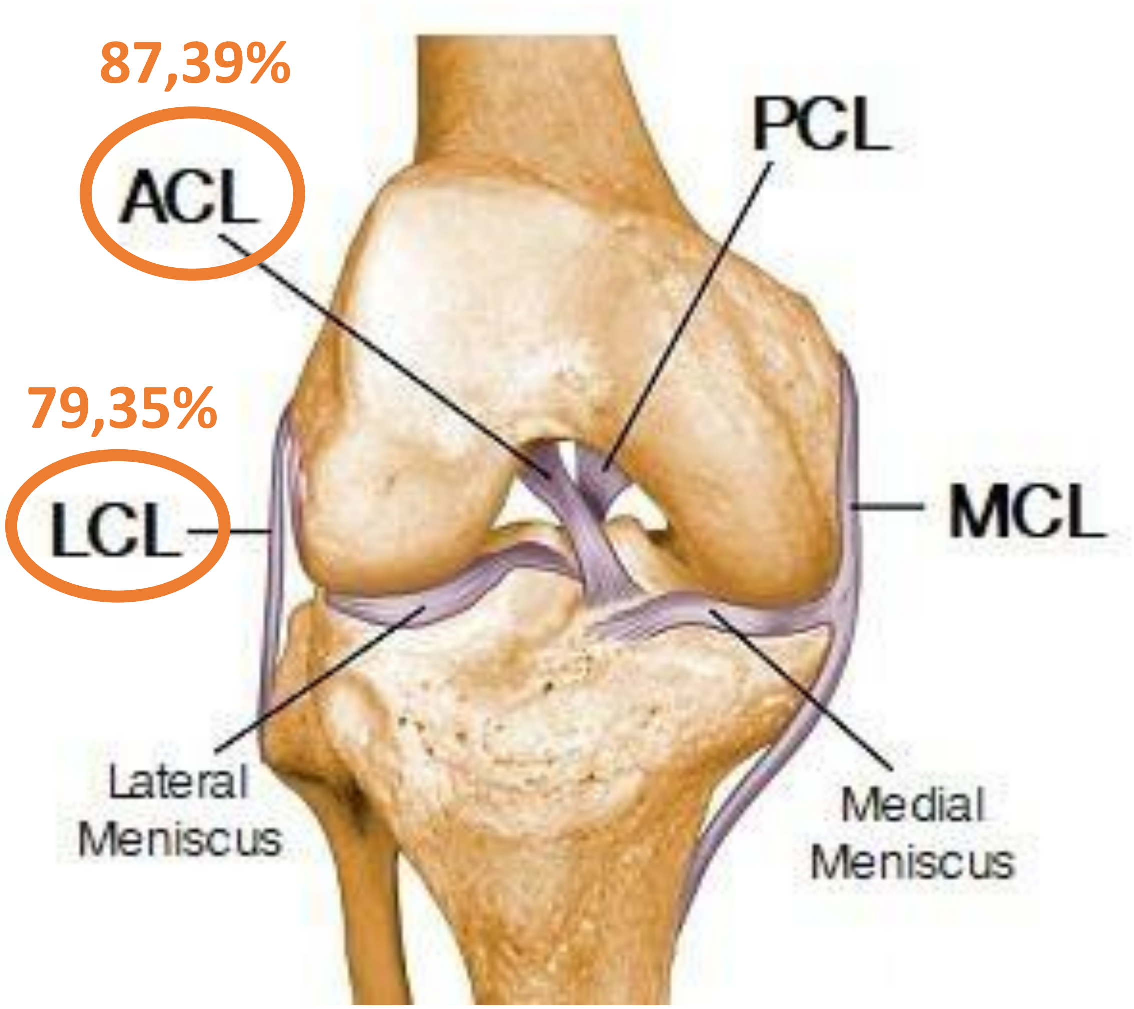
INCIDENCIA LESIÓN LCA SEGÚN DEPORTE





LESIONES LIGAMENTOSAS DE RODILLA EN FÚTBOL FEMENINO

Del total de lesiones reportadas durante la temporada 2010-2011, 222 (**10.5%**) fueron clasificadas como lesiones ligamentosa de rodilla.



(Del Coso et al., 2018)

LESIONES LIGAMENTOSAS DE RODILLA EN FÚTBOL FEMENINO

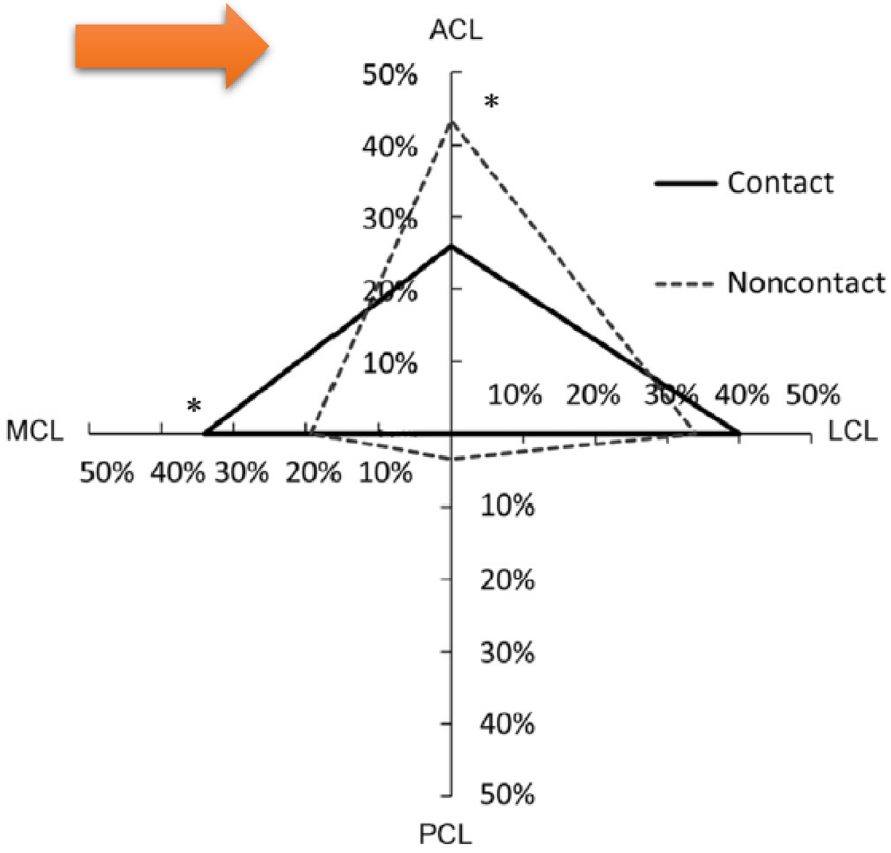
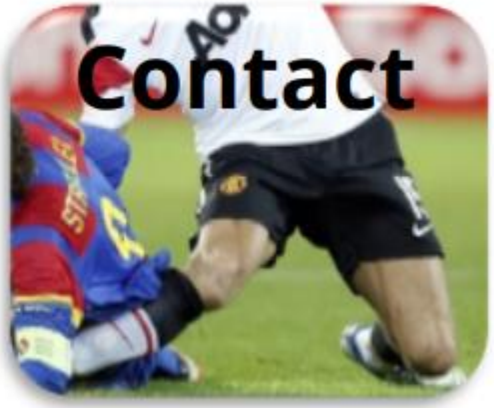
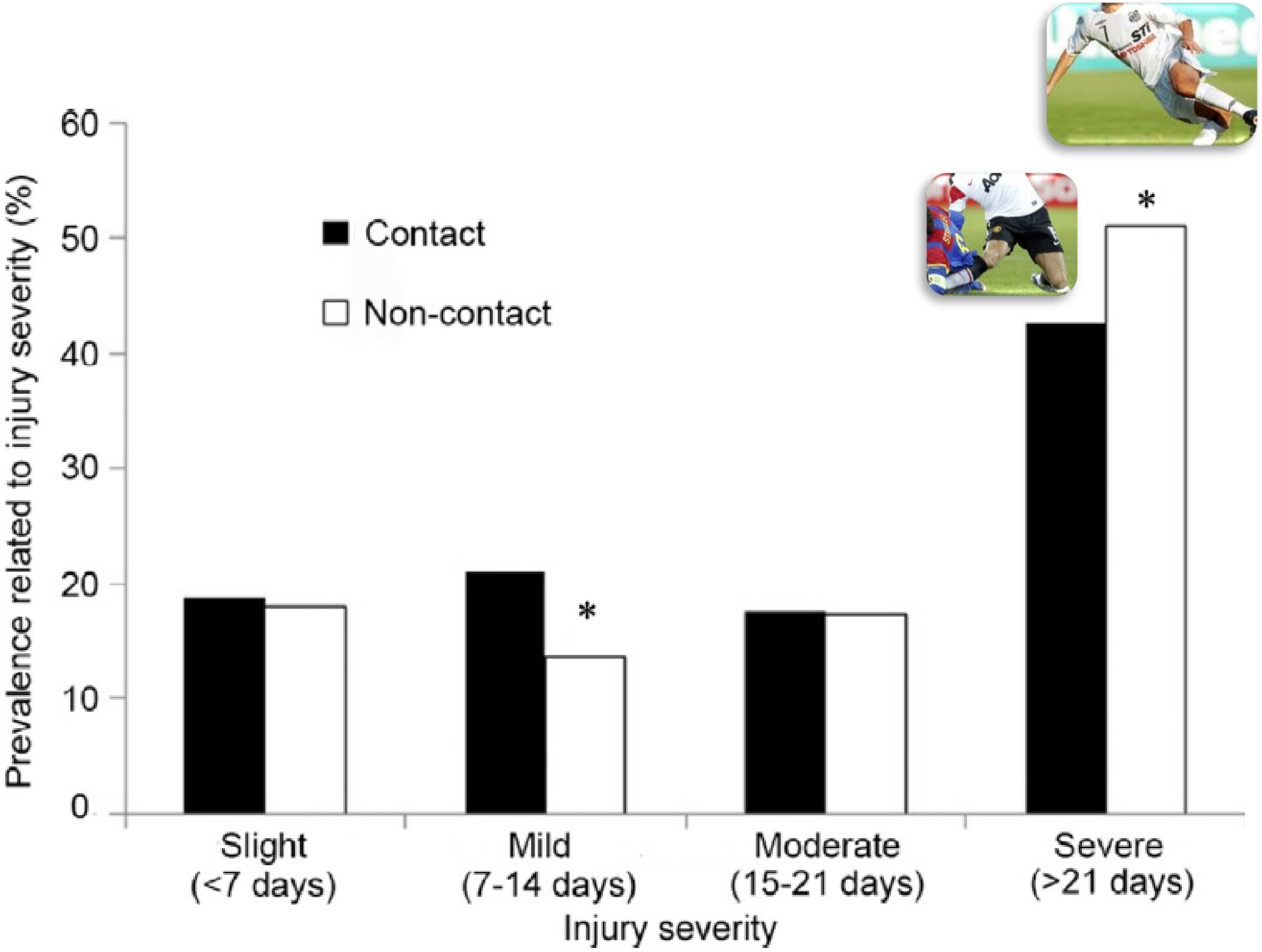


Fig. 3. Distribution of 222 knee ligament injuries according to the mechanism of injury (contact *vs.* noncontact). * $p < 0.001$, significant differences between contact *vs.* noncontact injuries. ACL = anterior cruciate ligament; LCL = lateral collateral ligament; MCL = medial collateral ligament; PCL = posterior cruciate ligament.



(Del Coso et al., 2018)

MECANISMO DE LESIÓN



Las **lesiones sin contacto se clasificaron como graves** (>21 días de baja) **más frecuentemente** que las lesiones del LCA por contacto

(Del Coso et al., 2018)

MECANISMO DE LESIÓN

decrease). Notably in this study, 60% of ACL injuries among females occurred through noncontact mechanisms, while male athletes sustained more ACL injuries due to contact mechanisms (59%).

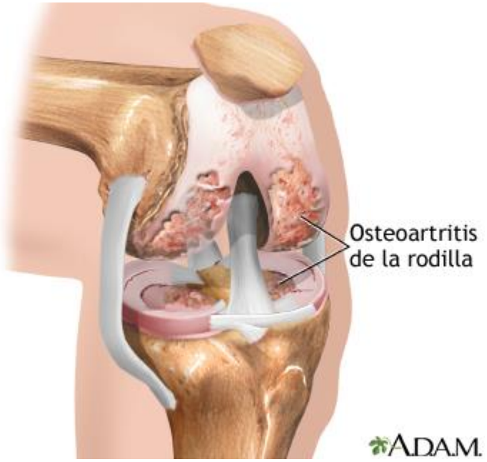
Agel J, Rockwood T, Klossner D. Collegiate ACL Injury Rates Across 15 Sports: National Collegiate Athletic Association Injury Surveillance System Data Update (2004-2005 Through 2012-2013). Clin J Sport Med 2016;26:518-23.

GRAVEDAD

- Días de baja que ocasiona, recidivas

- ACL injury can have serious consequences for **activity level and quality of life** (Tegnander, Olsen & Moholdt, 2008)

- **Many athletes with ACL injury do not return to full sport participation, gain weight, and develop degenerative knee conditions, such as osteoarthritis**, later in life (Kessler, Behrend, Henz et al., 2008; Myer, Faigenbaum, Foss et al., 2014)



GRAVEDAD

play after recovering from surgery. In a 2019 study assessing athletes at 2-years following ACL surgery, as many as 62% of female soccer athletes quit playing after sustaining an ACL injury due to lack of trust in the reconstructed knee or fear of new injury (2). Long-term consequences also exist for

Fältström A, Kvist J, Gauffin H, et al. Female Soccer Players with Anterior Cruciate Ligament Reconstruction Have a Higher Risk of New Knee Injuries and Quit Soccer to a Higher Degree Than Knee-Healthy Controls. Am J Sports Med 2019;47:31-40.

GRAVEDAD

Sports Medicine
https://doi.org/10.1007/s40279-021-01567-x

ORIGINAL RESEARCH ARTICLE

Check for updates

Anterior Cruciate Ligament Reconstruction Increases the Risk of Hamstring Strain Injury Across Football Codes in Australia

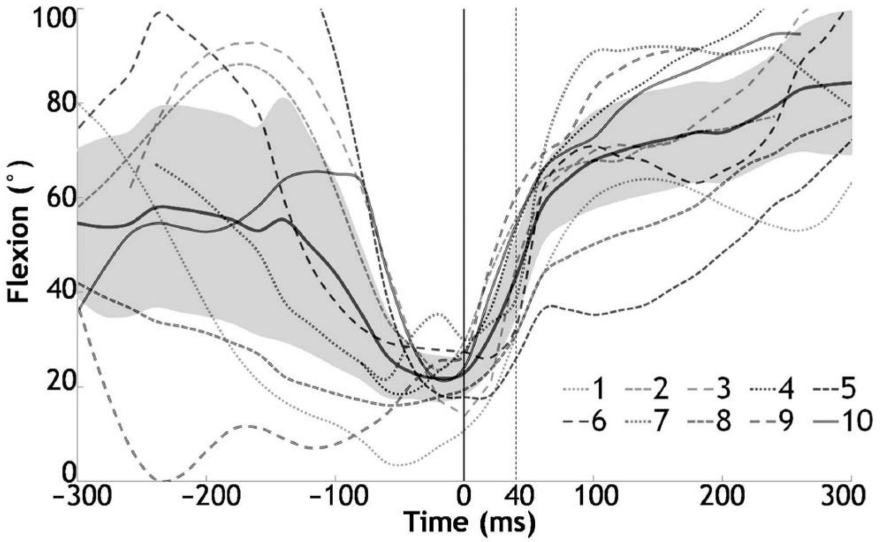
Daniel J. Messer[1,2] · Morgan D. Williams[3] · Matthew N. Bourne[4,5] · David A. Opar[6,7] · Ryan G. Timmins[6,7] · Anthony J. Shield[1,2]

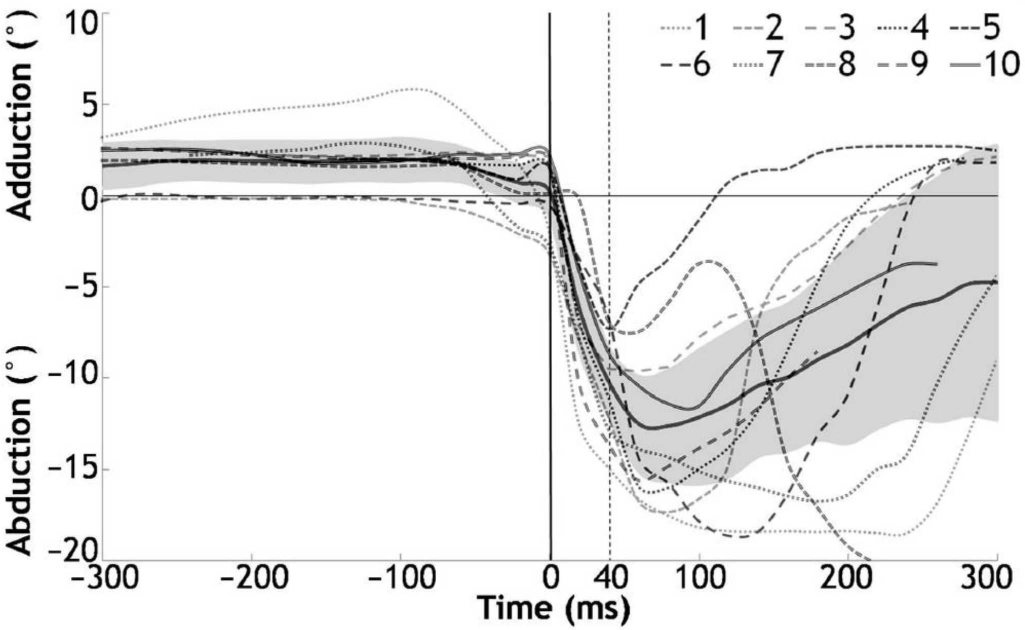
Accepted: 9 September 2021

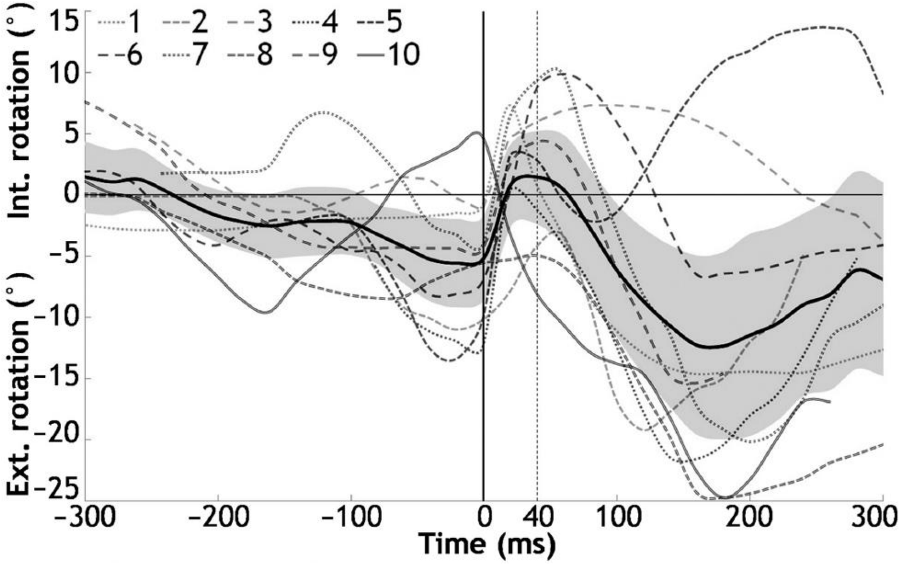
¿CÓMO?

Conoce cómo se ha producido la lesión al detalle para intentar entender las causas

HALLAZGOS CLAVE SOBRE MECANISMO LESIONAL LCA







It is likely that the anterior cruciate ligament **injury occurred approximately 40 milliseconds after IC**.

The kinematic patterns were consistent among the 10 cases. **All players had immediate valgus motion within 40 milliseconds after IC**. Moreover, the **tibia rotated internally during the first 40 milliseconds and then external rotation** was observed, possibly after the anterior cruciate ligament had torn.

Koga et al. (2010): Mechanisms for Noncontact Anterior Cruciate Ligament Injuries. Knee Joint Kinematics in 10 Injury Situations From Female Team Handball and Basketball

HALLAZGOS CLAVE SOBRE MECANISMO LESIONAL LCA

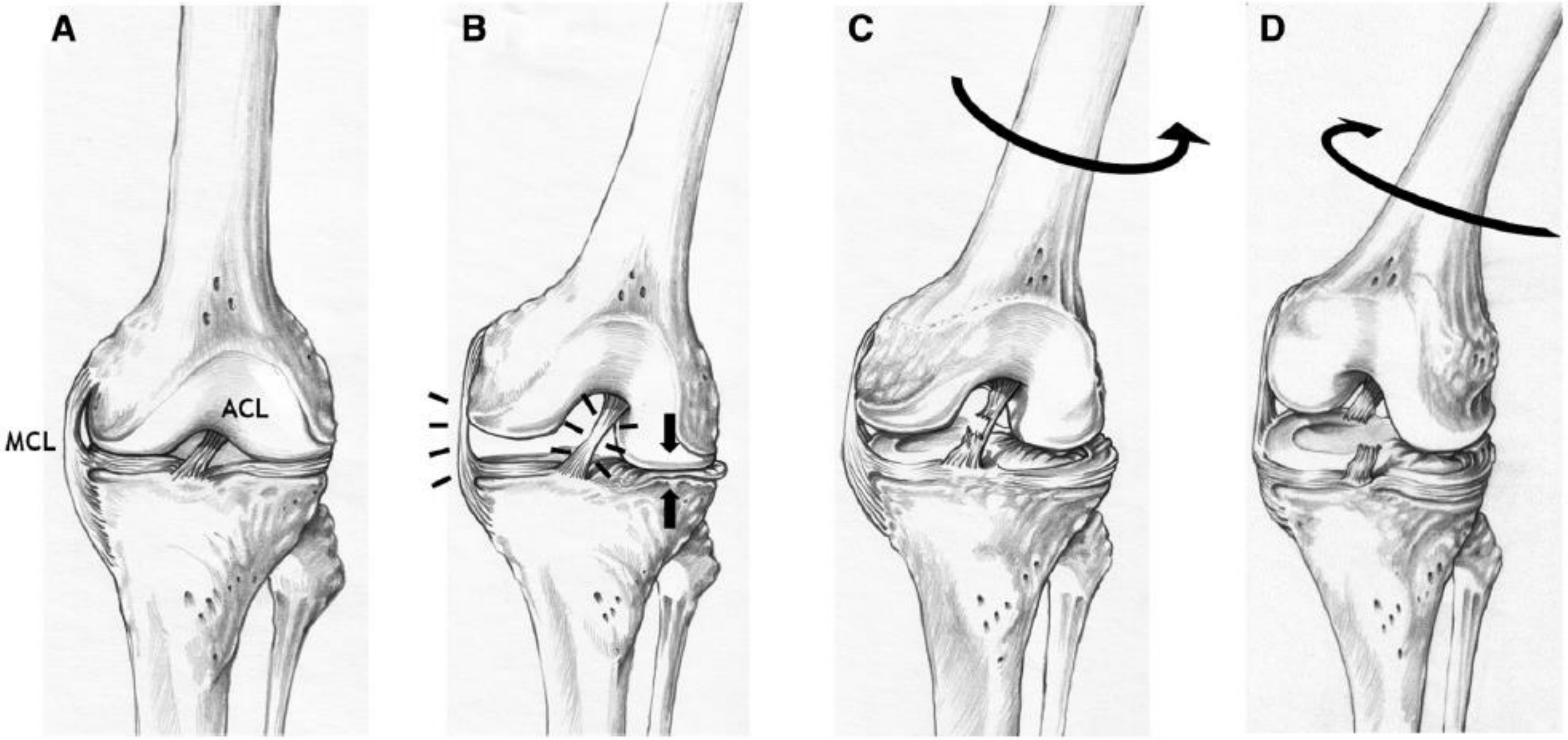


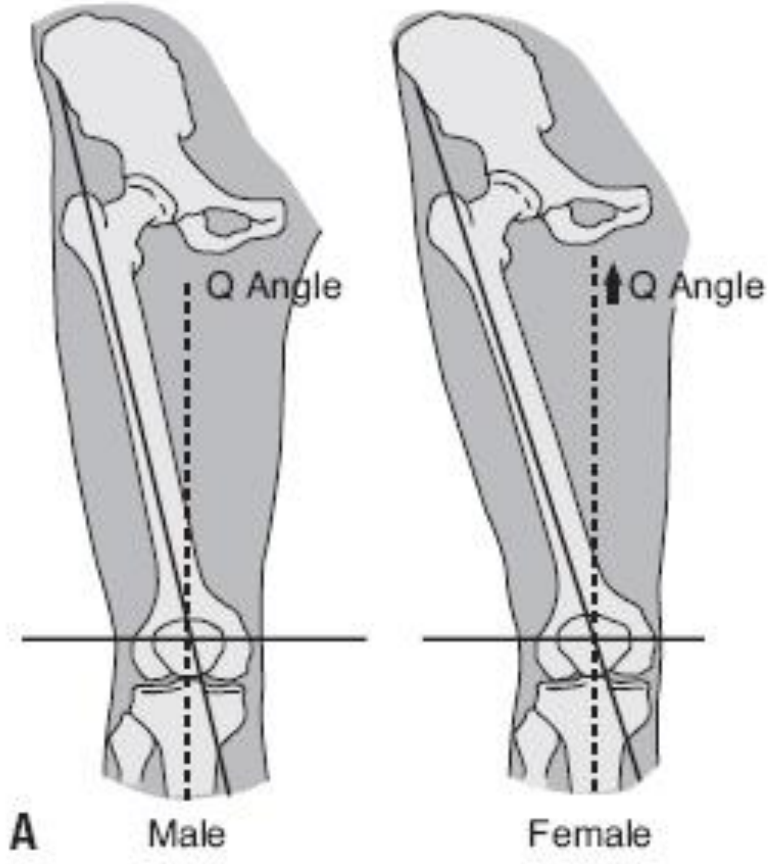
Figure 5. Our hypothesis for noncontact anterior cruciate ligament (ACL) injury mechanism. A, an unloaded knee. B, when valgus loading is applied, the medial collateral ligament becomes taut and lateral compression occurs. C, this compressive load, as well as the anterior force vector caused by quadriceps contraction, causes a displacement of the femur relative to the tibia where the lateral femoral condyle shifts posteriorly and the tibia translates anteriorly and rotates internally, resulting in ACL rupture. D, after the ACL is torn, the primary restraint to anterior translation of the tibia is gone. This causes the medial femoral condyle to also be displaced posteriorly, resulting in external rotation of the tibia.

Koga et al. (2010): Mechanisms for Noncontact Anterior Cruciate Ligament Injuries. Knee Joint Kinematics in 10 Injury Situations From Female Team Handball and Basketball

HALLAZGOS CLAVE SOBRE MECANISMO LESIONAL LCA

Carlson, Sheehan, & Boden (2016) performed a **systematic review** and included a total of **20 video-analysis studies of non contact ACL injury's mechanisms in athletes from different sports**. The analysed studies ranged from qualitative designs to quantitative analyses in either 2 or 3 dimensions.

It should be noted that in injured athletes, **higher valgus angles have been identified in females compared with males**. This increased valgus may contribute to the increased rate of NC-ACLI in female athletes as compared with their male counterparts.



Carlson, Sheehan, & Boden (2016)

HALLAZGOS CLAVE SOBRE MECANISMO LESIONAL LCA

Test del cajón anterior

https://www.youtube.com/watch?v=EepI2cuxdtM

The **pivot shift** is declared within the study as a **highly sensitive test** for ACL insufficiency.

https://www.youtube.com/watch?v=2jPGhT1zFeU

Quatman, Quatman-Yates, & Hewett (2010)

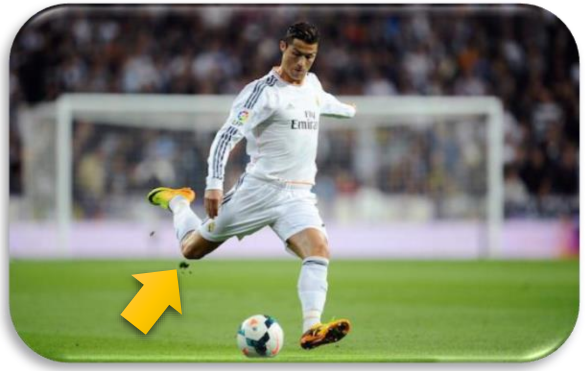
HALLAZGOS CLAVE SOBRE MECANISMO LESIONAL LCA

Table 1 Non-contact anterior cruciate ligament (NC ACL) injury with respect to leg dominance

		Dominant leg		NC ACL injury	
Gender	**N**	**Right**	**Left**	**Right**	**Left**
Female (N=52)					
Professional	3	2	1	2	2
College	17	16	1	1	5
High school/club	17	16	1	2	7
Youth/recreational	15	13	2	5	7
	52	47	5	10	21
Average age (injury) =20.4±7.99				32.26%	67.74%
Total NC ACL injuries: 31					
Male (N=41)					
Professional	12	11	1	5	3
College	6	5	1	5	1
High school/club	4	3	1	2	1
Youth/recreational	19	18	1	7	2
	41	37	4	20	7
Average age (injury) =30.6±8.84				74.07%	25.93%

Total NC ACL injuries: 27

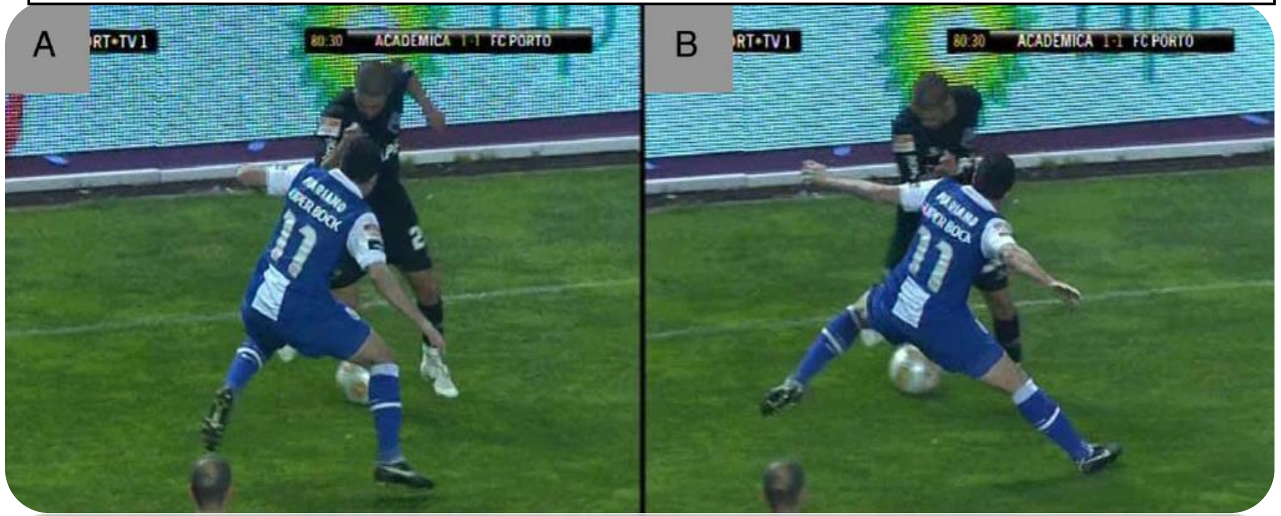
The authors stated that male athletes were statistically more likely to injure their preferred kicking leg while **females were more likely to injure their preferred support leg**



Brophy, Silvers, Gonzales, & Mandelbaum (2010)

HALLAZGOS CLAVE SOBRE MECANISMO LESIONAL LCA

Knee valgus was frequently seen regardless of the playing situation, but a dynamic valgus collapse was rarely identified.



The individual flexion angles at IC were in all cases 40° or less for the hip, and **20° or less for the knee**, with the median flexion angles 25° for the hip and 5° for the knee

Waldén et al. (2015)

HALLAZGOS CLAVE SOBRE MECANISMO LESIONAL LCA

In addition, the results of this study showed that a vast majority of injuries occurred during **dry weather conditions**.

Waldén et al. (2015)

UNIVERSIDAD DE MURCIA

RAQUiS
Grupo de Investigación
Aparato Locomotor y Deporte

Facultad de Ciencias del Deporte
Universidad de Murcia - Campus de San Javier

ANÁLISIS DE UN CUTTING DE 90º

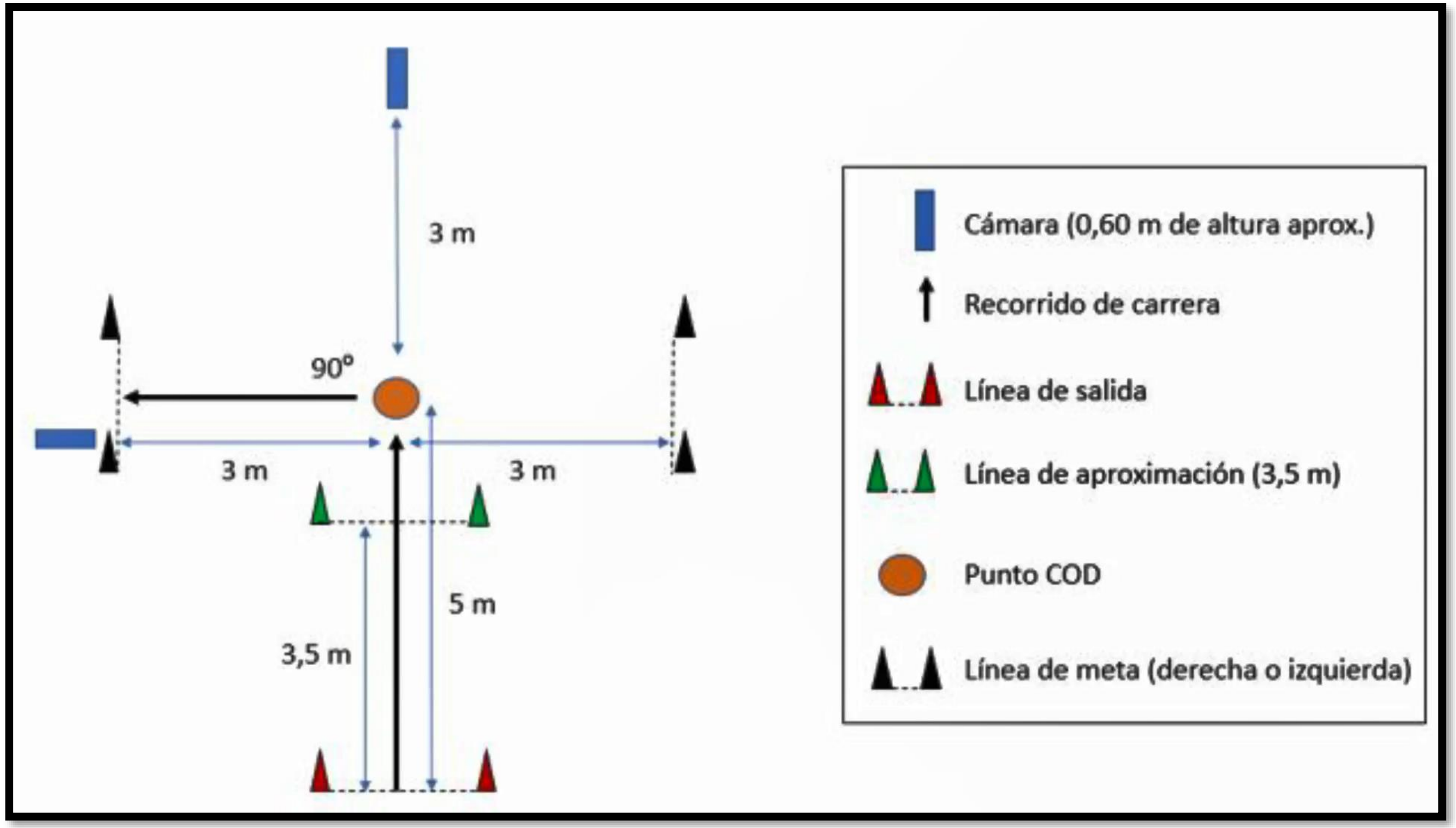
Análisis

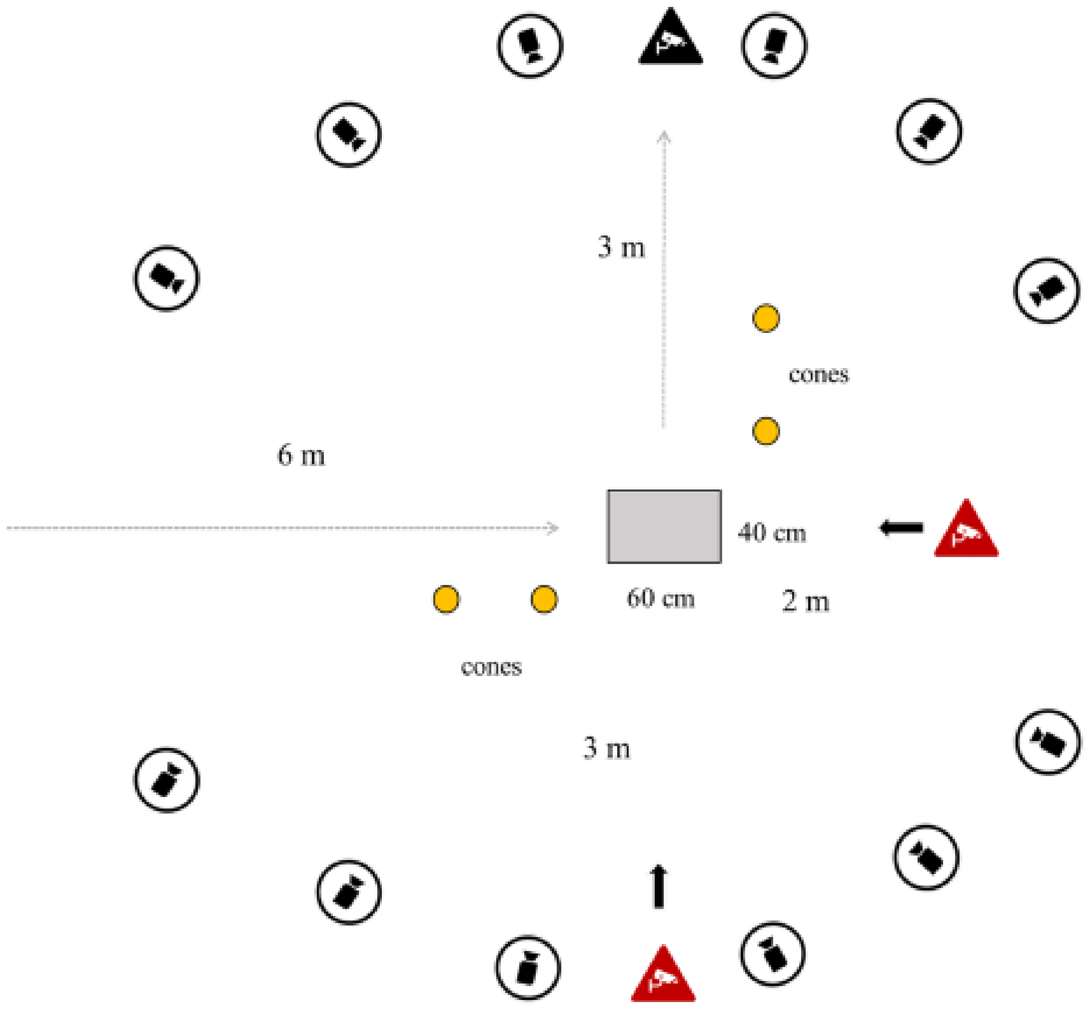
Plano frontal

Análisis

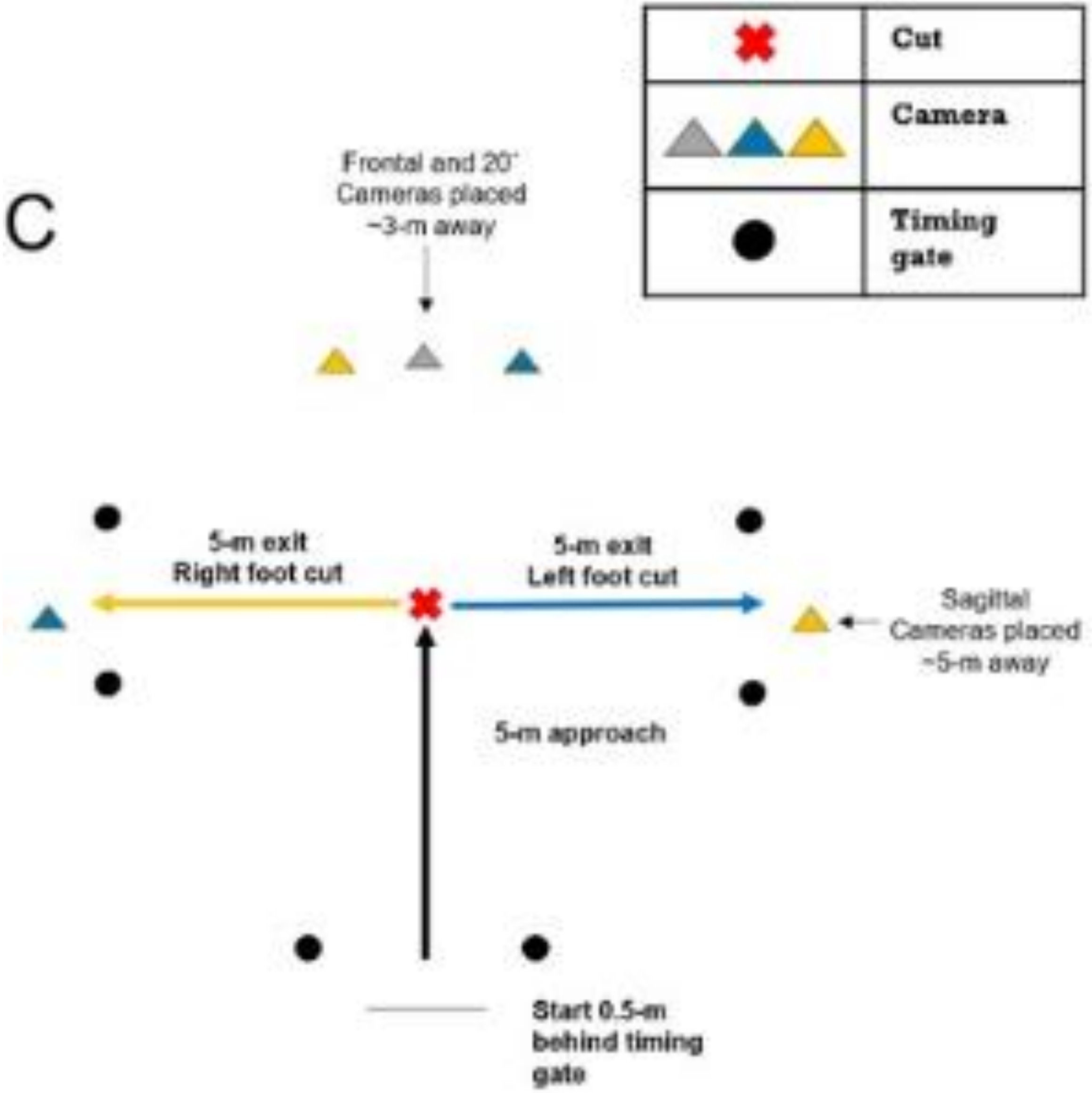
Plano sagital

[Pinche aquí para ver el videotutorial
de cómo montar y grabar la prueba]





Della Villa et al. (2021)



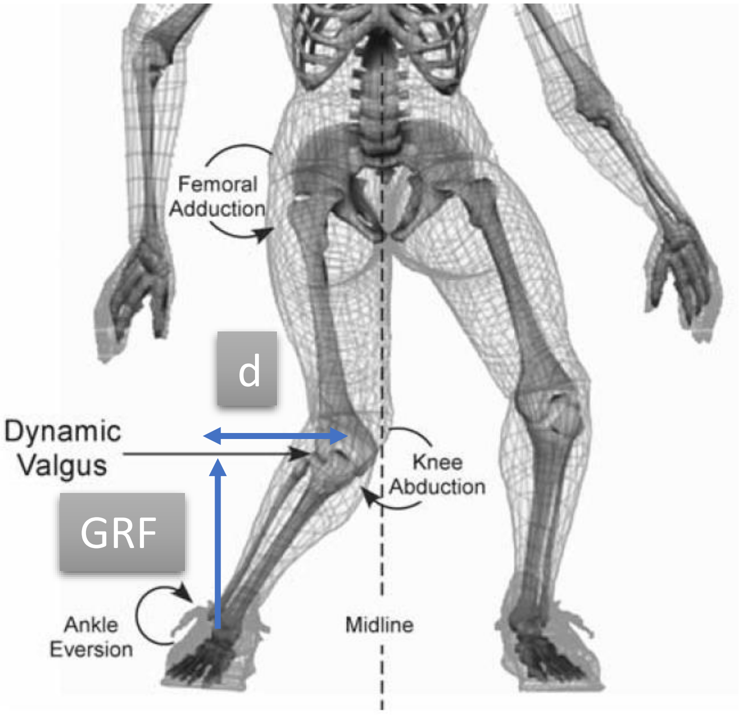
Dos'Santos et al. (2021)

SIDESTEP CUTTING EVALUATION: CMAS TOOL

Table 1
Cutting movement assessment score tool.

Camera	Variable	Observation	Score
Penultimate contact			
Side/ 45°	Clear PFC braking strategy (at initial contact) • Backward inclination of the trunk • Large COM to COP position – anterior placement of the foot • Effective deceleration – heel contact PFC	Y/N	Y = 0/N = 1
Final Contact			
Front/ 45°	**Wide lateral leg plant** (approx. > 0.35 m – dependent on subject anthropometrics) (at initial contact)	Y/N	Y = 2/N = 0
Front/ 45°	**Hip in an initial internally rotated position** (at initial contact)	Y/N	Y = 1/N = 0
Front/ 45°	**Initial knee 'valgus' position** (at initial contact)	Y/N	Y = 1/N = 0
All 3	**Foot not in neutral foot position** (at initial contact) Inwardly rotated foot position or externally rotated foot position (relative to original direction of travel)	Y/N	Y = 1/N = 0
Front/ 45°	**Frontal plane trunk position relative to intended direction; Lateral or trunk rotated towards stance limb, Upright, or Medial** (at initial contact and over WA)	L/TR/U/M	L/TR = 2/ U = 1, /M = 0
Side/ 45°	**Trunk upright or leaning back throughout contact** (not adequate trunk flexion displacement) (at initial contact and over WA)	Y/N	Y = 1/N = 0
Side/ 45°	**Limited Knee flexion during final contact (stiff) ≤ 30°** (over WA)	Y/N	Y = 1/N = 0
Front/ 45°	**Excessive Knee 'valgus' motion during contact** (over WA)	Y/N	Y = 1/N = 0

Key: PFC: Penultimate foot contact; COM: Centre of mass; COP: Centre of pressure; WA: weight acceptance; TR: Trunk rotation; Y: Yes; N: No; L: Lateral; TR: Trunk rotation; U: Upright; M: Medial.



$$KAM = GRF \times d$$

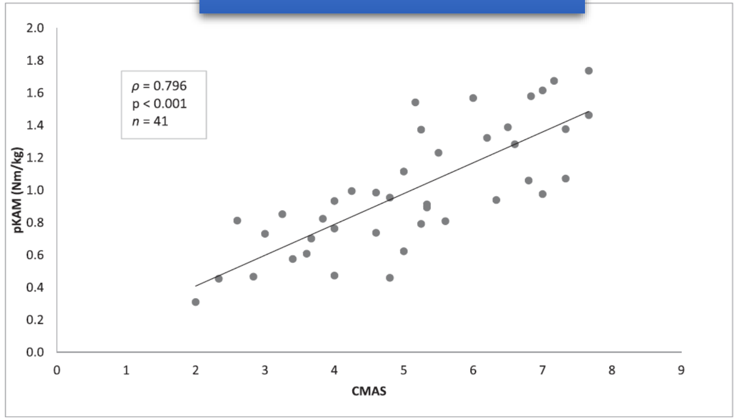


Fig. 2. Relationship between CMAS and peak KAMs (pKAM) subject mean data.

Dos'Santos, McBurnie, et al. (2019):

Análisis

“estrategia de deceleración pobre en el penúltimo apoyo”

Camera	Variable	Observation	Score
<u>Penultimate contact</u>			
Side / 45°	**Clear PFC braking strategy** (at initial contact) • Backward inclination of the trunk • Large COM to COP position – anterior placement of the foot • Effective deceleration – heel contact PFC	Y/N	Y=0/ N=1

Yes

No

HALLAZGOS CLAVE SOBRE MECANISMO LESIONAL LCA

Reducing the majority of momentum during PFC, will reduce the braking requirements of the FFC, which may result in lower knee joint loads and protect against injury

Jones et al. (2016). Braking characteristics during cutting and pivoting in female soccer players.

Análisis

"Gran amplitud lateral en el último apoyo"

Final Contact			
Front / 45°	**Wide lateral leg plant** (approx. > 0.35 m – dependent on subject anthropometrics) (at initial contact)	Y/N	Y=2/N=0

Yes

No

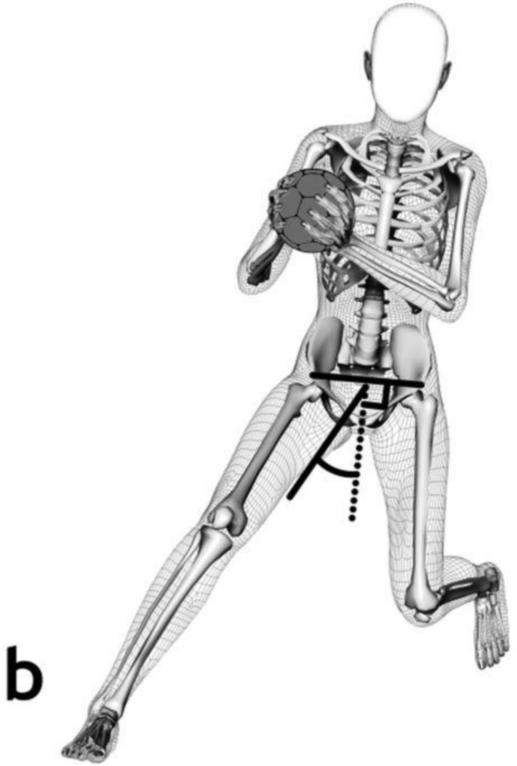
CUTTING MECHANICS

Lateral leg plant distance and initial lateral trunk lean during a 90º cutting maneuver could explain 67% (62% adjusted) of the variation in peak knee abduction moments ($F_{(1,2)}$= 8.869, p = 007) in female soccer players.

Jones et al. (2015)

HALLAZGOS CLAVE SOBRE MECANISMO LESIONAL LCA

Noncontact ACL injuries occurred more frequently with the **hip flexed (88%)** and **abducted (83%)**, the **knee in valgus (58%)** and **within 30° of full extension (71%)**, and the **foot flat (58%)**.



Brophy, Stepan, Silvers, & Mandelbaum (2015)

Análisis

“Rotación interna de cadera en el contacto inicial”

Final Contact			
Front / 45°	**Hip in an initial internally rotated position** (at initial contact)	Y/N	Y=1/N=0

Yes

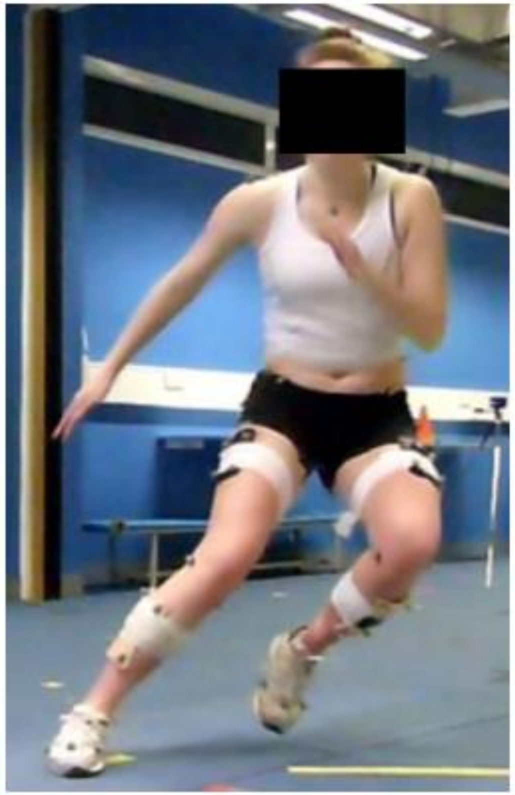
No

Análisis

“Valgo de rodilla inicial”

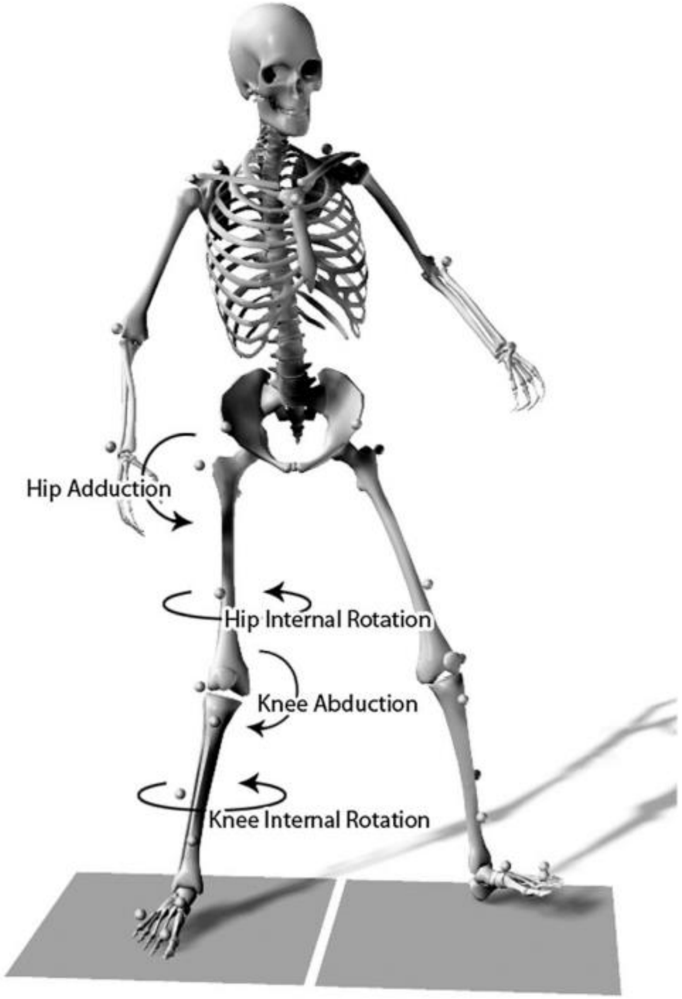
Final Contact			
Front / 45°	**Initial knee ‘valgus’ position** (at initial contact)	Y/N	Y=1/N=0

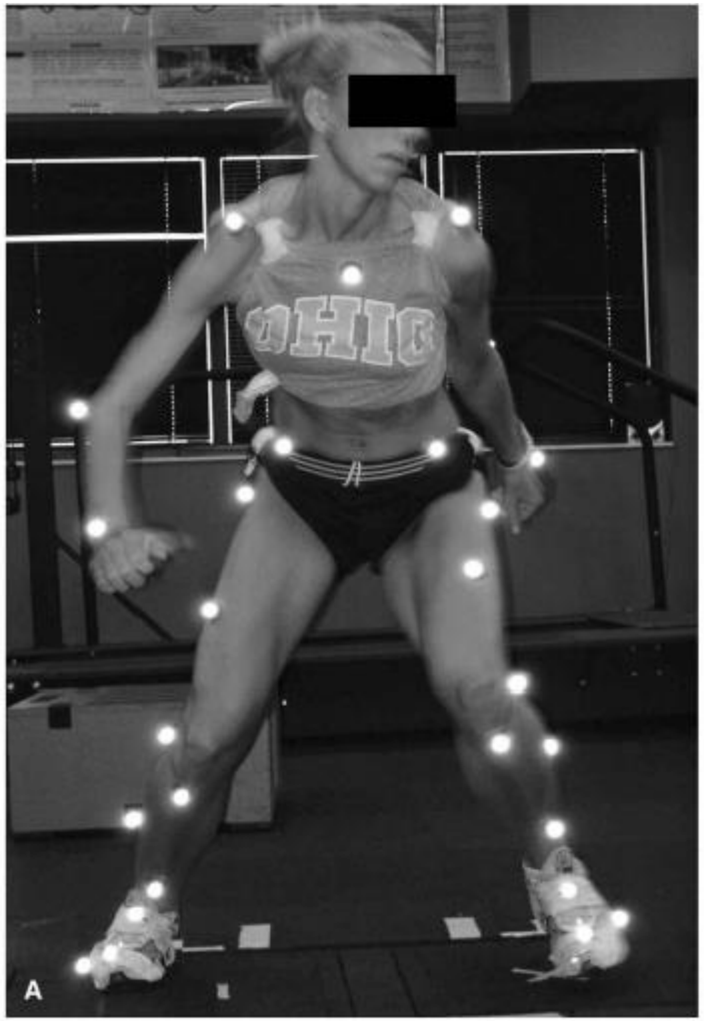
Yes



No

HALLAZGOS CLAVE SOBRE MECANISMO LESIONAL LCA





Video analyses of ACL injuries during sports indicate a common body posture during injury in which **the knee is near full extension** (between 0º and 30º), **the tibia is externally rotated**, the **foot is planted** and a **deceleration** followed by an **abduction collapse of the knee** joint occurs

Imwalle et al. (2009)

Quatman, Quatman-Yates, & Hewett (2010)

Análisis

“Rotación interna/externa del pie de apoyo”

<u>Final Contact</u>			
All 3	**Foot not in neutral foot position** (@ initial contact) Inwardly rotated foot position or externally rotated foot position (relative to original direction of travel)	Y/N	Y=1/N=0

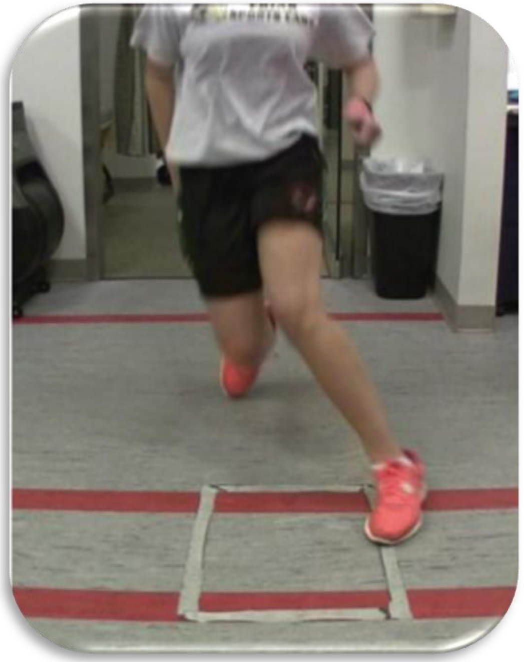
Yes

No

HALLAZGOS CLAVE SOBRE MECANISMO LESIONAL LCA

Excessive foot external rotation increases susceptibility to eversion and pronation which could lead to knee valgus and tibial internal rotation

Internally rotated foot positions during weight acceptance can lead to a more medially positioned knee relative to the GRF vector, thus increase moment arm distance and subsequent KAM



Jones et al. (2016). Technique determinants of knee abduction moments during pivoting in female soccer players

Análisis

“Inclinación lateral o rotación del tronco hacia la pierna de apoyo (x2) /Tronco erguido (x1)”

Final Contact

Front / 45°	**Frontal plane trunk position relative to intended direction; Lateral or trunk rotated towards stance limb, Upright or Medial.** (at initial contact and over WA)	L/TR/U/M	L/TR=2/ U = 1, /M=0

L

TR

U

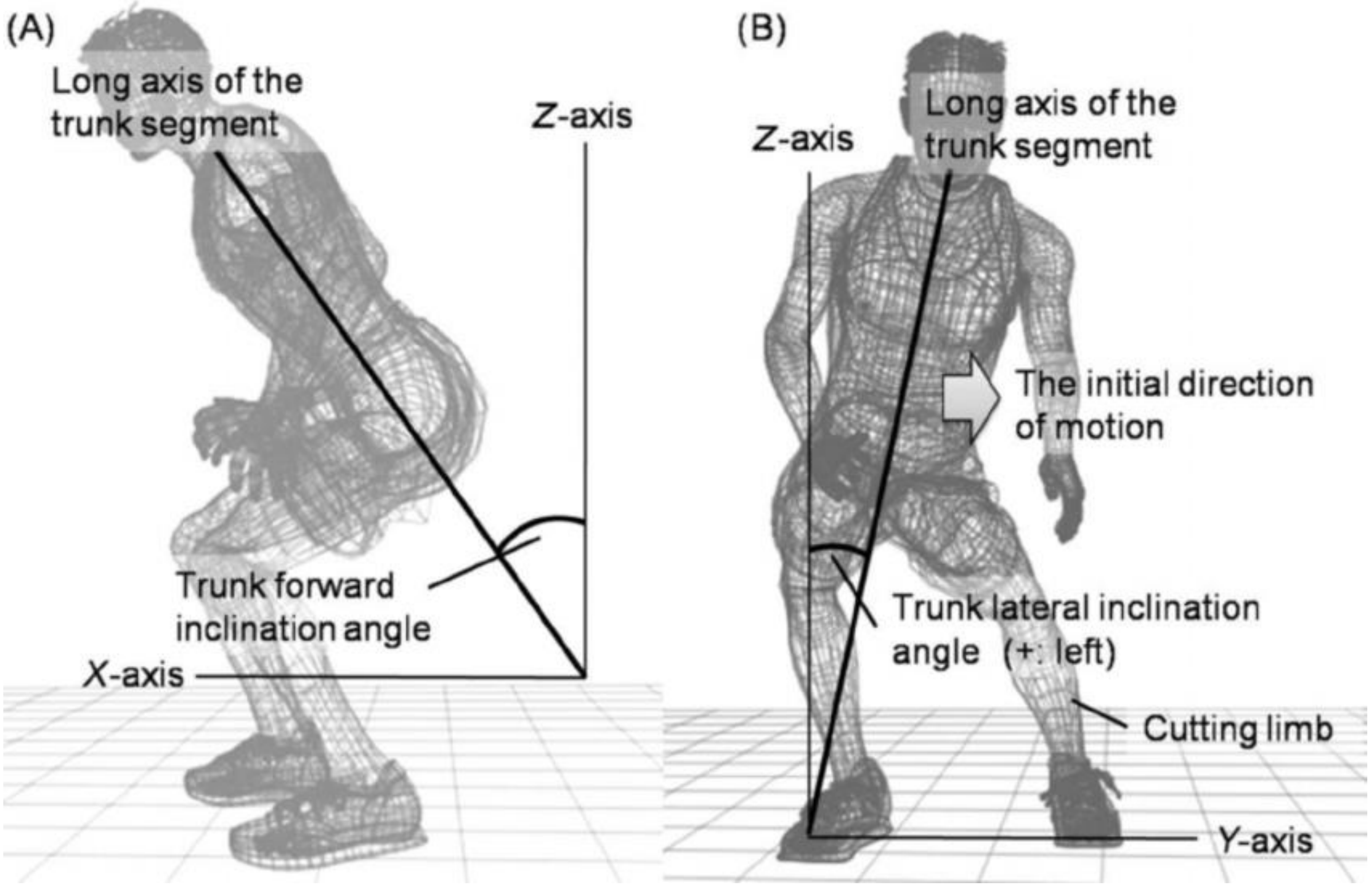
M

HALLAZGOS CLAVE SOBRE MECANISMO LESIONAL LCA

¿trunk and knee position of female and male athletes at the time of ACL injury?

23 injury videos met the criteria for this study: 10 female and 7 male ACL-injured players and 6 female controls performing similar landing and cutting tasks.

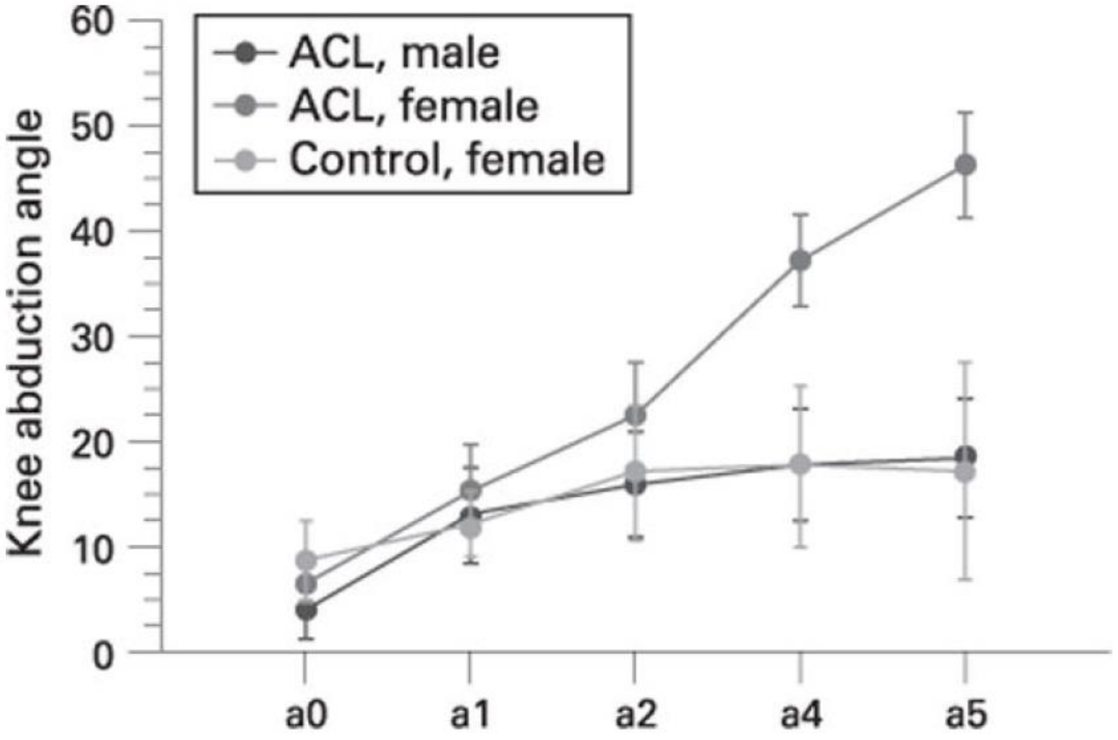
The subjects were athletes from several sports (basketball, rugby…; not all the sports are specified in the study)

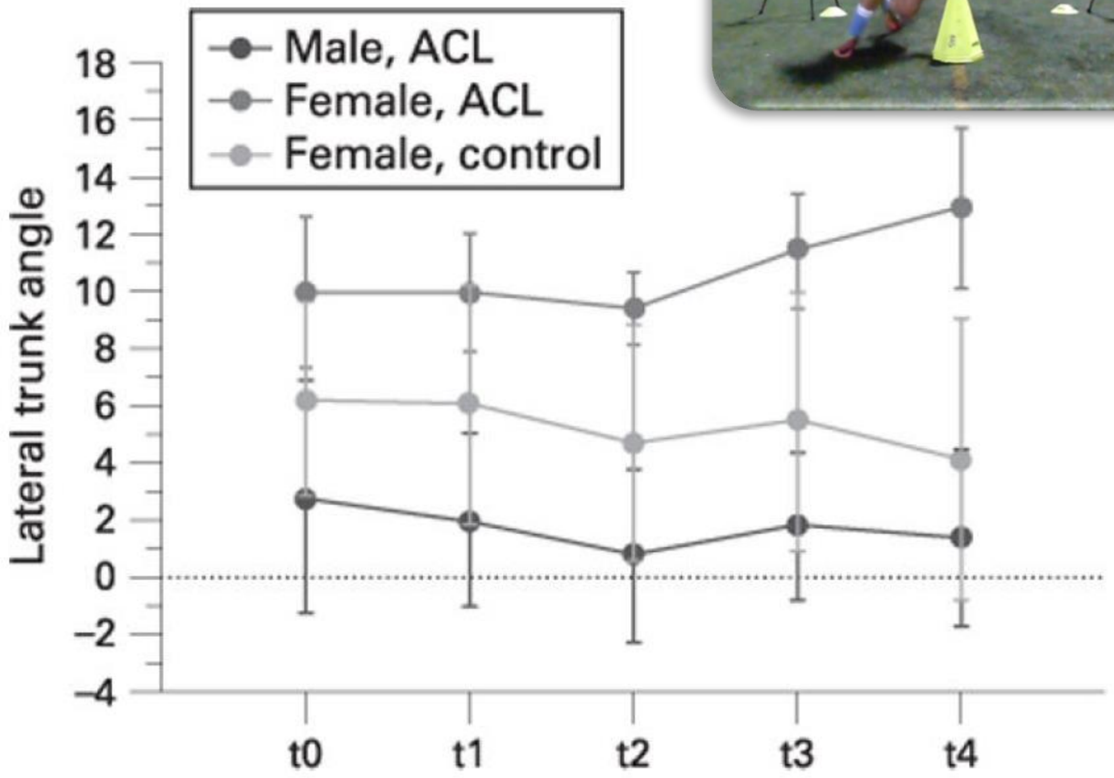


Hewett, Torg, & Boden (2009)

HALLAZGOS CLAVE SOBRE MECANISMO LESIONAL LCA

¿Knee abduction? ¿Lateral trunk flexion?





Female athletes landed with greater lateral trunk motion and knee abduction during ACL injury than did male athletes or control females during similar landing and cutting tasks.

Hewett, Torg, & Boden (2009)

Análisis

"Insuficiente flexión de tronco durante el último apoyo"

Final Contact

Side / 45°	**Trunk upright or leaning back throughout contact** (not adequate trunk flexion displacement) - (at initial contact and over WA)	Y/N	Y=1/N=0

Yes

No

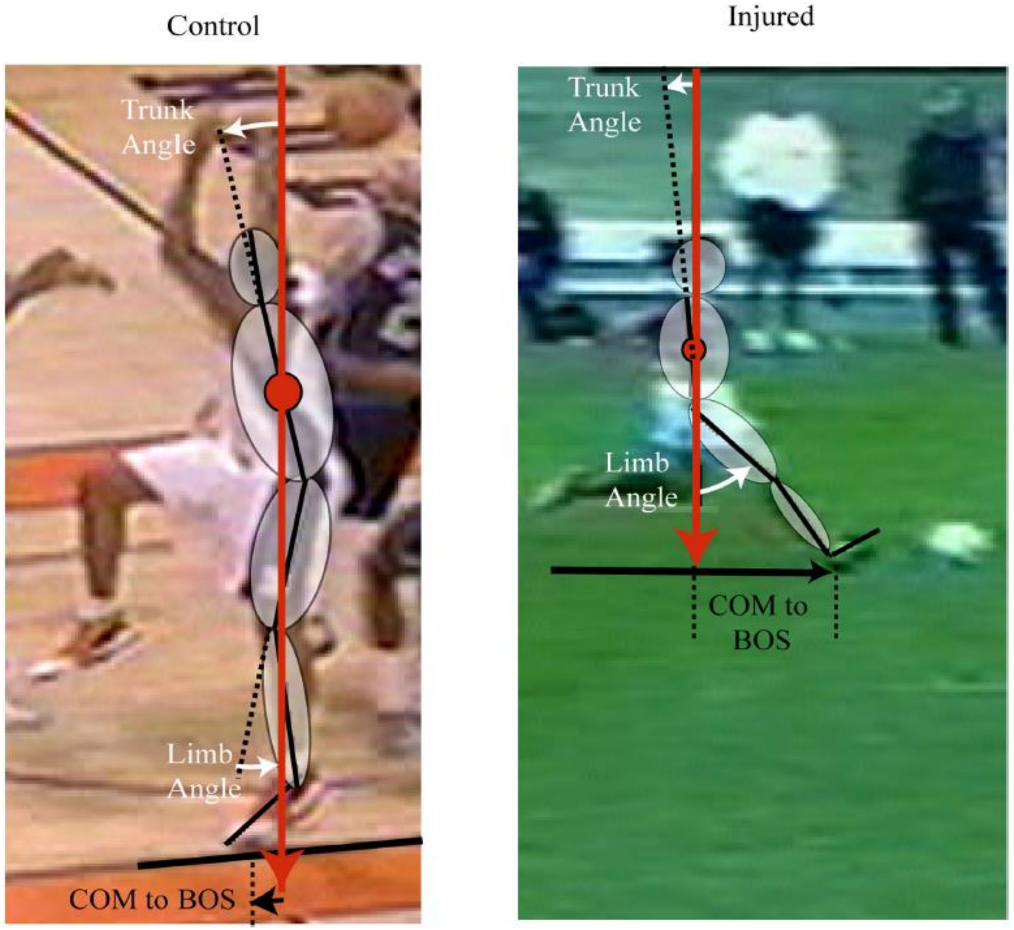
HALLAZGOS CLAVE SOBRE MECANISMO LESIONAL LCA

¿Trunk flexion/extenxion?

Female **ACL-injured athletes demonstrated less forward trunk lean than female controls**

Hewett, Torg, & Boden (2009)

MECANISMO LESIONAL LCA



The authors analysed videotapes to identify **limb angle, trunk angle, and the distance from the center of mass to the base of support (COM_BOS)** at initial contact during one leg landing maneuvers

The value of **COM_BOS discriminated between athletes who sustained an ACL-injury** and athletes that did not with **80% accuracy** (Wilks' Lamba, $p<0.001$)

Sipprell, Boden, & Sheehan (2012)

Análisis

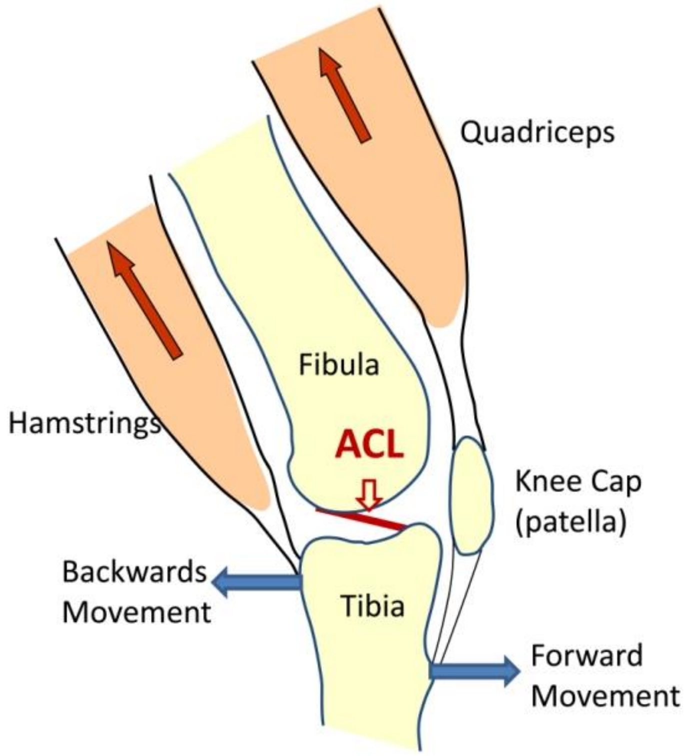
“Flexión de rodilla limitada durante el último apoyo”

Final Contact			
Side / 45°	**Limited Knee Flexion during final contact (stiff) ≤ 30°** (over WA)	**Y/N**	**Y=1/N=0**

Yes

No

HALLAZGOS CLAVE SOBRE MECANISMO LESIONAL LCA



The muscular forces acting on the knee and ACL. Contraction of the quadriceps tends to pull the tibia forward while contraction of the hamstrings tends to pull it backwards. Hamstring activation tends to help stabilize the knee and support the ACL during lading and cutting movements.

The knee joint has the potential to translate further anteriorly at **shallow angles of knee flexion** (displacement is greater at 30º than 90º of knee flexion) and **quadriceps contractions can produce ACL strains between 0º to 30º of knee flexion**;

Quatman, Quatman-Yates, & Hewett (2010)

Análisis

Excesivo desplazamiento medial de la rodilla (valgo)

Final Contact			
Front / 45°	**Excessive Knee 'valgus' motion during contact** (over WA)	Y/N	Y=1/N=0

Yes

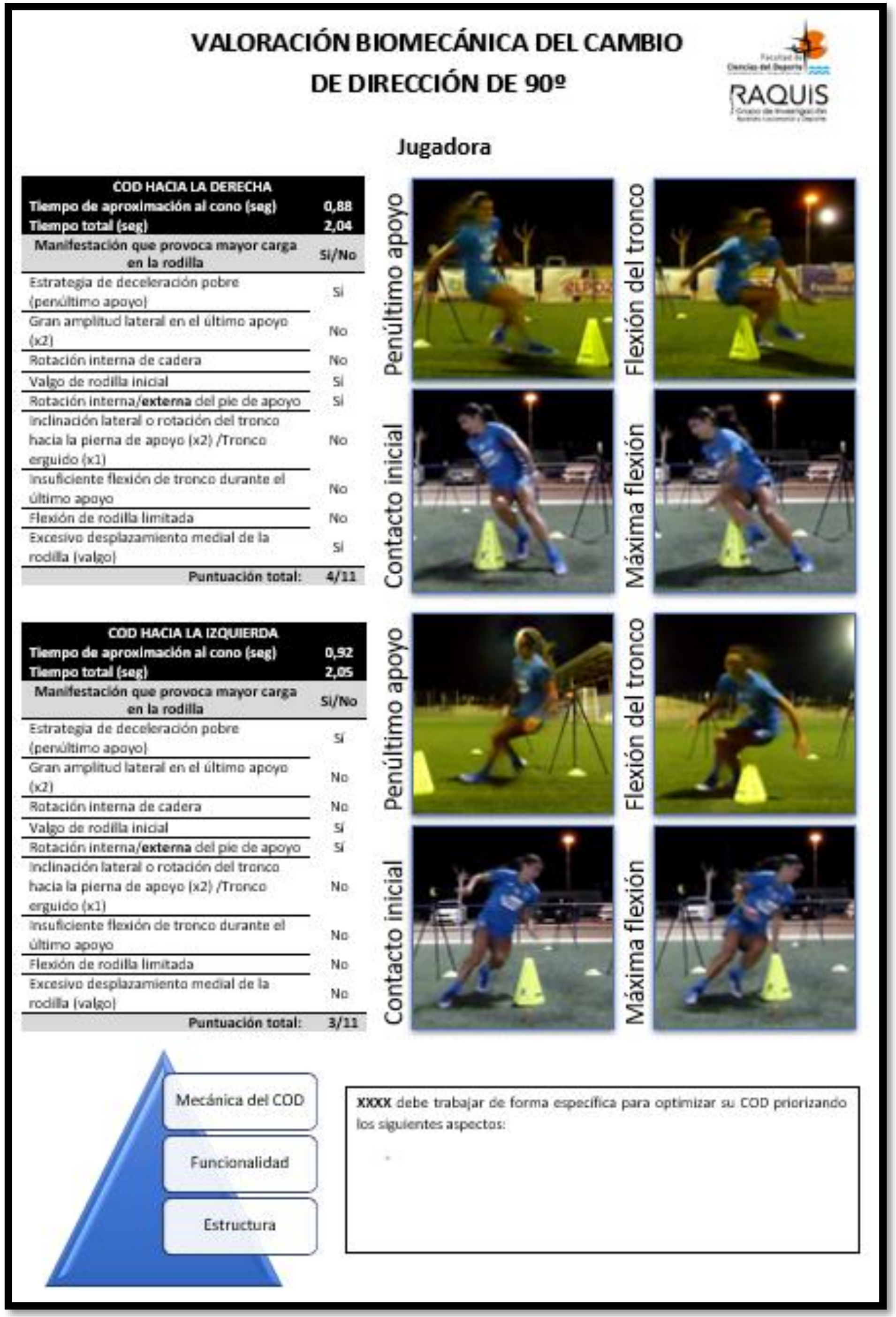
No

Análisis

COD HACIA LA DERECHA	
Manifestación que provoca mayor carga en la rodilla	**Si/No**
Estrategia de deceleración pobre (penúltimo apoyo)	
Gran amplitud lateral en el último apoyo (x2)	
Rotación interna de cadera	
Valgo de rodilla inicial	
Rotación interna/externa del pie de apoyo	
Inclinación lateral o rotación del tronco hacia la pierna de apoyo (x2) /Tronco erguido (x1)	
Insuficiente flexión de tronco durante el último apoyo	
Flexión de rodilla limitada	
Excesivo desplazamiento medial de la rodilla (valgo)	
Puntuación total:	/11

Informe final

CMAS PODRÍA SER UNA BUENA HERRAMIENTA PARA EVALUAR LA MECÁNICA DEL COD EN UN CONTEXTO DE CAMPO Y PLANTEAR PROPUESTAS DE MEJORA



VALORACIÓN BIOMECÁNICA DEL CAMBIO DE DIRECCIÓN DE 90º

RAQUIS

Jugadora

COD HACIA LA DERECHA	
Tiempo de aproximación al cono (seg)	0,88
Tiempo total (seg)	2,04
Manifestación que provoca mayor carga en la rodilla	Sí/No
Estrategia de deceleración pobre (penúltimo apoyo)	Sí
Gran amplitud lateral en el último apoyo (x2)	No
Rotación interna de cadera	No
Valgo de rodilla inicial	Sí
Rotación interna/**externa** del pie de apoyo	Sí
Inclinación lateral o rotación del tronco hacia la pierna de apoyo (x2) /Tronco erguido (x1)	No
Insuficiente flexión de tronco durante el último apoyo	No
Flexión de rodilla limitada	No
Excesivo desplazamiento medial de la rodilla (valgo)	Sí
Puntuación total:	4/11

Penúltimo apoyo

Flexión del tronco

Contacto inicial

Máxima flexión

COD HACIA LA IZQUIERDA	
Tiempo de aproximación al cono (seg)	0,92
Tiempo total (seg)	2,05
Manifestación que provoca mayor carga en la rodilla	Sí/No
Estrategia de deceleración pobre (penúltimo apoyo)	Sí
Gran amplitud lateral en el último apoyo (x2)	No
Rotación interna de cadera	No
Valgo de rodilla inicial	Sí
Rotación interna/**externa** del pie de apoyo	Sí
Inclinación lateral o rotación del tronco hacia la pierna de apoyo (x2) /Tronco erguido (x1)	No
Insuficiente flexión de tronco durante el último apoyo	No
Flexión de rodilla limitada	No
Excesivo desplazamiento medial de la rodilla (valgo)	No
Puntuación total:	3/11

Penúltimo apoyo

Flexión del tronco

Contacto inicial

Máxima flexión

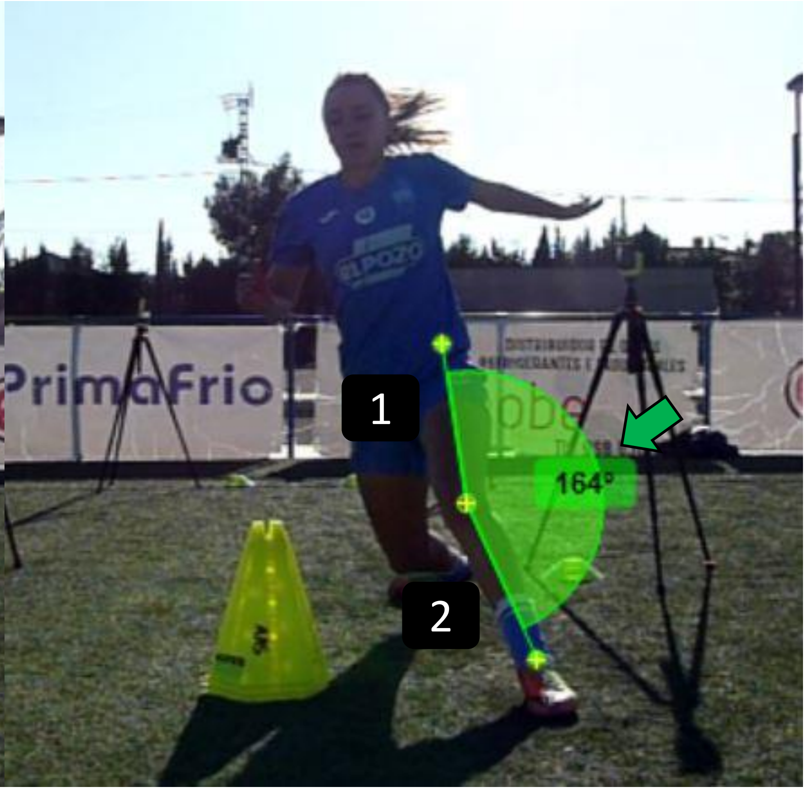
Mecánica del COD

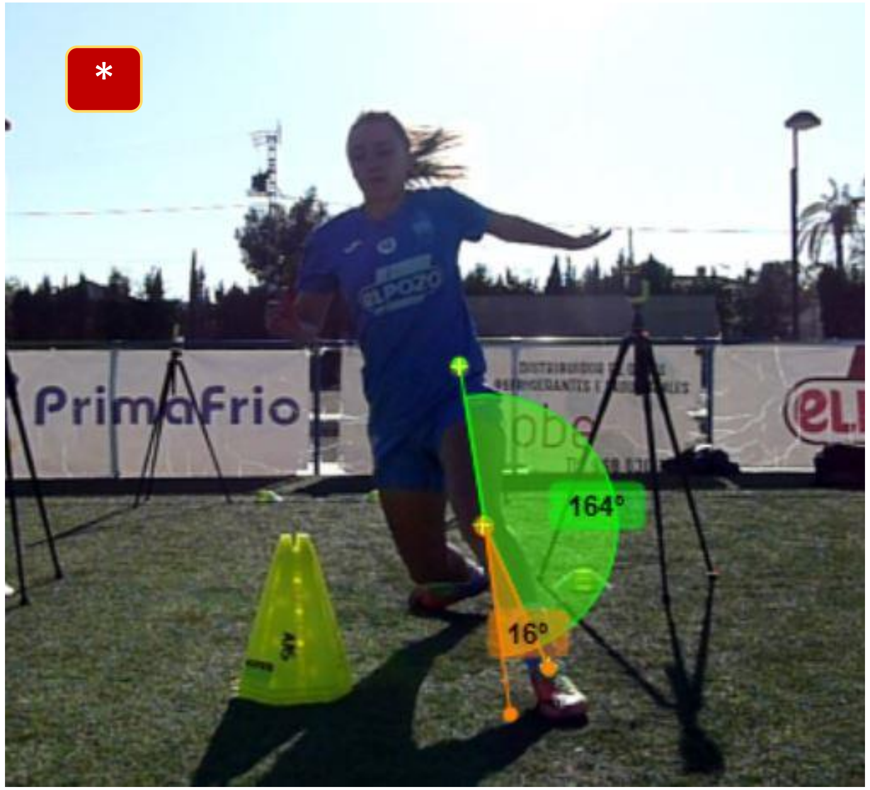
Funcionalidad

Estructura

XXXX debe trabajar de forma específica para optimizar su COD priorizando los siguientes aspectos:

VALGO DE RODILLA (VR)





1. Línea desde la ASIS de la pierna de apoyo hasta el KJC

2. Línea desde el KJC de la pierna de apoyo hasta el AJC

Registrar ángulo lateral formado entre la línea 1 y la línea 2 (grados) =164º

*Valor analizado: 180º menos el valor angular registrado→ 180-164= **16º**

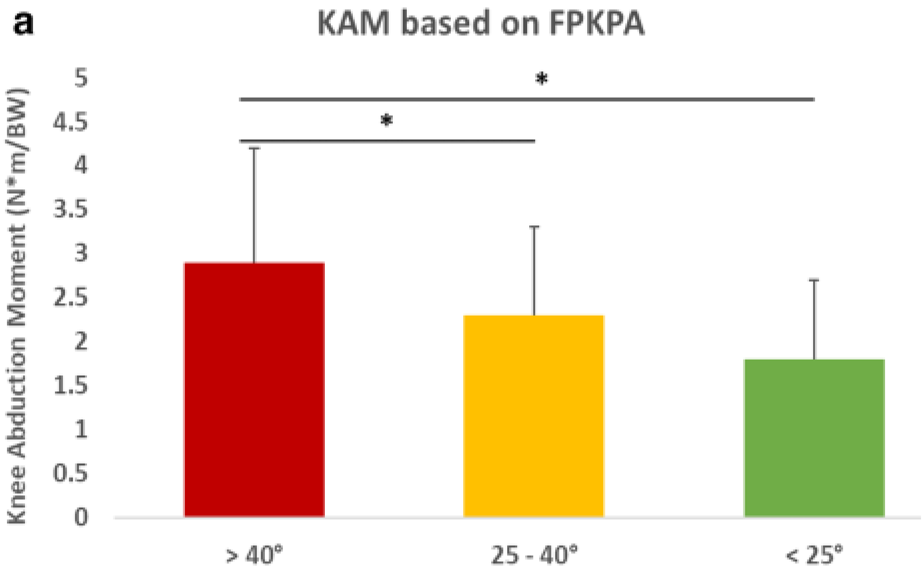
(+): valgo de rodilla

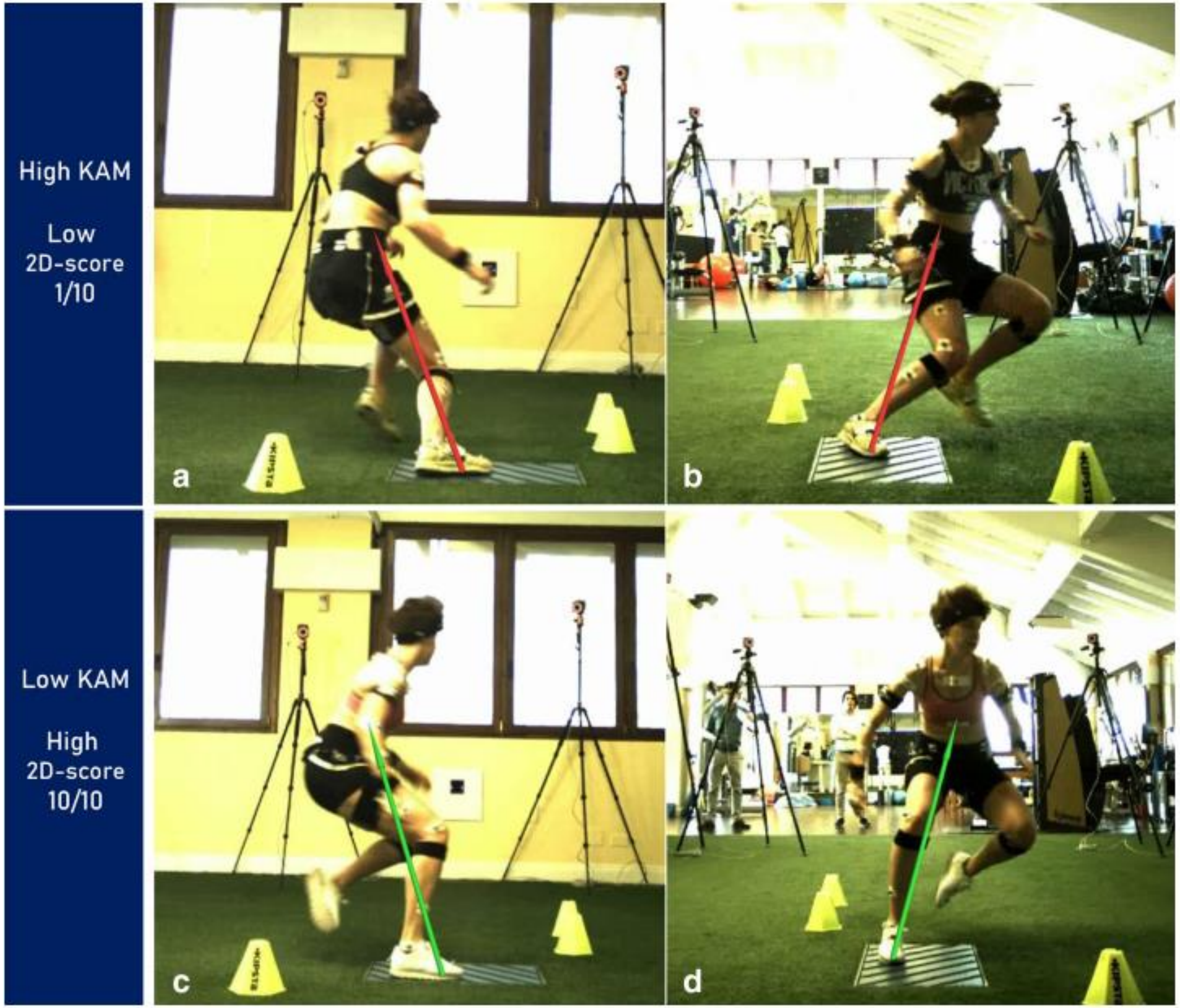
(-): varo de rodilla

VR – MOMENTOS DE ANÁLISIS

A) Valor registrado durante el **apoyo final**: en el momento del **contacto inicial** (IC)

B) **Máximo valor** encontrado durante el **apoyo final**: desde el contacto inicial (IC) y a lo largo de la fase de aceptación del peso o weight acceptance (WA)

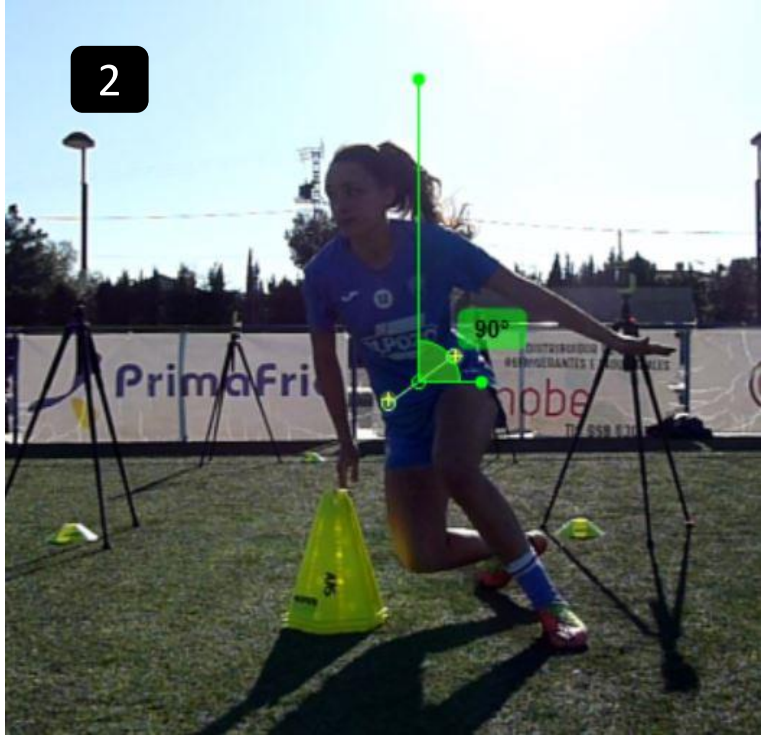




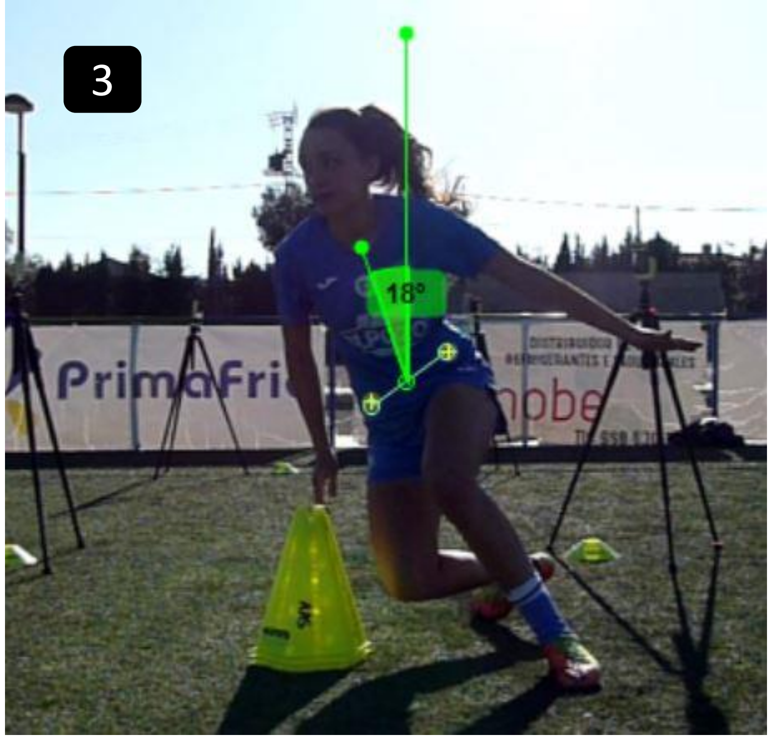
Della Villa et al. (2021)

FLEXIÓN LATERAL DEL TRONCO (FLT-Peak)

1. Línea que une la ASIS derecha con la ASIS izquierda



2. Eje vertical desde el punto medio de la línea 1



3. Línea desde el punto medio de la línea 1 hasta la CLAV

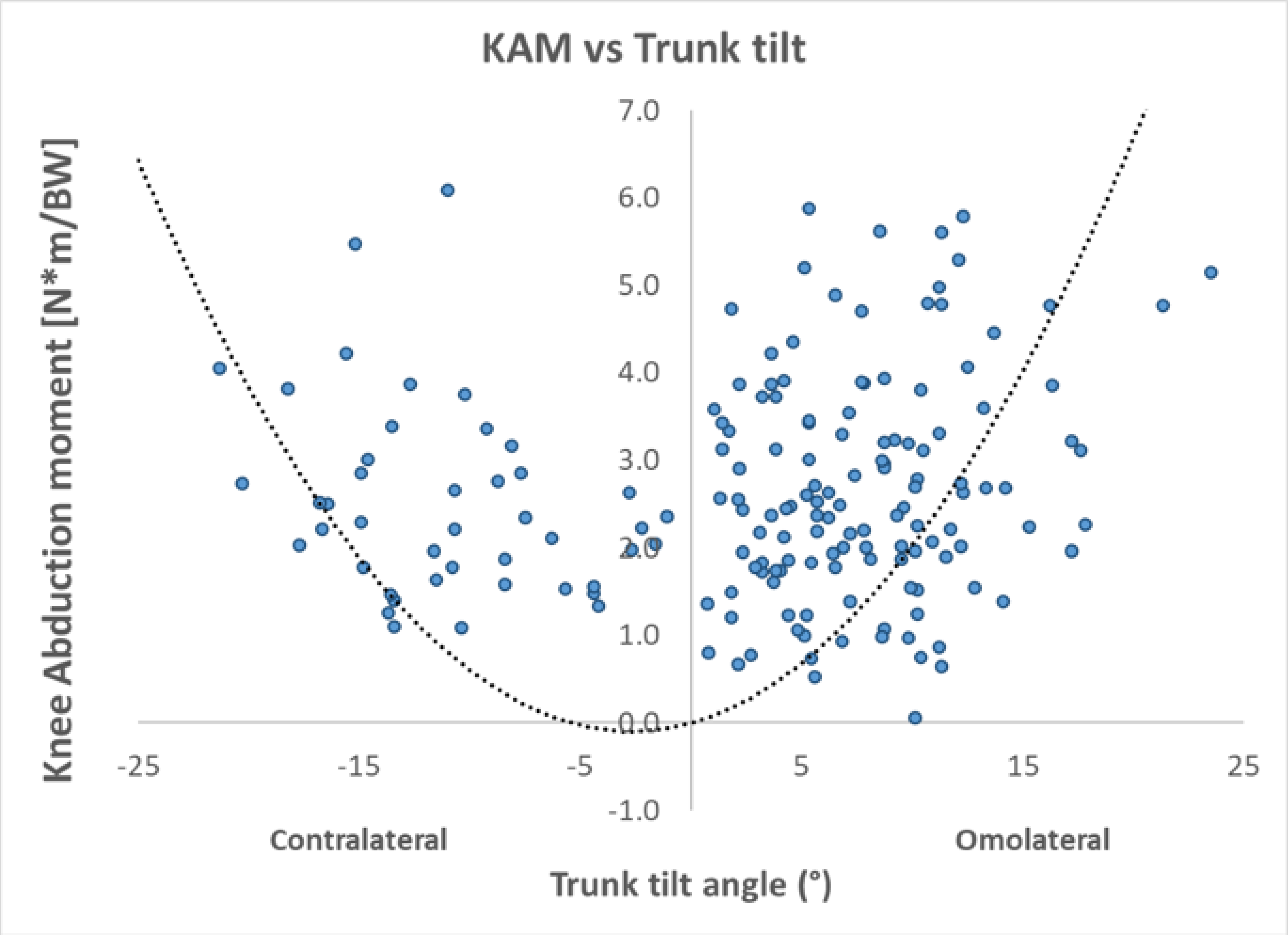
*Registrar **ángulo** formado entre la línea 2 y la línea 3 (grados) * -18º

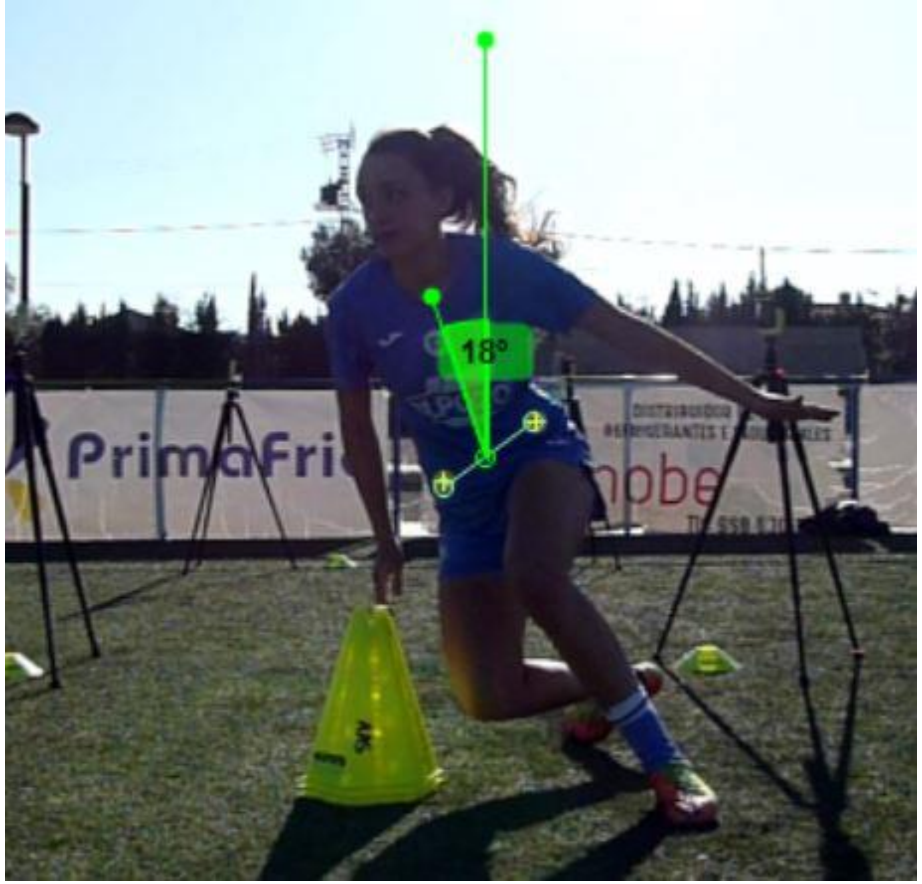
(+): hacia la pierna de apoyo

(-): hacia la nueva dirección

FLT-Peak – MOMENTO DE ANÁLISIS

Máximo valor encontrado durante el **apoyo final**: desde el contacto inicial (IC) y a lo largo de la fase de aceptación del peso o weight acceptance (WA)





*Knee Abduction Moment (KAM, [N*m/BW]) evaluated through the 3D motion capture over the trunk tilt angle (°) evaluated through the 2D video analysis. A trend of increase in KAM can be noted as absolute trunk tilt angle increases.*

Della Villa et al. (2021)

LANDING MECHANICS