



# Lesiones ligamentosas – Lesiones de rodilla (Parte 2)

Asignatura: Readaptación deportiva y reentrenamiento  
físico-deportivo

## Docentes

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# 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

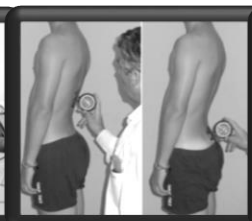
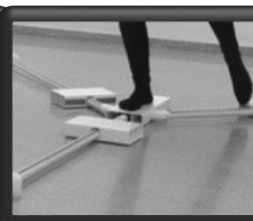
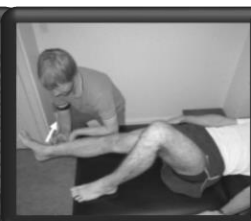
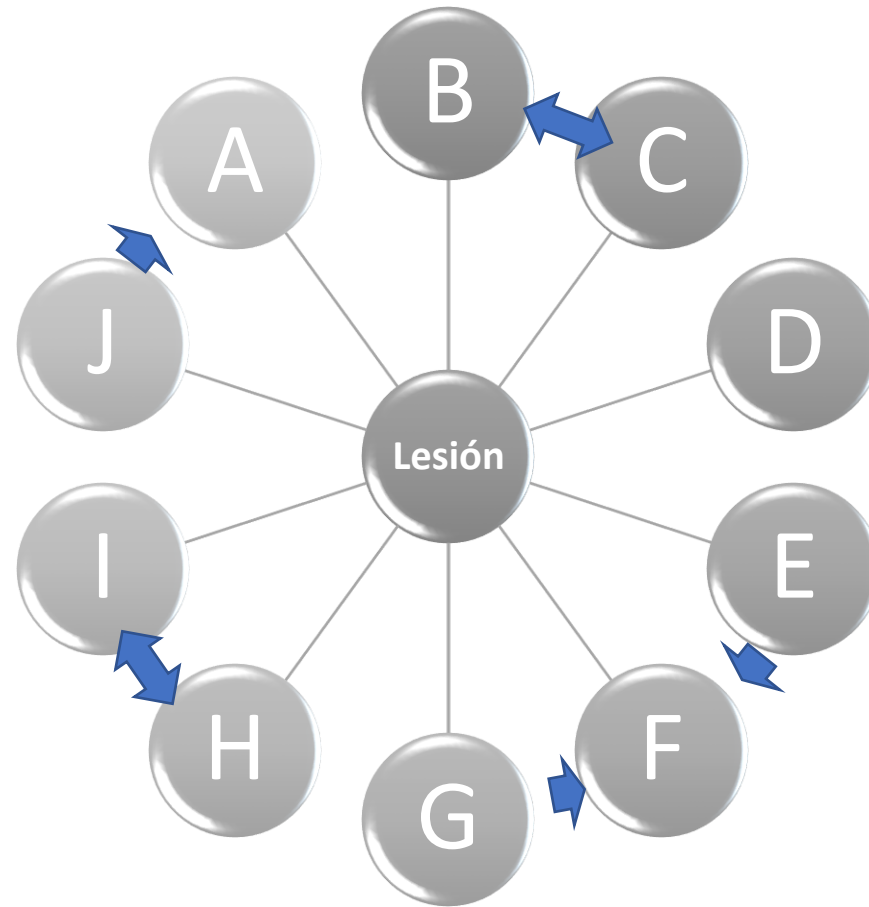
MANOS A LA OBRA: Claves para la prevención de lesiones de rodilla

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

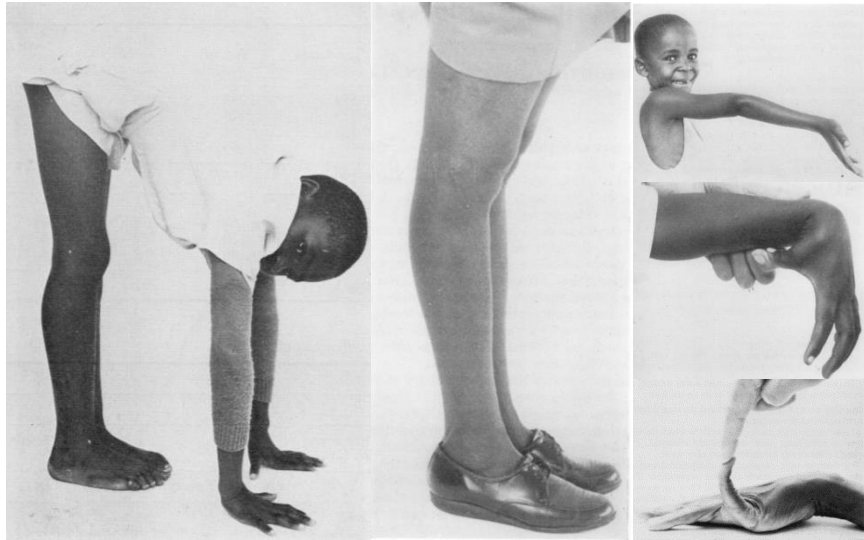
5. TRABAJA EN EQUIPO: Mantén contacto con fisio, entrenador/a, psicólogo/a y con el/la deportista

# ¿POR QUÉ?

Estudia las posibles causas de la lesión para saber qué factores de riesgo abordar en la readaptación



# JOINT LAXITY

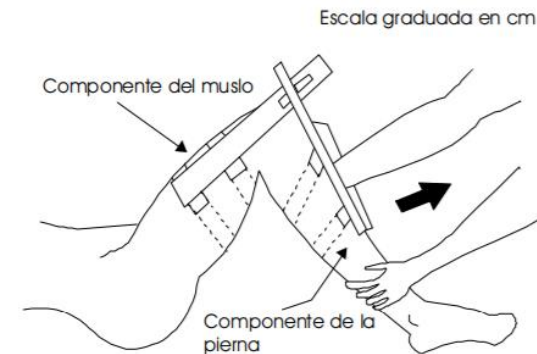


(Ostenberg & Roos, 2000;  
Beighton et al., 1973)



(Myer et al., 2008)

Artrómetro de rodilla CompuKT



(Arango-García et al., 1998)

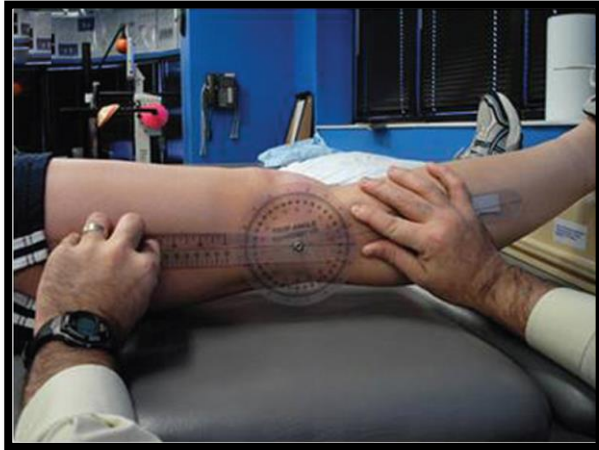
Artrómetro de fabricación artesanal



Artrómetro de rodilla Lachmeter

# KNEE JOINT LAXITY

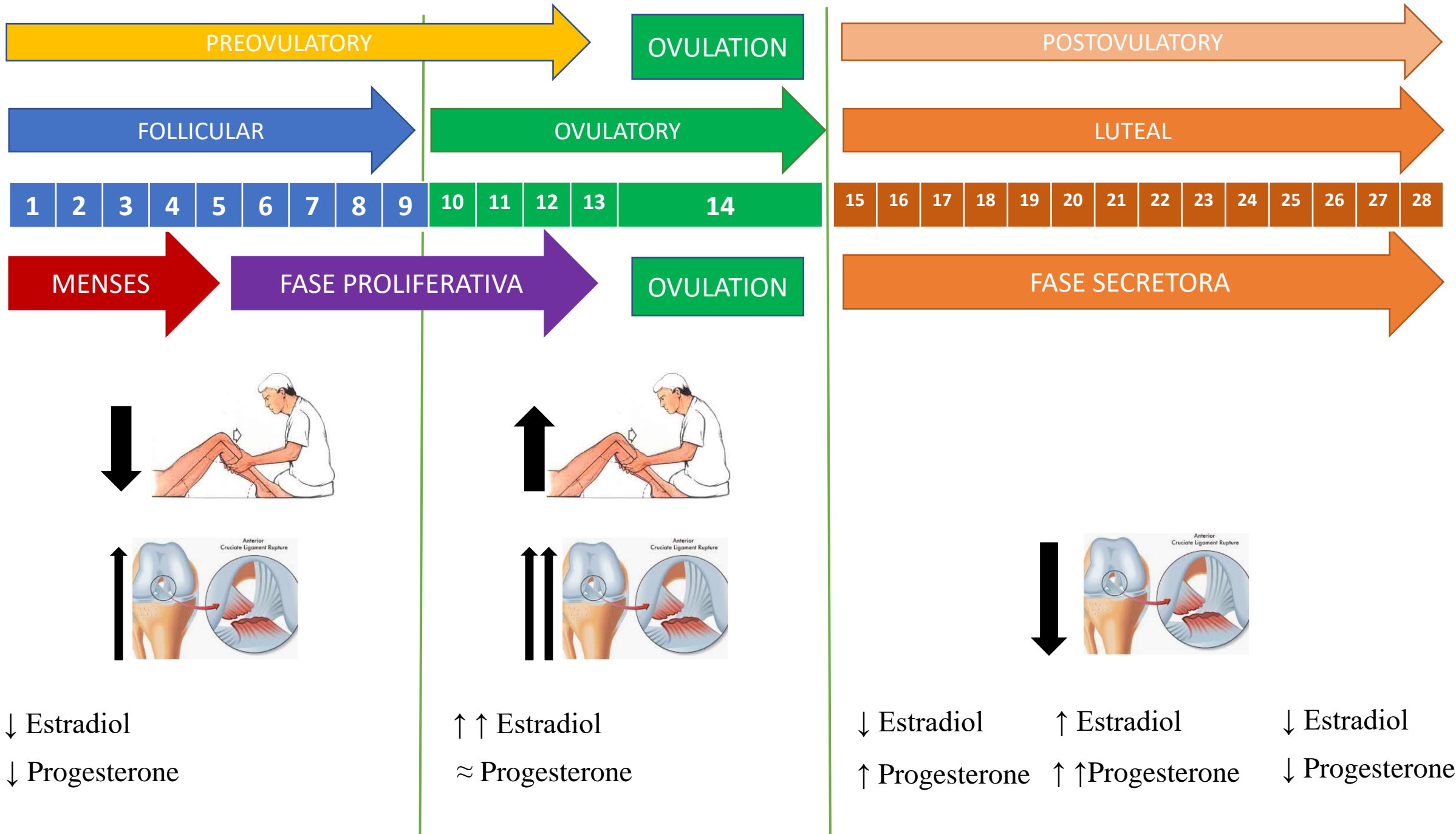
## KNEE HYPEREXTENSION TEST



## DESPLAZAMIENTO ANTEROPOSTERIOR DE LA TIBIA



Los resultados mostraron que por cada incremento de 1,3 mm en la asimetría en el desplazamiento anteroposterior de la rodilla, la probabilidad de lesión del LCA se cuatuplicaba. También se halló que una medida positiva en el test de hiperextensión de rodilla quintuplicaba la probabilidad de rotura del LCA.



# OTROS FACTORES: TRAINING AND COMPETITION WORKLOAD



GPS devices (McCall et al., 2018)



# WORKLOAD

Haddad et al. (2017)

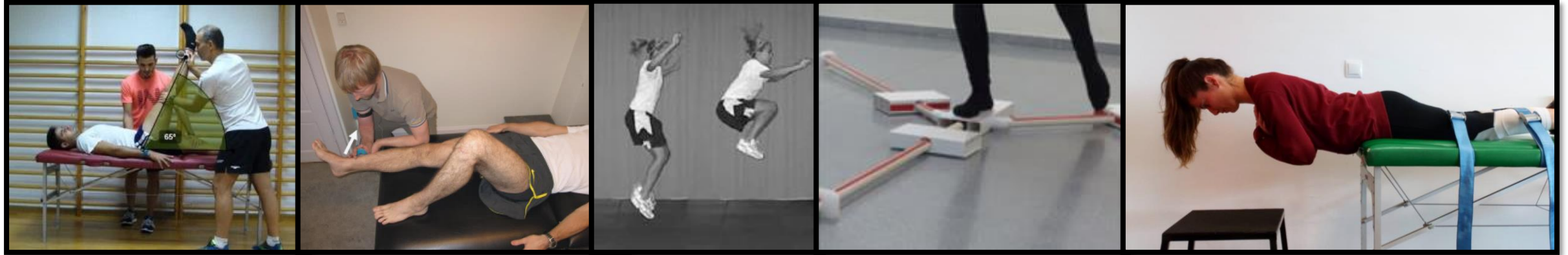


SESSION-RPE + WELLNESS



(Colby et al., 2017; Gabbett, 2016; Gatin et al., 2013; Sampson et al., 2019)

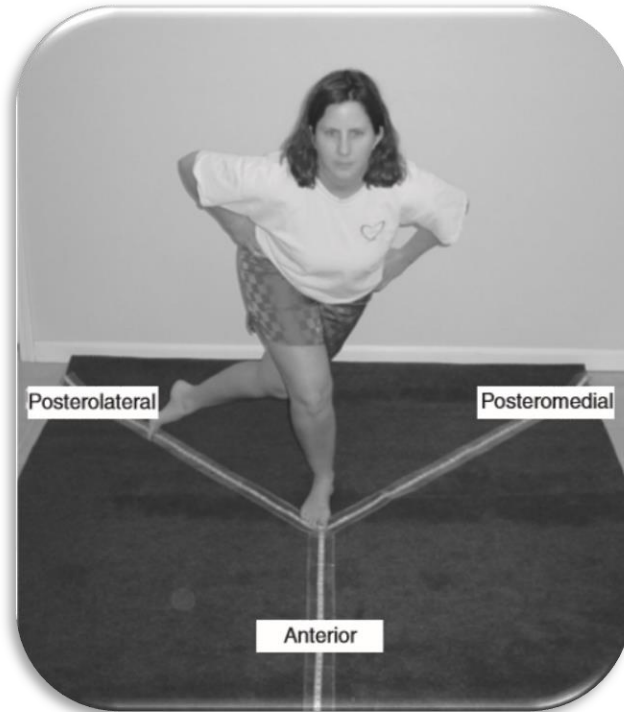
# FACTORES DE RIESGO NEUROMUSCULARES Y BIOMECÁNICOS



<i>Neuromuscular</i>	Decreased resistance to fatigue	M	1	2 (0)	Alentorn-Geli 2015 <sup>54</sup>	-	-
	Altered EMG muscular pre-activity	F	1	3 (0)	Zebis 2009 <sup>55</sup>		
	Core stability	F	1	6 (0)	Zazulak 2007 <sup>51</sup>	Multiple	-
	Decreased knee abductor strength	B	1	5 (0)	Khayambashi 2016 <sup>52</sup>	OR <sup>c</sup> : 1.12	1.05-1.20
	Decreased hip external rotation strength	B	1	5 (0)	Khayambashi 2016 <sup>52</sup>	OR <sup>c</sup> : 1.23	1.08-1.39
	Decreased hamstring strength	F	1	3 (0)	Myer 2009 <sup>52</sup>	-	-
	Multi-Factor strength	B	1	0 (0)	Raschner 2012 <sup>50</sup>	Multiple	-
	Illiotalibial band flexibility	F	1	6 (0)	Kramer 2007 <sup>45</sup>	-	-
<i>Biomechanical</i>	Increased knee abduction moment and angle on landing	F	2	2 (1-3)	Hewett 2005 <sup>60</sup> Myer 2015 <sup>57</sup>	- -	- -
	Increased knee valgus on landing	F	2	2.5 (2-3)	Hewett 2005 <sup>60</sup> Quatman 2011 <sup>61</sup>	- Multiple	- -
	Decreased hip external (ER) & internal (IR) rotation	B	1	3 (0)	Tainaka 2014 <sup>63</sup>	OR <sup>c</sup> : IR: 0.18 OR <sup>c</sup> : ER: 0.23	0.10-0.34 0.14-0.39

(Craig et al., 2018)

# DYNAMIC BALANCE



Basketball players with a composite distance less than 94% of their leg's length are 6.5 more likely to sustain a lower limb injury (Plisky et al., 2006).



An asymmetry in the anterior reach distance  $\geq 4$  cm is significantly associated with a higher risk of injury in female athletes (Plisky et al., 2006; Smith et al., 2015).

# DYNAMIC BALANCE





## 4. Assessing the kinetic chain



# CRITERIOS PARA LA SELECCIÓN DE PRUEBAS



**A) Deporte**

**B) Edad**

**C) Sexo**

**D) Nivel de rendimiento**

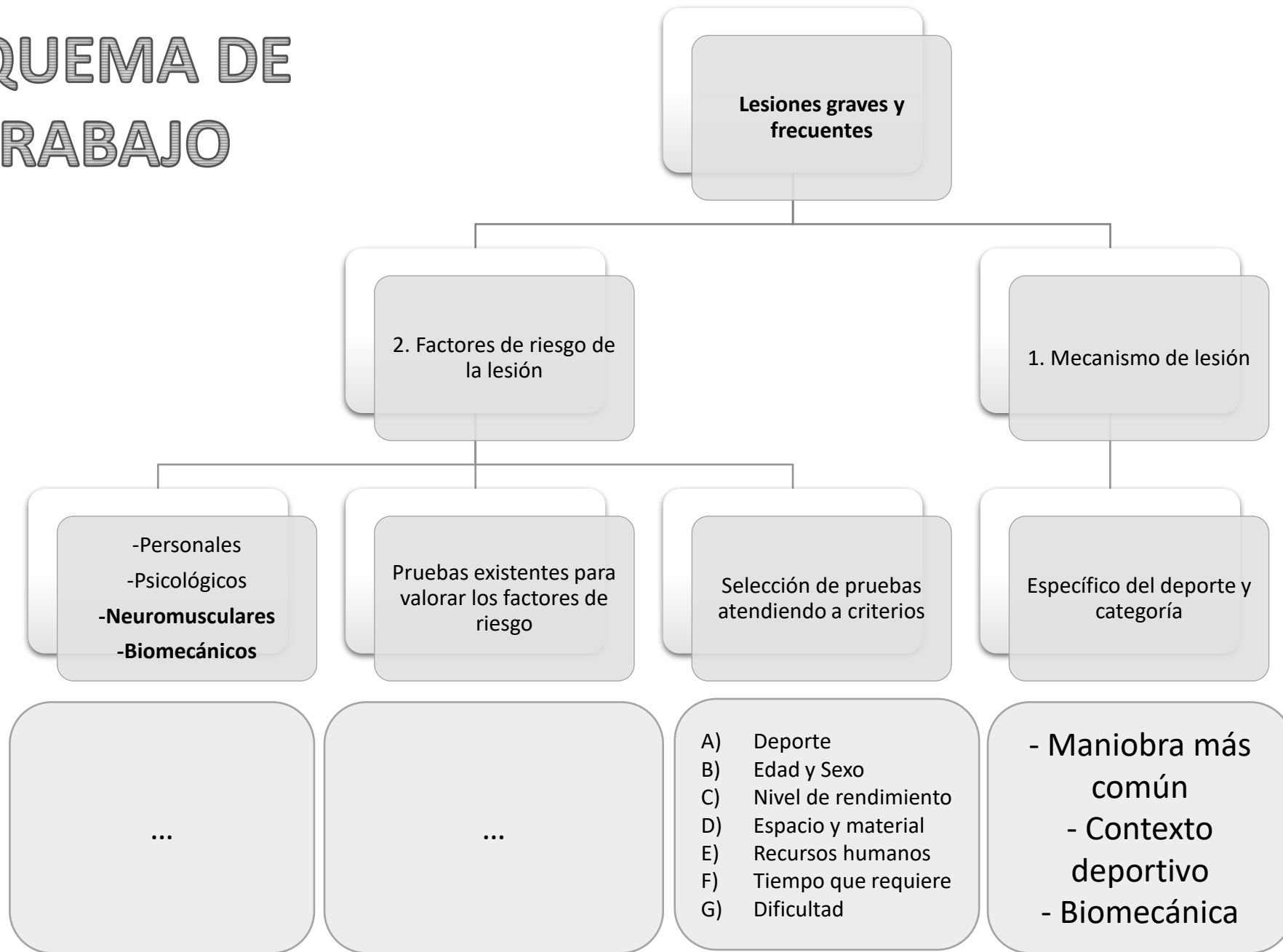
**E) Espacio e instrumentos necesarios (coste)**

**F) Recursos humanos necesarios**

**G) Tiempo que requiere**

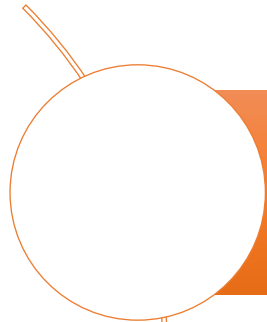
**H) Dificultad en el análisis e interpretación de resultados**

# ESQUEMA DE TRABAJO

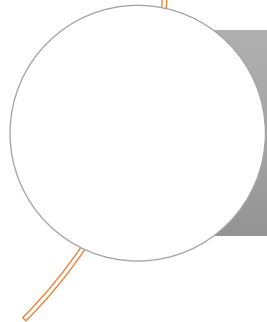




## 4. Assessing the kinetic chain: performance measures



It is important that the tests replicate the key movements of the sport.



Considering conducting them when the athlete is fatigued



# WOMEN SOCCER PROJECT

Grupo de investigación RAQUIS: Aparato locomotor y deporte.  
Facultad de Ciencias del Deporte (San Javier). Universidad de Murcia

UNIVERSIDAD DE MURCIA

**RAQUIS**  
Grupo de Investigación  
Aparato Locomotor y Deporte

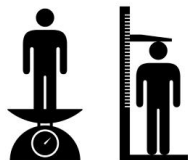
## RESUMEN DE VALORACIONES



Valoraciones presenciales de factores de riesgo de lesión en el propio campo de entrenamiento y seguimiento de las lesiones a lo largo de toda la temporada

Antropometría, mecánicas de salto-aterrizaje, cambio de dirección y sprint

40 min aprox.



1. Peso, altura, etc...

2. Single leg CMJ y Tuck Jump

3. Side-Step cutting 90°

4. Sprint 30 metros

Rango de movimiento, fuerza-resistencia del tronco y fuerza de miembros inferiores

40 min aprox.



5. ROM-SPORT MMII

6. Side-Bridge test

7. Ratio ABD-ADD

Morfotipo raquídeo, patrones motores básicos y control postural dinámico

40 min aprox.



8. Morfotipo sagital integral

9. Valoración Funcional Básica

10. Y-Balance test



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# WOMEN SOCCER PROJECT



IDENTIFICACIÓN DEL RIESGO  
DE LESIÓN EN FÚTBOL FEMENINO

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



## ACL INJURY PREVENTION

# ¡BUENAS NOTICIAS! LOS PROGRAMAS PREVENTIVOS FUNCIONAN

jumping, landing, and cutting movements. A recent 2019 systematic review of randomized controlled trials with meta-analysis of injury prevention programs reported that use of such programs led to a 53% overall reduction in ACL injury rates (24). In this extensive review, the authors found



Huang YL, Jung J, Mulligan CMS, et al. A Majority of Anterior Cruciate Ligament Injuries Can Be Prevented by Injury Prevention Programs: A Systematic Review of Randomized Controlled Trials and Cluster-Randomized Controlled Trials With Meta-analysis. Am J Sports Med 2020;48:1505-15.

## Reducción de lesiones en fútbol femenino: revisión sistemática y meta-análisis de programas preventivos en 11 773 jugadoras de fútbol

Crossley, Patterson, Culvenor, Bruder, Mosler & Mentiplay (2020)



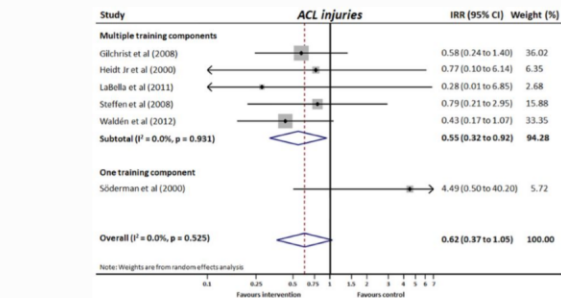
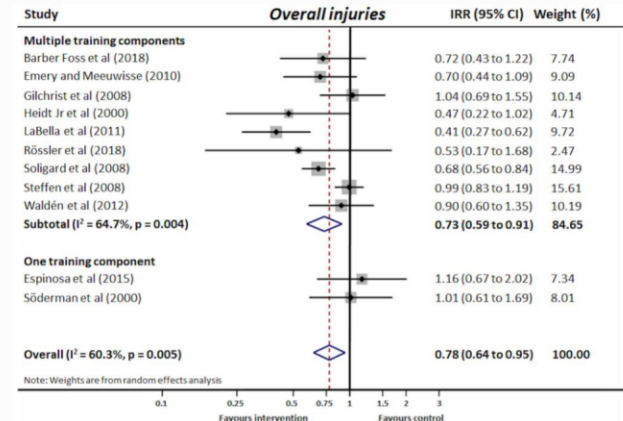
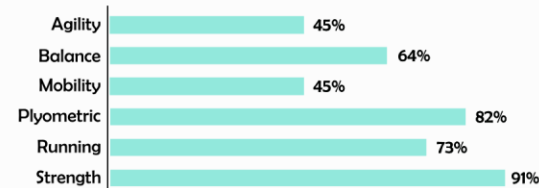
Evaluar los efectos de los programas preventivos sobre la incidencia lesional en el fútbol femenino y explorar las relaciones entre los componentes del entrenamiento y el riesgo de lesión

### Tipos de programas preventivos

- Entrenamiento neuromuscular multicomponente basado en ejercicio físico (n=9 estudios)
- Entrenamiento basado en el ejercicio físico con un sólo componente de trabajo (n=2 estudios): programa de ejercicios de estabilidad en casa y programa de fortalecimiento excéntrico de los isquiosurales.
- El último estudio incluido en la revisión (Zebis et al.) examinó el efecto de un balón de fútbol más pequeño y menos pesado sobre la incidencia

### Intervenciones basadas en el ejercicio físico

	Agility	Balance	Mobility	Plyometric	Running	Strength
Barber Foss et al.		★		★		★
Emery and Meeuwisse		★	★	★	★	★
Espinosa et al.						★
Gilchrist et al.	★		★	★	★	★
Heidt et al.	★		★	★	★	★
LaBella et al.	★		★	★	★	★
Rössler et al.		★		★	★	★
Söderman et al.		★				
Soligard et al.	★	★	★	★	★	★
Steffen et al.	★	★		★	★	★
Waldén et al.		★		★	★	★



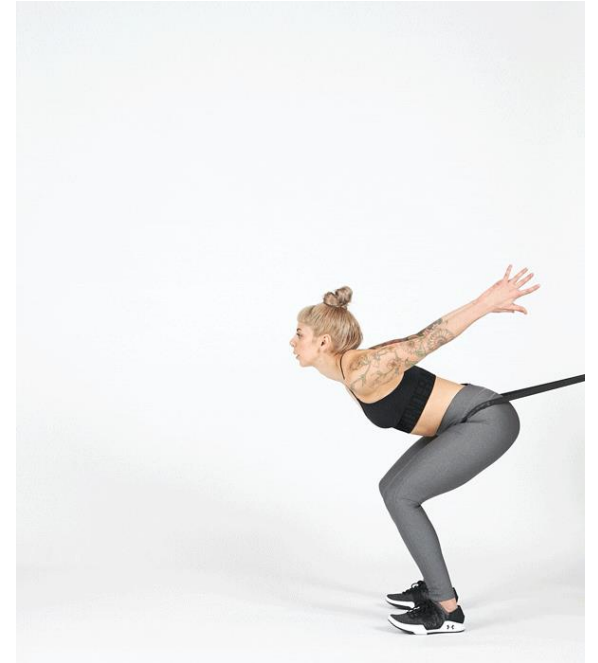
### Puntos clave

- En fútbol femenino, los programas preventivos basados en el ejercicio multicomponente reducen las lesiones totales en un 27% y las lesiones del LCA en un 45%.
- Parece haber mayores reducciones en las lesiones generales y de rodilla, a mayor número de componentes de entrenamiento incluidos en la intervención.



# ACL INJURY PREVENTION

In this extensive review, the authors found strong evidence that the most effective programs included **plyometric, agility, and strengthening exercises**. In a 2-part review of ACL injuries in soccer players, the authors reported that **plyometric activities** have been shown to be one of the most effective component of prevention programs

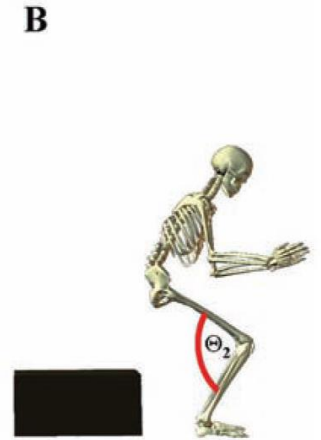
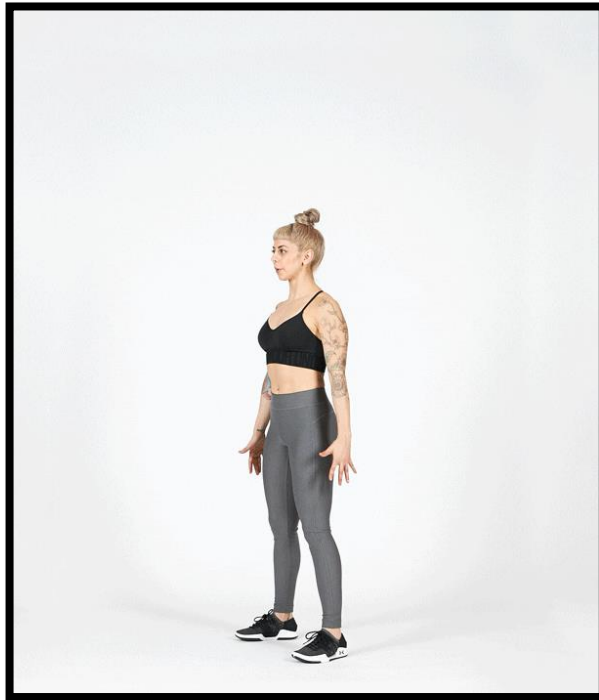


Huang YL, Jung J, Mulligan CMS, et al. A Majority of Anterior Cruciate Ligament Injuries Can Be Prevented by Injury Prevention Programs: A Systematic Review of Randomized Controlled Trials and Cluster-Randomized Controlled Trials With Meta-analysis. *Am J Sports Med* 2020;48:1505-15.



# ACL INJURY PREVENTION

The preventative outcomes that result from plyometric training are related to improved landing mechanics, and some studies have specifically observed a **decrease in knee valgus and increase in knee flexion** at landing after implementing training

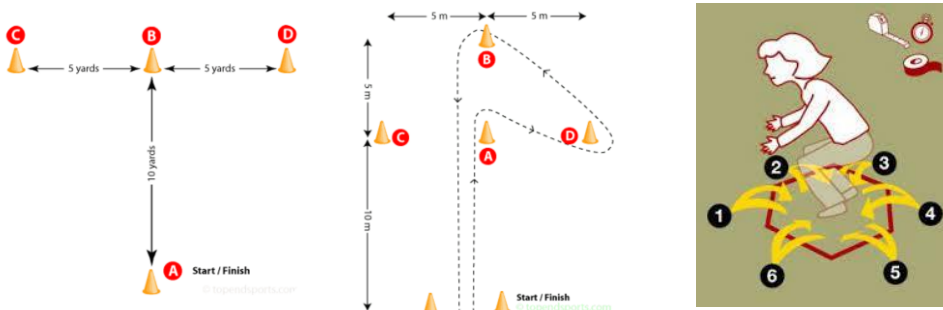
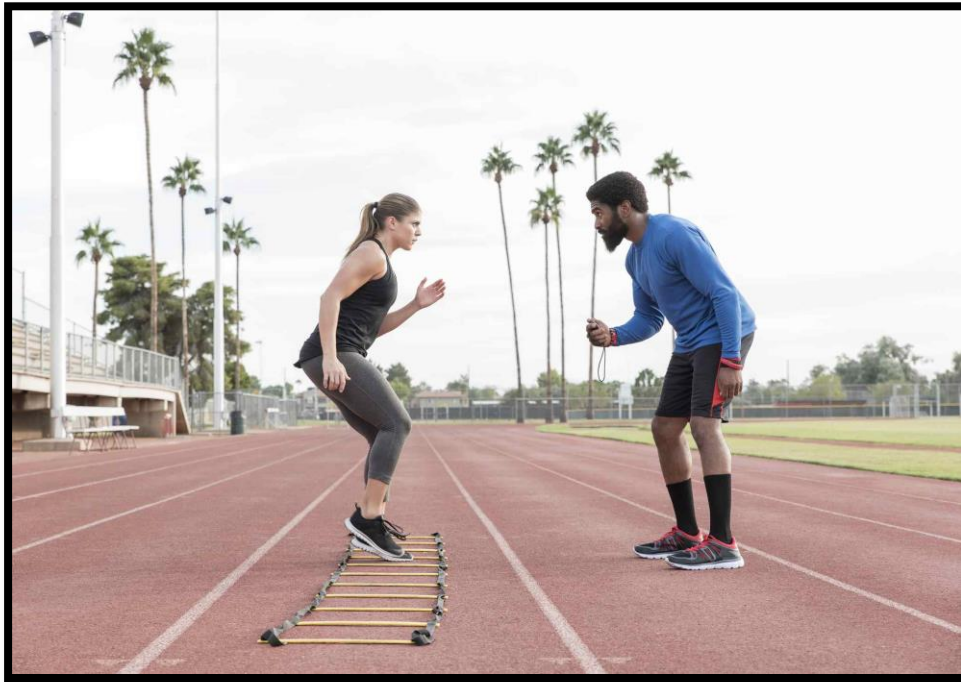


Willadsen EM, Zahn AB, Durall CJ. What Is the Most Effective Training Approach for Preventing Noncontact ACL Injuries in High School–Aged Female Athletes? J Sport Rehabil 2019;28:94-8.



# ACL INJURY PREVENTION

Agility exercises appear to be more impactful when these are **sport-specific** and are performed in combination with **plyometric, strength, and balance** exercises as part of a **multicomponent program**



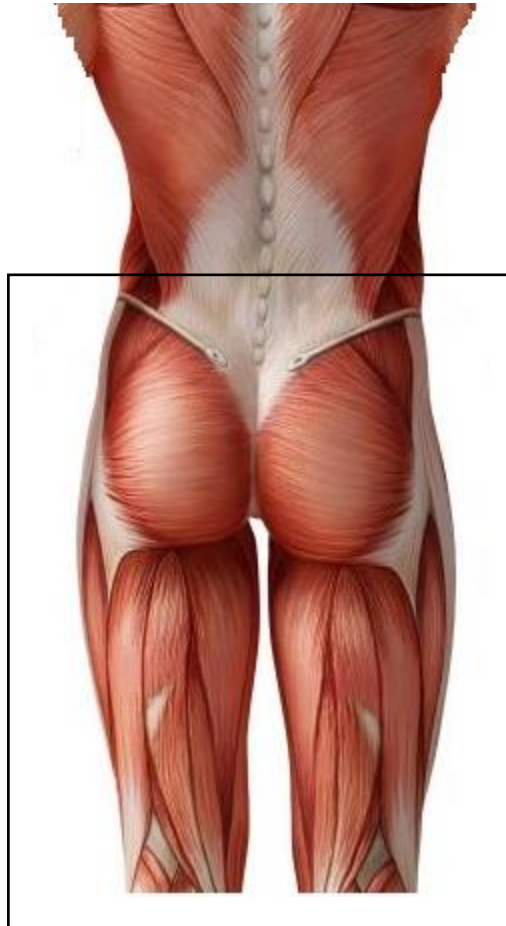
Brunner R, Friesenbichler B, Casartelli NC, et al. (2019)





# ACL INJURY PREVENTION

Lower body strength training has also been frequently reported to be an imperative component of reducing ACL injury risk. As described by Acevedo *et al.*, specific targets to consider include the **hamstring** muscle and the **gluteus maximus** and **medius** muscles



Acevedo RJ, Rivera-Vega A, Miranda G, et al. Anterior Cruciate Ligament Injury.



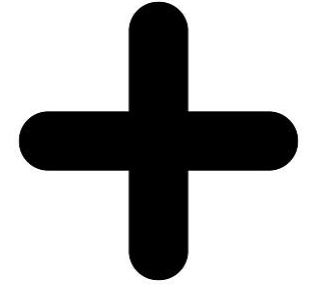
# ACL INJURY PREVENTION

Separate analyses have also specified an importance of including **balance training** in multicomponent prevention programs





# ACL INJURY PREVENTION



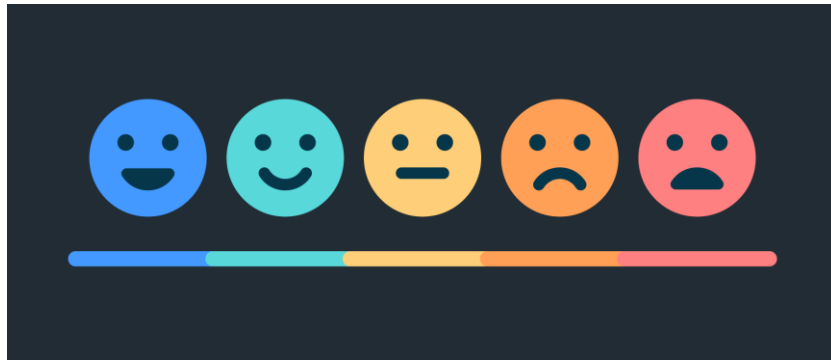
## Flexibility and mobility exercises





# ACL INJURY PREVENTION

In addition to the program itself, studies have shown the importance of **providing feedback**, particularly placing **emphasis on good technique and correcting errors**, in effectively reducing ACL injury.



**Table 1** Summary of established prevention programs and their impact on anterior cruciate ligament (ACL) injury rates

Program	Training components	Duration and format	Reduction in injury rate	Reference(s)
Prevent Injury and Enhance Performance™ (PEP)	3 basic warm-up activities, 5 stretching techniques for trunk and lower extremity, 3 strengthening exercises, 5 plyometric activities, and 3 sport-specific agility drills	20 min/session, 3 times a week, on-field warm-up to replace traditional warm-up	Up to 88%	Mandelbaum <i>et al.</i> (30)
The "HarmoKnee" Program	Warm-up, muscle activation, balance, strength, and core stability	20–25 min/session, twice a week during preseason, once a week during regular season	70%	Kiani <i>et al.</i> (31)
FIFA 11+	Part 1: initial running exercise session at lower intensity with forward, backwards, and sideways jogging, and active stretching  Part 2: 6-set exercise session focusing on strength, plyometrics, and balance, with 3 levels of difficulty for each exercise Part 3: intensive running exercise session with more high-speed and change-of-direction running	20 min/session, at least twice a week, standard on-field warm-up, only part 1 performed prior to matches	20–50% in the long term	Bizzini <i>et al.</i> (32), Al Attar <i>et al.</i> (33)
Knäkontroll (SISU Idrottsböcker, Sweden, 2005)	Low intensity running followed by 6 exercises focusing on knee control and core stability: one-legged knee squat, pelvic lift, two-legged knee squat, the bench, the lunge, and jump/landing technique; each exercise is subdivided into 4 steps of increasing difficulty (progression is sport-specific and based on feedback of good technique) and a partner exercise for variation	15 min/session, 2 times a week, on-field warm-up	64%	Hägglund <i>et al.</i> (34), Waldén <i>et al.</i> (35)
Sportsmetrics™	Stretching, jump training exercises/plyometrics, strength and weight training, and sport-specific agility drills	90 min/session, 3 times a week for 6 weeks	3.6 times higher injury incidence in untrained female athletes vs. trained female athletes	Hewett <i>et al.</i> (36), Barber-Westin <i>et al.</i> (37)

<https://la84.org/a-practicalguide-to-the-pep-program/>

<http://www.harmoknee.com/>

<https://www.fifamedicalnetwork.com/lessons/prevention-fifa-11/>

[https://www.fifamedicalnetwork.com/wp-content/uploads/cdn/20\\_years\\_of\\_fm marc.pdf](https://www.fifamedicalnetwork.com/wp-content/uploads/cdn/20_years_of_fm marc.pdf)

<https://utbildning.sisuidrottsbocker.se/fotboll/tranare/spelarutbildning/knakontroll/>

<https://sportsmetrics.org/>



## ACL INJURY PREVENTION

Despite the substantial evidence of the effects of ACL injury prevention programs and their value in benefiting athletes, ACL injury rates have not successfully improved





# ACL INJURY PREVENTION

Los programas se usan poco

Falta formación a entrenadorxs y preparadorxs físicos

Tareas y ejercicios planteados deben ser específicos del deporte

Debe haber mayor implicación del cuerpo técnico en el diseño del programa





# ACL INJURY PREVENTION

Entrenamiento  
multicomponente

Pliometría

Agilidad (tareas  
adaptadas al  
deporte)

Fuerza (isquios,  
glúteo mayor y  
glúteo medio)

Estabilidad y  
propiocepción

LO IDEAL ES QUE EL CUERPO TÉCNICO DISEÑE EL PROGRAMA EN CONJUNTO Y QUE ÉSTE SEA ADAPTADO AL DEPORTE, CATEGORÍA, SEXO, NIVEL Y RECURSOS DE CADA EQUIPO