

Supplementary table 1 Football-specific variables recorded for 39 ACL injury cases analysed using systematic video analysis

Case	Playing situation	Field location	Player action	Duel type	Player contact preceding injury	Player contact at injury
Pressing						
#3	Defense	Midfield zone 2	No ball possession	Pressing	No	No
#9	Defense	Midfield zone 1	No ball possession	Pressing	No	Indirect, to trunk/arm
#11	Defense	Midfield zone 1	No ball possession	Pressing	No	No
#13	Defense	Midfield zone 2	No ball possession	Pressing	No	No
#17	Defense	Defensive third	No ball possession	Pressing	No	No
#25	Defense	Midfield zone 2	No ball possession	Pressing	No	No
#26	Defense	Defensive third	No ball possession	Pressing	No	No
#28	Defense	Offensive third	No ball possession	Pressing	No	No
#32	Defense	Offensive third	No ball possession	Pressing	No	No
#37	Defense	Midfield zone 1	No ball possession	Pressing	No	No
#40	Defense	Midfield zone 2	No ball possession	Pressing	No	No
Kicking						
#2	Offense	Offensive third	Passing	No duel	No	No
#15	Defense	Midfield zone 1	Clearing	Other (clash of legs)	Yes, to injured leg	Yes, to trunk/arm
#30	Offense	Offensive third	Shooting	Tackled by other player	Yes, to uninjured leg	No
#38	Defense	Midfield zone 1	Clearing	No duel	No	No
#39	Defense	Defensive third	Clearing	Tackled by other player	Yes, to trunk/arm	Yes, to trunk/arm
Heading						
#10	Defense	Midfield zone 1	Heading	Heading duel	Yes, to trunk/arm	No
#14	Defense	Defensive third	Heading	No duel	No	No

#18	Defense	Defensive third	Heading	No duel	No	No
#27	Defense	Midfield zone 1	Heading	Heading duel	Yes, to trunk/arm	No
#35	Offense	Offensive third	Heading	No duel	No	No
Other						
#1	Offense	Midfield zone 2	Screening	Tackled by other player	No	Yes, to injured knee
#4	Defense	Defensive third	No ball possession	Running	Yes, to trunk/arm	Yes, to trunk/arm
#5	Defense	Defensive third	Screening	Screening	Yes, to trunk/arm	Yes, to trunk/arm
#6	Defense	Defensive third	No ball possession	Running	Yes, to trunk/arm	Yes, to trunk/arm
#7	Defense	Offensive third	No ball possession	No duel	Yes, to injured leg	No
#8	Offense	Offensive third	Receiving	No duel	No	No
#12	Defense	Defensive third	No ball possession	No duel	No	No
#16	Offense	Midfield zone 2	Screening	Tackled by other player	Yes, to trunk/arm	Yes, to injured knee
#19	Defense	Defensive third	Turning	Tackled by other player	Yes, to trunk/arm	Yes, to injured knee
#20	Defense	Defensive third	No ball possession	Running	No	No
#21	Offense	Offensive third	Dribbling	Tackled by other player	Yes, to uninjured leg	No
#22	Defense	Defensive third	Other (goalkeeping)	Collision	No	Yes, to injured leg (not knee)
#23	Offense	Midfield zone 2	Receiving	No duel	No	No
#24	Defense	Defensive third	No ball possession	Collision	Yes, to trunk/arm	Yes, to injured knee
#29	Defense	Midfield zone 1	Passing	Collision	No	Yes, to injured knee
#33	Defense	Midfield zone 2	No ball possession	Collision	Yes, to trunk/arm and injured leg	Yes, to trunk/arm
#34	Defense	Defensive third	No ball possession	Running	Yes, to trunk/arm	Yes, to trunk/arm
#36	Offense	Midfield zone 2	No ball possession	No duel	No	No

ACL, anterior cruciate ligament.

Supplementary table 2 Biomechanical variables recorded for 33 non-contact and indirect contact ACL injury cases analysed using systematic video analysis

Case	In balance	Movement	Cutting angle	Leg loading	Horizontal speed at IC	Vertical speed at IC	Trunk rotation at IF	Foot rotation at IC	Foot strike
Pressing									
#3	Yes	Forward	30-90°	One leg	High	Zero	Neutral	External	Heel
#9	Yes	Forward	30-90°	One leg	High	Zero	Toward uninjured leg	Neutral	Heel
#11	Yes	Forward	30-90°	One leg	Low	Zero	Unsure	Unsure	Unsure
#13	Yes	Forward	30-90°	One leg	High	Zero	Neutral	Neutral	Unsure
#17	Yes	Sideways	30-90°	One leg	Low	Zero	Neutral	Internal >45°	Toe
#25	Yes	Forward	Stopping/>90°	One leg	High	Zero	Toward uninjured leg	Neutral	Heel
#26	No	Forward	30-90°	One leg	High	Zero	Toward uninjured leg	External	Heel
#28	Yes	Forward	30-90°	One leg	High	Zero	Toward uninjured leg	Neutral	Flat
#32	Yes	Forward	30-90°	One leg	Low	Zero	Toward uninjured leg	Neutral	Heel
#37	Yes	Forward	30-90°	One leg	High	Zero	Neutral	Neutral	Heel
#40	No	Forward	0-30°	One leg	High	Zero	Toward uninjured leg	External	Heel
Kicking									
#2	No	Sideways	Stopping/>90°	One leg	High	Zero	Neutral	Internal >45°	Unsure
#15	No	Backward	N/A	One leg	Low	Zero	Neutral	N/A	Toe
#30	No	Backward	N/A	One leg	Low	Zero	N/A	N/A	Toe
#38	No	Sideways	N/A	One leg	Low	Zero	Toward uninjured leg	Internal >45°	Toe
#39	No	Forward	Stopping/>90°	Two legs, mainly injured leg	Low	Zero	Toward uninjured leg	Neutral	Flat
Heading									
#10	No	Downward	N/A	One leg	Zero	High	Neutral	N/A	Toe
#14	Yes	Backward	N/A	One leg	Low	Low	Toward uninjured leg	N/A	Toe

#18	Yes	Sideways	Stopping/>90°	Two legs, mainly injured leg	Low	Low	Neutral	Internal >45°	Flat
#27	No	Downward	Stopping/>90°	One leg	Zero	High	Toward uninjured leg	Neutral	Toe
#35	No	Forward	30-90°	One leg	Low	High	Neutral	Neutral	Toe
Other									
#4	Unsure	Forward	0-30°	Unsure	High	Zero	Unsure	Unsure	Unsure
#5	Yes	Forward	Stopping/>90°	Two legs, mainly injured leg	Low	Zero	Neutral	Neutral	Flat
#6	Unsure	Forward	30-90°	One leg	High	Zero	Toward uninjured leg	External	Heel
#7	No	Forward	Stopping/>90°	One leg	High	Zero	Toward uninjured leg	Internal 0-45°	Heel
#8	Yes	Sideways	Stopping/>90°	One leg	Low	Zero	Toward uninjured leg	Internal >45°	Flat
#12	No	Sideways	Stopping/>90°	Two legs, mainly injured leg	Low	Zero	Toward uninjured leg	Internal >45°	Flat
#20	No	Forward	Stopping/>90°	One leg	High	Zero	Toward uninjured leg	Unsure	Unsure
#21	No	Combined*	30-90°	One leg	High	Zero	Neutral	Neutral	Flat
#23	Yes	Sideways	30-90°	One leg	Low	Low	Toward injured leg	External	Toe
#33	No	Forward	0-30°	Two legs, mainly injured leg	High	Zero	Toward uninjured leg	Unsure	Unsure
#34	No	Forward	0-30°	One leg	High	Zero	Toward injured leg	Neutral	Heel
#36	Yes	Forward	Stopping/>90°	One leg	High	Zero	Neutral	Internal 0-45°	Heel

ACL, anterior cruciate ligament; IC, initial contact; IF, index frame.

*Combined forward and sideways.

Supplementary table 3 Joint flexion angles of the hip, knee and ankle joints for the main non-contact and indirect contact ACL injury mechanisms

Case	Hip flexion angle (°)*				Knee flexion angle (°)*				Ankle flexion angle (°)*			
	IC	IC+40 ms	IC+80 ms	IF	IC	IC+40 ms	IC+80 ms	IF	IC	IC+40 ms	IC+80 ms	IF
Pressing†												
#3	25 (±13)	35 (±15)	35 (±14)	35 (±14)	10 (±0)	27.5 (±6)	45 (±6)	45 (±6)	0 (±4)	Unsure	Unsure	Unsure
#9	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure
#13	10 (±9)	15 (±10)	40 (±12)	40 (±12)	0 (±3)	30 (±10)	55 (±9)	55 (±9)	10 (±8)	10 (±7)	-10 (±11)	-10 (±11)
#17	40 (±5)	30 (±5)	40 (±7)	30 (±3)	20 (±4)	25 (±1)	35 (±3)	30 (±5)	30 (±8)	0 (±4)	-5 (±6)	-5 (±4)
#25	10 (±8)	20 (±5)	40 (±3)	20 (±5)	5 (±3)	30 (±4)	60 (±8)	30 (±4)	Unsure	5 (±3)	-5 (±3)	5 (±3)
#26	20 (±7)	30 (±8)	35 (±6)	35 (±6)	10 (±4)	10 (±8)	20 (±7)	20 (±7)	10 (±8)	20 (±10)	10 (±8)	10 (±9)
#28	30 (±11)	30 (±9)	30 (±7)	30 (±7)	5 (±4)	10 (±3)	20 (±6)	30 (±8)	10 (±2)	5 (±5)	0 (±4)	-5 (±2)
#32	20 (±5)	20 (±4)	20 (±6)	20 (±6)	5 (±3)	20 (±4)	30 (±5)	25 (±5)	-10 (±4)	10 (±3)	-5 (±2)	0 (±2)
#37	25 (±7)	35 (±9)	30 (±6)	30 (±8)	10 (±2)	30 (±7)	40 (±11)	35 (±10)	15 (±7)	0 (±1)	-5 (±5)	-5 (±4)
#40	30 (±9)	30 (±3)	30 (±6)	30 (±3)	5 (±7)	20 (±7)	40 (±6)	20 (±7)	0 (±5)	15 (±5)	10 (±2)	15 (±5)
Kicking												
#2	15 (±6)	10 (±3)	Unsure	Unsure	10 (±5)	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure
#15	25 (±10)	22.5 (±10)	30 (±8)	30 (±8)	15 (±4)	25 (±9)	35 (±12)	30 (±11)	10 (±1)	0 (±3)	0 (±7)	0 (±6)
#30	10 (±6)	15 (±5)	20 (±5)	20 (±5)	10 (±8)	15 (±7)	20 (±6)	15 (±7)	20 (±5)	0 (±4)	5 (±6)	5 (±4)
#38	5 (±5)	20 (±5)	30 (±8)	20 (±5)	15 (±3)	30 (±6)	45 (±5)	30 (±6)	15 (±3)	10 (±3)	5 (±6)	10 (±5)

#39	10 (± 6)	30 (± 9)	40 (± 7)	20 (± 6)	10 (± 8)	35 (± 6)	50 (± 11)	25 (± 7)	10 (± 2)	-5 (± 2)	-5 (± 3)	0 (± 2)
Heading‡:												
#10	5 (± 8)	Unsure	Unsure	Unsure	0 (± 1)	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure
#18	40 (± 4)	45 (± 2)	45 (± 4)	45 (± 3)	5 (± 2)	45 (± 10)	55 (± 7)	50 (± 9)	0 (± 4)	-15 (± 3)	-15 (± 5)	-15 (± 3)
#27	15 (± 4)	20 (± 5)	30 (± 3)	25 (± 4)	5 (± 4)	20 (± 5)	30 (± 11)	25 (± 7)	30 (± 4)	0 (± 4)	0 (± 9)	0 (± 6)
#35	0 (± 3)	10 (± 3)	15 (± 6)	15 (± 6)	10 (± 1)	17.5 (± 4)	30 (± 4)	30 (± 4)	30 (± 4)	0 (± 3)	-10 (± 3)	-10 (± 3)

ACL, anterior cruciate ligament; IC, initial contact; IF, index frame.

*Flexion angles are reported as the median of the individual estimates along with the mean absolute deviation from the median. Positive values mean flexion and negative values mean extension.

†Case #11 excluded.

‡Case #14 excluded.