

SUPPLEMENTARY MATERIAL

Table S1: The *COL12A1* rs970547 (A/G) genotype effects on all the participants general characteristics, Beighton score and sit and reach measurements, as well as the subset of participants that had their external and internal tibial rotation measured using the Robotic Knee Testing (RKT) device.

<i>COL12A1</i> rs970547	All Participants			External and Internal Rotation		
	AA	AG + GG ^a	P-value	AA	AG + GG ^b	P-value
	n = 71	n = 56		n = 40	n = 38	
Sex (% male)	57.7 (41)	57.1 (32)	1.000	65.0 (26)	57.9 (22)	0.642
Age (years)	26.0 (24.0; 32.0)	27.0 (24.3; 32.3)	0.280	25.5 (23.0; 28.8)	28.0 (25.0; 30.8)	0.067
Height (cm)	174.8 ± 10.2	174.0 ± 9.4	0.674	175.7 ± 9.7	174.5 ± 9.8	0.585
Weight (kg)	74.4 ± 13.3	71.1 ± 12.4	0.149	75.0 (67.7; 87.4)	74.2 (60.5; 79.3)	0.095
BMI (kg/m ²)	23.8 (22.1; 25.7)	23.5 (21.1; 25.7)	0.204	24.1 (22.7; 26.4)	23.7 (21.2; 25.5)	0.106
Flexibility Training (% Yes)	59.2 (42)	50.0 (28)	0.370	60.0 (24)	50.0 (19)	0.495
Beighton Score	1.0 (0.0; 3.0)	1.5 (0.0; 5.0)	0.391	2.0 (0.0; 3.0)	1.5 (0.0; 5.0)	0.511
Sit and Reach (cm)	43.9 ± 10.6 ^c	41.2 ± 10.4 ^d	0.161	46.1 ± 9.6 ^e	41.1 ± 10.5	0.034

Sex and flexibility training are reported as relative percentages with number of males and participants who do flexibility training, respectively, in parenthesis. The remaining continuous variables are reported as average ± standard deviation or median (IQR) for parametric and non-parametric data respectively

Unable to genotype 1 participant for rs970547

Significant differences are indicated in bold

BMI, body mass index

The rare GG (^a n = 7, ^b n = 6) genotype and the GA genotype were combined for the analysis

^c n = 68, ^d n = 55, ^e n = 37

Table S2: The *TNC* rs1061494 (T/C) genotype effects on all the participants general characteristics, Beighton score and sit and reach measurements, as well as the subset of participants that had their external and internal tibial rotation measured using the Robotic Knee Testing (RKT) device.

<i>TNC</i> rs1061494	All Participants				External and Internal Rotation			
	TT	TC	CC	P-Value	TT	TC	CC	P-Value
	n = 38	n = 62	n = 28		n = 25	n = 35	n = 18	
Sex (% male)	47.4 (18)	59.7 (37)	67.9 (19)	0.229	60.0 (15)	54.3 (19)	77.8 (14)	1.000 ^a
Age (years)	25.0 (23.0; 33.0)	27.0 (24.8; 30.0)	30.0 (24.5; 34.5)	0.176	25.0 (23.0; 28.5)	27.0 (25.0; 32.3)	28.5 (25.5; 32.3)	0.091
Height (cm)	173.0 ± 9.8	175.9 ± 9.8	173.8 ± 9.8	0.304	174.2 ± 10.6	174.6 ± 9.7	177.2 ± 8.6	0.569
Weight (kg)	71.9 (60.2; 80.7)	74.9 (62.1; 84.5)	73.5 (62.1; 78.3)	0.474	74.3 ± 12.6	73.2 ± 13.1	76.0 ± 11.7	0.293
BMI (kg/m ²)	23.8 (22.1; 25.2)	23.8 (21.2; 26.1)	23.4 (21.5; 25.8)	0.949	24.0 (22.8; 25.7)	23.8 (21.2; 25.5)	23.9 (21.6; 25.9)	0.662
Flexibility Training (% Yes)	47.4 (18)	56.5 (35)	60.7 (17)	0.520	48.0 (12)	57.1 (20)	61.1 (11)	0.660
Beighton Score	1.0 (0.0; 3.3)	2.0 (0.0; 4.0)	1.0 (0.0; 4.8)	0.486	1.0 (0.0; 4.0)	3.0 (1.0; 4.0)	1.0 (0.0; 4.0)	0.379
Sit and Reach (cm)	41.9 ± 9.8	42.7 ± 11.8 ^b	42.8 ± 10.1 ^c	0.929	41.0 (35.3; 47.8)	45.4 (33.6; 54.1) ^d	44.0 (41.3; 48.5) ^e	0.330

Sex and flexibility training are reported as relative percentages with number of males and participants who do flexibility training, respectively, in parenthesis.

The remaining continuous variables are reported as average ± standard deviation or median (IQR) for parametric and non-parametric data respectively

BMI, body mass index

^a The TC and CC genotypes were combined for the analysis because there were only 4 females in the CC genotype group

^b n = 60, ^c n = 26, ^d n = 34, ^e n = 16

Table S3: The *TNC* rs1138545 (C/T) genotype effects on all the participants general characteristics, Beighton score and sit and reach measurements, as well as the subset of participants that had their external and internal tibial rotation measured using the Robotic Knee Testing (RKT) device.

<i>TNC</i> rs1138545	All Participants			External and Internal Rotation		
	CC	CT + TT ^a	P-value	CC	CT + TT ^b	P-value
	n = 95	n = 31		n = 57	n = 20	
Sex (% male)	62.1 (59)	45.2 (14)	0.142	63.2 (36)	60.0 (12)	0.796
Age (years)	26.0 (24.0; 32.0)	28.0 (25.0; 33.0)	0.182	26.0 (24.0; 30.0)	29.0 (25.3; 33.0)	0.089
Height (cm)	176.0 (167.0; 182.4)	171.2 (164.4; 181.2)	0.135	175.9 ± 9.7	173.5 ± 9.5	0.338
Weight (kg)	74.4 (62.4; 81.5)	71.0 (60.2; 80.9)	0.275	74.4 ± 12.1	74.4 ± 13.8	0.999
BMI (kg/m ²)	24.0 ± 3.0	23.8 ± 3.2	0.827	24.0 ± 2.8	24.6 ± 3.4	0.410
Flexibility Training (% Yes)	53.7 (95)	58.1 (18)	0.685	54.4 (31)	55.0 (11)	1.000
Beighton Score	1.0 (0.0; 4.0)	2.0 (1.0; 5.0)	0.155	1.0 (0.0; 4.0)	2.0 (1.0; 4.8)	0.296
Sit and Reach (cm)	42.6 ± 10.6 ^c	43.6 ± 10.2	0.633	44.4 ± 9.6 ^d	42.2 ± 11.6	0.405

Sex and flexibility training are reported as relative percentages. The remaining continuous variables are reported as average ± standard deviation or median (IQR) for parametric and non-parametric data respectively

Unable to genotype 2 participants for rs1138545

BMI, body mass index

The rare TT (^a n = 4, ^b n = 1) genotype and the CT genotype were combined for the analysis

^c n = 91, ^d n = 54

Table S4: The *TNC* rs2104772 (T/A) genotype effects on all the participants general characteristics, Beighton score and sit and reach measurements, as well as the subset of participants that had their external and internal tibial rotation measured using the Robotic Knee Testing (RKT) device.

<i>TNC</i> rs2104772	All Participants				External and Internal Rotation			
	TT	TA	AA	P-Value	TT	TA	AA	P-Value
	n = 50	n = 62	n = 15		n = 30	n = 38	n = 10	
Sex (% male)	64.0 (32)	53.2 (33)	60.0 (9)	0.511	63.3 (19)	57.9 (22)	70.0 (7)	0.816 ^a
Age (years)	26.0 (23.0; 30.0)	27.0 (24.0; 34.0)	27.0 (26.0; 32.0)	0.125	26.0 (23.0; 29.3)	27.5 (23.8; 33.3)	26.0 (25.0; 29.3)	0.430
Height (cm)	175.4 ± 9.5	173.4 ± 9.9	176.2 ± 10.8	0.803	175.1 (171.8; 181.0)	174.3 (164.4; 182.6)	183.0 (173.7; 186.2)	0.203
Weight (kg)	75.8 (62.4; 86.6)	73.1 (60.5; 80.6)	76.5 (61.8; 88.0)	0.301	74.2 ± 13.3	72.5 ± 11.5	80.8 ± 12.7	0.177
BMI (kg/m ²)	23.9 (21.1; 26.1)	23.6 (21.5; 25.2)	23.8 (21.9; 25.8)	0.604	24.0 ± 2.8	24.0 ± 2.8	25.0 ± 3.8	0.577
Flexibility Training (% Yes)	54.0 (27)	54.8 (34)	60.0 (9)	0.918	53.3 (16)	55.3 (21)	60.0 (6)	0.819 ^a
Beighton Score	2.0 (0.0; 4.0)	1.0 (0.0; 4.0)	1.0 (1.0; 4.0)	0.708	2.0 (0.0; 4.0)	1.0 (0.0; 3.3)	1.5 (0.8; 4.3)	0.623
Sit and Reach (cm)	41.4 ± 9.6 ^b	42.3 ± 12.1 ^c	46.6 ± 8.7	0.271	43.0 ± 9.0 ^d	43.3 ± 12.3 ^e	46.1 ± 5.2	0.704

Sex and flexibility training are reported as relative percentages. The remaining continuous variables are reported as average ± standard deviation or median (IQR) for parametric and non-parametric data respectively

Unable to genotype 1 participant for rs2104772

BMI, body mass index

^a The TA and AA genotypes were combined for the analysis because there were only 3 females and 4 participants who did not do any flexibility training in the AA genotype group

^b n = 48, ^c n = 60, ^d n = 29, ^e n = 36

Table S5: The *COL12A1* rs970547 (A/G) genotype effects on the (i) passive and active genu recurvatum measurements, and (ii) anterior (Ant) and posterior (Post) tibial translation (displacement), active and maximum (Max) displacement, as well as compliance index measured using the KT-1000 arthrometer of participants uninjured dominant and non-dominant legs.

<i>COL12A1</i> rs970547	Dominant Leg			Non-Dominant Leg		
	AA	AG + GG	P-value	AA	AG + GG	P-value
Genu Recurvatum	n = 64	n = 49 ^c		n = 68	n = 52 ^c	
▪ Passive (°)	177.7 ± 5.3	177.0 ± 6.5	0.533	177.3 ± 5.0	176.8 ± 6.6	0.670
▪ Active (°)	175.8 ± 5.2	174.8 ± 6.4	0.457	175.0 ± 5.0	174.9 ± 6.2	0.933
Ant-Post Translation	n = 64	n = 49 ^c		n = 68	n = 52 ^c	
▪ 133 N Ant Translation (mm)	6.0 (5.0; 8.5)	6.5 (5.0; 8.3)	0.927	7.4 ± 2.2	7.0 ± 2.7	0.387
▪ 133 N Post Translation (mm)	4.5 (3.0; 6.0) ^d	4.0 (3.0; 5.3)	0.251	4.0 (3.0; 5.5) ^e	3.8 (3.0; 5.0)	0.543
▪ Compliance Index (mm)^b	4.7 ± 1.9	4.6 ± 1.9	0.794	4.9 ± 1.9	4.6 ± 2.1	0.350
▪ Active Displacement (mm)	4.0 (2.5; 6.0)	4.0 (2.0; 6.0)	0.753	4.9 ± 2.5	4.9 ± 2.9 ^f	0.940
▪ Max Displacement (mm)	7.0 (5.1; 8.5)	7.0 (5.5; 9.3)	0.911	7.0 (5.0; 10.0)	7.5 (6.0; 9.9)	0.405

Values are expressed as either average ± standard deviation or median (IQR) for parametric and non-parametric data respectively

Unable to genotype 1 participant for rs970547

^a Lower degree values for genu recurvatum indicates a greater amount of hyperextension

^b Compliance index = 133 N - 67 N Anterior Translation

The rare GG (^c n = 7) genotype and the GA genotype were combined for the analysis

^d n = 63, ^e n = 67, ^f n = 51

Table S6: The *TNC* rs1061494 (T/C) genotype effects on the (i) passive and active genu recurvatum measurements, and (ii) anterior (Ant) and posterior (Post) tibial translation (displacement), active and maximum (Max) displacement, as well as compliance index, measured using the KT-1000 arthrometer of participants uninjured dominant and non-dominant legs.

<i>TNC</i> rs1061494	Dominant Leg				Non-Dominant Leg			
	TT	TC	CC	P-Value	TT	TC	CC	P-Value
Genu Recurvatum^a	n = 37	n = 55	n = 22		n = 37	n = 58	n = 25	
▪ Passive (°)	178.4 ± 5.4	176.3 ± 6.5	178.7 ± 4.2	0.249	178.4 ± 5.9	176.6 ± 6.0	176.4 ± 4.6	0.254
▪ Active (°)	176.4 ± 5.3	174.0 ± 6.1	176.6 ± 4.8	0.066	175.7 ± 5.7	174.6 ± 5.6	174.6 ± 5.0	0.576
Ant-Post Translation	n = 37	n = 55	n = 22		n = 37	n = 58	n = 25	
▪ 133 N Ant Translation (mm)	6.5 (5.0; 8.3)	6.5 (5.5; 8.5)	6.0 (4.9; 8.1)	0.814	7.2 ± 2.3	7.1 ± 2.4	7.4 ± 2.9	0.091
▪ 133 N Post Translation (mm)	4.0 (3.5; 6.0)	4.0 (3.0; 6.0)	4.0 (3.0; 5.0) ^c	0.835	3.5 (3.0; 5.0)	4.3 (3.0; 6.0)	4.0 (3.0; 5.0) ^d	0.308
▪ Compliance Index (mm)^b	4.6 ± 1.8	4.9 ± 2.0	4.4 ± 1.7	0.532	4.5 (3.5; 6.5)	4.3 (3.0; 6.0)	4.5 (3.0; 7.0)	0.478
▪ Active Displacement (mm)	4.0 (2.0; 5.8)	4.0 (3.0; 6.0)	3.3 (1.0; 6.0)	0.270	4.5 (2.8; 7.0)	5.0 (3.0; 7.0) ^e	5.0 (1.8; 7.0)	0.886
▪ Max Displacement (mm)	7.0 (5.3; 8.5)	7.0 (6.0; 8.5)	7.3 (4.5; 10.0)	0.637	7.0 (5.0; 10.0)	7.0 (6.0; 10.3)	7.0 (5.0; 10.0)	0.497

Values are expressed as either average ± standard deviation or median (IQR) for parametric and non-parametric data respectively

^a Lower degree values for genu recurvatum indicates a greater amount of hyperextension

^b Compliance index = 133 N - 67 N Anterior Translation

^c n = 21, ^d n = 24, ^e n = 57

Table S7: The *TNC* rs1138545 (C/T) genotype effects on the (i) passive and active genu recurvatum measurements, (ii) anterior (Ant) and posterior (Post) tibial translation (displacement), active and maximum (Max) displacement, as well as compliance index measured using the KT-1000 arthrometer, and (iii) external and internal tibial rotation, as well as slack measured using the Robotic Knee Testing (RKT) device of participants uninjured dominant and non-dominant legs.

<i>TNC</i> rs1138545	Dominant Leg			Non-Dominant Leg		
	CC	CT + TT	P-value	CC	CT + TT	P-value
Genu Recurvatum ^a	n = 86	n = 26 ^c		n = 87	n = 31 ^c	
▪ Passive (°)	179.0 (174.0; 182.0)	177.3 (172.0; 182.4)	0.596	177.2 ± 5.8	177.1 ± 5.7	0.968
▪ Active (°)	175.4 ± 5.5	175.6 ± 6.1	0.897	175.2 ± 5.5	174.6 ± 5.5	0.630
Ant-Post Translation	n = 86	n = 26 ^d		n = 87	n = 31 ^d	
▪ 133 N Ant Translation (mm)	6.0 (5.0; 8.5)	7.0 (5.9; 7.6)	0.608	7.1 ± 2.4	7.5 ± 2.8	0.433
▪ 133 N Post Translation (mm)	4.0 (3.0; 5.8) ^f	4.0 (3.0; 6.0)	0.406	4.0 (3.0; 5.0) ^g	5.0 (3.0; 6.0)	0.125
▪ Compliance Index (mm) ^b	4.7 ± 1.9	4.7 ± 1.7	0.896	4.7 ± 1.9	5.1 ± 2.2	0.334
▪ Active Displacement (mm)	4.0 (2.0; 6.0)	3.8 (3.0; 6.0)	0.666	4.9 ± 2.6	5.0 ± 2.9 ^h	0.878
▪ Max Displacement (mm)	7.0 (5.4; 9.0)	7.0 (5.5; 8.1)	0.707	7.5 (5.0; 10.0)	6.5 (6.0; 10.0)	0.752
External-internal Rotation	n = 49	n = 16 ^e		n = 54	n = 20 ^e	
▪ External Rotation (°)	5.4 ± 1.4	5.5 ± 1.5	0.746	5.4 ± 1.2	5.4 ± 1.3	0.965
▪ Internal Rotation (°)	5.7 ± 1.0	5.6 ± 1.5	0.665	5.5 (5.0; 6.3)	5.6 (5.1; 6.4)	0.614
▪ Slack (°) ^c	17.5 ± 3.4	17.6 ± 4.4	0.942	17.3 ± 3.0	17.8 ± 4.1	0.603

Values are expressed as either average ± standard deviation or median (IQR) for parametric and non-parametric data respectively

Unable to genotype 2 participants for rs1138545

^a Lower degree values for genu recurvatum indicates a greater amount of hyperextension

^b Compliance index = 133 N - 67 N Anterior Translation

^c Slack is defined as the amount of tibial rotation which occurred between the two turning points of the load deformation curve in the area of play between flanking external and internal rotation regions

The rare TT (^d n = 4, ^e n = 1) genotype and the CT genotype were combined for the analysis

^f n = 85, ^g n = 86, ^h n = 30

Table S8: The *TNC* rs2104772 (T/A) genotype effects on the (i) passive and active genu recurvatum measurements, (ii) anterior (Ant) and posterior (Post) tibial translation (displacement), active and maximum (Max) displacement, as well as compliance index measured using the KT-1000 arthrometer, and (iii) external and internal tibial rotation, as well as slack measured using the Robotic Knee Testing (RKT) device of participants uninjured dominant and non-dominant legs.

<i>TNC</i> rs2104772	Dominant Leg				Non-Dominant Leg			
	TT	TA	AA	P-Value	TT	TA	AA	P-Value
Genu Recurvatum ^a	n = 43	n = 57	n = 13		n = 48	n = 57	n = 14	
▪ Passive (°)	180.0 (174.0; 182.0)	176.0 (172.0; 180.8)	178.0 (174.3; 181.3)	0.195	178.0 (174.0; 181.9)	176.5 (173.0; 181.3)	176.0 (174.9; 179.1)	0.795
▪ Active (°)	176.3 ± 5.9	174.6 ± 5.4	174.6 ± 6.5	0.315	175.5 ± 5.8	175.0 ± 5.1	173.2 ± 6.1	0.405
Ant-Post Translation	n = 43	n = 57	n = 13		n = 48	n = 57	n = 14	
▪ 133 N Ant Translation (mm)	6.0 (5.0; 8.0)	6.5 (4.8; 8.3)	7.0 (5.0; 8.8)	0.695	7.0 (6.0; 9.5)	7.0 (5.5; 9.0)	7.0 (6.0; 7.9)	0.700
▪ 133 N Post Translation (mm)	4.0 (3.0; 5.1) ^d	4.0 (3.0; 6.0)	5.0 (3.3; 7.0)	0.315	4.0 (2.5; 5.0) ^e	4.0 (3.3; 5.5)	3.8 (2.5; 5.1)	0.389
▪ Compliance Index (mm) ^b	4.6 ± 2.1	4.7 ± 1.8	4.8 ± 1.5	0.949	4.9 ± 2.1	4.8 ± 1.9	4.2 ± 1.7	0.578
▪ Active Displacement (mm)	4.0 (2.0; 6.0)	4.0 (3.0; 6.0)	5.0 (2.8; 7.0)	0.521	5.0 (2.5; 7.0) ^e	4.5 (3.0; 6.3)	5.3 (3.0; 8.1)	0.412
▪ Max Displacement (mm)	7.0 (5.0; 8.0)	7.0 (6.0; 8.8)	7.0 (4.3; 9.0)	0.749	7.3 (5.1; 10.5)	7.0 (6.0; 9.0)	7.0 (5.0; 10.3)	0.983
External-internal Rotation	n = 24	n = 34	n = 8		n = 30	n = 36	n = 10	
▪ External Rotation (°)	5.5 ± 1.5	5.3 ± 1.4	5.5 ± 1.2	0.893	5.4 (4.8; 6.2) ^f	5.4 (4.6; 6.4)	5.0 (4.0; 5.8)	0.415
▪ Internal Rotation (°)	6.1 (5.2; 6.6)	5.7 (4.7; 6.0)	6.0 (5.5; 7.2)	0.191	5.8 (5.2; 6.6)	5.5 (5.1; 6.3)	5.4 (4.5; 6.0)	0.250
▪ Slack (°) ^c	18.1 ± 3.7	17.1 ± 3.7	17.2 ± 3.2	0.584	17.5 (16.0; 20.0)	17.1 (14.5; 20.0)	15.8 (14.9; 18.9)	0.230

Values are expressed as either average ± standard deviation or median (IQR) for parametric and non-parametric data respectively

Unable to genotype 1 participant for rs2104772

^a Lower degree values for genu recurvatum indicates a greater amount of hyperextension

^b Compliance index = 133 N - 67 N Anterior Translation

^c Slack is defined as the amount of tibial rotation which occurred between the two turning points of the load deformation curve in the area of play between flanking external and internal rotation regions

^d n = 42, ^e n = 47, ^f n = 29

Table S9: The *COL1A1* rs1107946 (G/T) and rs1800012 (G/T) genotype effects on the participants (i) general characteristics, (ii) Beighton score and sit and reach measurements, and (iii) external and internal tibial rotation, as well as slack, measured using the Robotic Knee Testing (RKT) device of the uninjured dominant leg.

	<i>COL1A1</i> rs1107946 ^a			<i>COL1A1</i> rs1800012		
	GG	GT	P-value	GG	GT + TT ^b	P-value
	n = 45	n = 21		n = 43	n = 23	
Sex (% male)	62.2 (28)	52.4 (11)	0.592	58.1 (25)	60.9 (14)	1.000
Age (years)	26.0 (24.5; 29.5)	26.0 (23.0; 30.0)	0.698	26.0 (24.0; 29.0)	27.0 (24.0; 35.0)	0.096
Height (cm)	175.9 ± 9.3	172.1 ± 10.7	0.139	174.3 ± 10.4	175.4 ± 8.9	0.659
Weight (kg)	75.3 ± 12.7	71.5 ± 11.8	0.245	72.8 ± 12.4	76.6 ± 12.4	0.235
BMI (kg/m ²)	24.0 (22.6; 25.9)	23.7 (22.5; 25.6)	0.591	23.8 ± 2.2	24.9 ± 3.9	0.143
Flexibility Training (% Yes)	62.2 (28)	47.6 (10)	0.295	62.8 (27)	47.8 (11)	0.300
Beighton Score	1.0 (0.0; 4.0)	3.0 (0.0; 5.0)	0.892	2.0 (0.0; 4.0)	1.0 (0.0; 3.0)	0.246
Sit and Reach (cm)	44.6 ± 8.9 ^c	41.4 ± 12.8 ^d	0.260	44.5 ± 10.3 ^e	41.7 ± 10.5 ^f	0.313
External Tibial Rotation (°)	5.3 ± 1.6	5.4 ± 1.3	0.842	5.5 ± 1.6	5.3 ± 1.1	0.576
Internal Tibial Rotation (°)	5.7 (5.0; 6.2)	5.5 (4.3; 6.0)	0.189	5.8 ± 1.1	5.4 ± 1.1	0.105
Slack (°)	16.9 (15.0; 19.4)	16.8 (13.9; 18.9)	0.497	17.9 ± 3.9	16.7 ± 3.0	0.199

Sex and flexibility training are reported as relative percentages, while the remaining continuous variables are reported as average ± standard deviation or median (IQR) for parametric and non-parametric data respectively

BMI, body mass index

^a None of the participants had the rare rs1107946 TT genotype

^b The rare TT (n = 1) and GT genotypes of rs1800012 were combined for the analysis

^c n = 43, ^d n = 20, ^e n = 41, ^f n = 23

Table S10: The *COL1A1* rs1107946 (G/T) and rs1800012 (G/T) genotype-genotype effects on the participants (i) general characteristics, (ii) Beighton score and sit and reach measurements, and (iii) external and internal tibial rotation, as well as slack, measured using the Robotic Knee Testing (RKT) device of the uninjured dominant leg.

<i>COL1A1</i>	rs1107946 GG and rs1800012 GG	Remaining Genotype Combinations	P-value
	n = 30	n = 36	
Sex (% male)	63.3 (19)	55.6 (20)	0.618
Age (years)	26.0 (24.8; 29.3)	26.5 (23.0; 30.0)	0.707
Height (cm)	175.3 ± 9.9	174.2 ± 9.9	0.682
Weight (kg)	74.3 ± 11.9	73.9 ± 13.1	0.881
BMI (kg/m ²)	24.1 ± 2.2	24.3 ± 3.5	0.788
Flexibility Training (% Yes)	63.3 (19)	52.8 (19)	0.458
Beighton Score	2.0 (0.0; 4.0)	1.0 (0.0; 4.0)	0.627
Sit and Reach (cm)	45.0 ± 9.6 ^a	42.3 ± 11.0 ^b	0.304
External Tibial Rotation (°)	5.3 (4.8; 6.6)	5.2 (4.5; 5.8)	0.524
Internal Tibial Rotation (°)	6.0 ± 1.1	5.4 ± 1.0	0.025
Slack (°)	18.2 ± 3.9	16.9 ± 3.3	0.126

Sex and flexibility training are reported as relative percentages, while the remaining continuous variables are reported as average ± standard deviation or median (IQR) for parametric and non-parametric data respectively

BMI, body mass index

Significant differences are indicated in bold

^a n = 29; ^b n = 34

Table S11: Spearman's correlation (r) and P-value (P) between the participants age, height, weight and body mass index (BMI), as well as differences in sex, with external (Ext) and internal (Int) tibial rotation, as well as slack of the uninjured dominant leg.

	n	Age	Height	Weight	BMI	Sex
Ext Rotattion (°)	66	r = -0.100 P = 0.424	r = -0.096 P = 0.444	r = -0.235 P = 0.058	r = -0.238 P = 0.054	M: 5.1 ± 1.2 F: 5.9 ± 1.6 P = 0.022
Int Rotation (°)	66	r = -0.179 P = 0.151	r = 0.011 P = 0.930	r = -0.271 P = 0.028	r = -0.389 P = 0.001	M: 5.6 ± 1.0 F: 5.9 ± 1.3 P = 0.293
Slack (°)^a	66	r = -0.185 P = 0.138	r = -0.133 P = 0.289	r = -0.333 P = 0.006	r = -0.338 P = 0.006	M: 16.8 ± 3.1 F: 18.6 ± 4.1 P = 0.045

Significant correlations and differences are in bold

The number of partipants (n) in each analysis is indicated

The male (M) and female (F) values are represented as average ± standard deviation

^a Slack is defined as the amount of tibial rotation which occurred between the two turning points of the load deformation curve in the area of play between flanking external and internal rotation regions

Table S12: The *COL12A1* rs970547 (A/G) genotype effects on the absolute change in the calculated length of the anterior bundle of the ACL (aACL), posterior bundle of the ACL (pACL), anterior bundle of the PCL (aPCL), posterior bundle of the PCL (pPCL), and the LCL during internal to external tibial rotation of the uninjured dominant and non-dominant legs.

<i>COL12A1</i> rs970547	Dominant Leg			Non-Dominant Leg		
	AA	AG + GG	P-value	AA	AG + GG	P-value
	n = 36	n = 30 ^a		n = 40	n = 35 ^b	
aACL (mm)	1.0 (0.8; 1.5)	1.4 (1.0; 1.7)	0.068	1.1 (0.8; 1.6)	1.2 (0.9; 1.5)	0.837
pACL (mm)	3.0 ± 1.5	3.3 ± 1.4	0.352	3.0 ± 1.3	2.9 ± 1.4	0.673
aPCL (mm)	2.0 (1.1; 2.8)	2.0 (1.6; 3.3)	0.954	1.5 (0.9; 2.6)	2.0 (1.3; 3.2)	0.202
pPCL (mm)	1.5 (0.6; 2.3)	1.4 (0.7; 2.2)	0.431	1.3 (0.8; 2.5)	1.4 (0.9; 2.1)	0.747
LCL (mm)	1.5 (0.9; 1.9)	1.3 (0.9; 1.9)	0.652	1.1 (0.9; 1.5)	1.2 (0.8; 1.9)	0.829

Values are expressed as average ± standard deviation or median (IQR) for parametric and non-parametric data respectively

The rare GG (^a n = 4 and ^b n = 5) genotype and the GA genotype were combined for the analysis

Table S13: The *TNC* rs1061494 TT versus the combined TC and CC genotype effects on the absolute change in the calculated length of the anterior bundle of the ACL (aACL), posterior bundle of the ACL (pACL), anterior bundle of the PCL (aPCL), posterior bundle of the PCL (pPCL), anterior bundle of the superficial layer of the MCL (aMCL), inferior bundle of the superficial layer of the MCL (iMCL), posterior bundle of the superficial layer of the MCL (pMCL), anterior bundle of the deep layer of the MCL (aDMCL), posterior bundle of the deep layer of the MCL (pDMCL) and the LCL during internal to external tibial rotation of the uninjured dominant and non-dominant legs.

<i>TNC rs1061494</i>	Dominant Leg			Non-Dominant Leg		
	TT	TC + CC	P-value	TT	TC + CC	P-value
	n = 24	n = 42		n = 24	n = 51	
aACL (mm)	1.0 (0.8; 1.6)	1.3 (1.0; 1.6)	0.145	1.1 (0.8; 1.3)	1.3 (0.8; 1.6)	0.317
pACL (mm)	3.0 ± 1.6	3.2 ± 1.4	0.381	2.7 (1.7; 3.4)	2.8 (2.1; 3.7)	0.491
aPCL (mm)	1.9 ± 1.1	2.3 ± 1.2	0.282	1.5 (1.0; 3.0)	1.9 (1.1; 2.6)	0.987
pPCL (mm)	1.1 (0.6; 2.1)	1.5 (1.1; 2.2)	0.224	1.1 (0.6; 2.2)	1.4 (1.1; 2.5)	0.195
aMCL (mm)	3.8 ± 1.3	4.5 ± 1.4	0.045	3.6 ± 1.3	4.1 ± 1.6	0.142
iMCL (mm)	3.4 ± 1.1	4.0 ± 1.3	0.043	3.1 ± 1.1	3.6 ± 1.4	0.214
pMCL (mm)	4.1 ± 1.1	4.7 ± 1.3	0.067	3.8 ± 1.2	4.2 ± 1.6	0.284
aDMCL (mm)	6.0 ± 2.0	7.3 ± 2.0	0.020	5.5 (4.7;6.3)	5.9 (4.8; 7.9)	0.246
pDMCL (mm)	6.8 ± 2.0	9.1 ± 2.2	0.023	6.1 (5.3; 7.4)	6.8 (5.4; 8.9)	0.446
LCL (mm)	1.2 (0.9; 1.7)	1.6 (1.0; 2.2)	0.049	1.0 (0.8; 1.5)	1.3 (0.9; 1.8)	0.345

Values are expressed as average ± standard deviation or median (IQR) for parametric and non-parametric data respectively

Significant differences are in bold

Table S14: The *TNC* rs1061494 (T/C) genotype effects on the absolute change in the calculated length of the anterior bundle of the anterior bundle of the PCL (aPCL), posterior bundle of the PCL (pPCL), anterior bundle of the superficial layer of the MCL (aMCL), inferior bundle of the superficial layer of the MCL (iMCL) , posterior bundle of the superficial layer of the MCL (pMCL), anterior bundle of the deep layer of the MCL (aDMCL), posterior bundle of the deep layer of the MCL (pDMCL) and the LCL during internal to external tibial rotation of the uninjured dominant and non-dominant legs.

<i>TNC</i> rs1061494	Dominant Leg				Non-Dominant Leg			
	TT	TC	CC	P-Value	TT	TC	CC	P-Value
	n = 24	n = 28	n = 14		n = 24	n = 34	n = 17	
aPCL (mm)	1.9 ± 1.1	2.5 ± 1.3	1.8 ± 0.9	0.086	1.5 (1.0; 3.0)	2.1 (1.4; 3.4)	1.2 (0.9; 2.2)	0.079
pPCL (mm)	1.1 (0.6; 2.1)	1.5 (1.1; 2.5)	1.4 (1.0; 2.2)	0.422	1.1 (0.6; 2.2)	1.4 (1.0; 2.5)	1.4 (1.0; 2.4)	0.418
aMCL (mm)	3.8 ± 1.3	4.4 ± 1.6	4.8 ± 0.8	0.138	3.6 ± 1.3	3.9 ± 1.5	4.5 ± 1.7	0.138
iMCL (mm)	3.4 ± 1.1	3.9 ± 1.5	4.2 ± 0.8	0.111	3.1 ± 1.1	3.4 ± 1.4	3.8 ± 1.6	0.314
pMCL (mm)	4.1 ± 1.1	4.6 ± 1.5	4.8 ± 0.8	0.148	3.8 ± 1.2	4.1 ± 1.6	4.5 ± 1.6	0.390
aDMCL (mm)	6.0 ± 2.0	7.2 ± 2.4	7.4 ± 1.1	0.065	5.7 ± 1.6	6.3 ± 1.9	6.5 ± 2.5	0.348
pDMCL (mm)	6.8 ± 2.0	8.2 ± 2.6	8.0 ± 1.3	0.601	6.5 ± 1.7	7.1 ± 2.1	6.9 ± 2.5	0.551
LCL (mm)	1.2 (0.9; 1.7)	1.7 (1.1; 2.4)	1.5 (1.0; 2.1)	0.086	1.0 (0.8; 1.5)	1.3 (0.8; 2.0)	1.2 (0.9; 1.4)	0.464

Values are expressed as either average ± standard deviation or median (IQR) for parametric and non-parametric data respectively

Table S15: The *TNC* rs2104772 (T/A) genotype effects on the absolute change in the calculated length of the anterior bundle of the ACL (aACL), posterior bundle of the ACL (pACL), anterior bundle of the PCL (aPCL), posterior bundle of the PCL (pPCL), anterior bundle of the superficial layer of the MCL (aMCL), inferior bundle of the superficial layer of the MCL (iMCL), posterior bundle of the superficial layer of the MCL (pMCL), anterior bundle of the deep layer of the MCL (aDMCL), posterior bundle of the deep layer of the MCL (pDMCL) and the LCL during internal to external tibial rotation of the uninjured dominant and non-dominant legs.

<i>TNC</i> rs2104772	Dominant Leg				Non-Dominant Leg			
	TT	TA	AA	P-Value	TT	TA	AA	P-Value
	n = 24	n = 34	n = 8		n = 29	n = 36	n = 10	
aACL (mm)	1.5 (1.0; 1.8)	1.1 (0.8; 1.4)	1.0 (1.0; 1.4)	0.089	1.2 (0.8; 1.4)	1.2 (0.8; 1.7)	1.3 (0.8; 1.4)	0.878
pACL (mm)	3.6 ± 1.5	2.9 ± 1.4	2.7 ± 1.1	0.088	3.2 ± 1.4	2.8 ± 1.3	3.1 ± 0.9	0.751
aPCL (mm)	2.0 ± 1.2	2.2 ± 1.2	2.2 ± 1.2	0.757	1.6 (1.1; 2.6)	2.2 (1.3; 3.0)	1.4 (0.8; 2.2)	0.288
pPCL (mm)	1.5 (0.7; 2.2)	1.4 (1.0; 2.0)	1.7 (0.4; 2.5)	0.976	1.5 (1.0; 2.3)	1.3 (0.7; 2.5)	1.2 (0.8; 1.8)	0.613
aMCL (mm)	4.8 ± 1.2	3.9 ± 1.4	4.3 ± 1.5	0.076	4.2 (3.3; 4.9)	3.5 (3.0; 4.4)	3.1 (2.4; 5.3)	0.140
iMCL (mm)	4.2 ± 1.1	3.5 ± 1.2	4.0 ± 1.2	0.087	3.7 ± 1.2	3.3 ± 1.4	3.0 ± 1.4	0.320
pMCL (mm)	4.8 ± 1.2	4.1 ± 1.3	4.6 ± 1.2	0.092	4.4 ± 1.3	4.0 ± 1.6	3.6 ± 1.4	0.296
aDMCL (mm)	7.5 (5.9; 8.9)	6.4 (4.7; 7.5)	7.1 (5.2; 8.4)	0.112	6.1 (5.0; 7.5)	5.6 (4.7; 7.4)	4.7 (3.4; 7.7)	0.212
pDMCL (mm)	8.1 ± 2.4	7.1 ± 8.4	8.0 ± 1.8	0.285	6.3 (5.6; 8.0)	6.5 (5.3; 8.8)	5.3 (4.4; 8.0)	0.175
LCL (mm)	1.3 (0.9; 1.8)	1.4 (1.0; 2.1)	1.7 (1.5; 2.1)	0.158	1.2 (0.9; 1.7)	1.2 (0.8; 1.8)	0.9 (0.8; 1.3)	0.448

Values are expressed as either average ± standard deviation or median (IQR) for parametric and non-parametric data respectively

Table S16: The *TNC* rs1138545 (C/T) genotype effects on the absolute change in the calculated length of the anterior bundle of the ACL (aACL), posterior bundle of the ACL (pACL), anterior bundle of the PCL (aPCL), posterior bundle of the PCL (pPCL), anterior bundle of the superficial layer of the MCL (aMCL), inferior bundle of the superficial layer of the MCL (iMCL), posterior bundle of the superficial layer of the MCL (pMCL), anterior bundle of the deep layer of the MCL (aDMCL), posterior bundle of the deep layer of the MCL (pDMCL) and the LCL during internal to external tibial rotation of the uninjured dominant and non-dominant legs.

<i>TNC rs1138545</i>	Dominant Leg			Non-Dominant Leg		
	CC	CT + TT	P-value	CC	CT + TT	P-value
	n = 49	n = 16		n = 54	n = 20	
aACL (mm)	1.1 (1.0; 1.6)	1.0 (0.8; 1.4)	0.235	1.1 (0.8; 1.5)	1.3 (0.8; 1.6)	0.795
pACL (mm)	3.3 ± 1.5	2.6 ± 1.4	0.685	3.0 ± 1.4	2.9 ± 1.1	0.685
aPCL (mm)	2.0 (0.9; 2.8)	2.3 (1.7; 3.7)	0.060	1.6 (1.1; 2.6)	2.0 (1.0; 3.0)	0.758
pPCL (mm)	1.5 (0.7; 2.2)	1.4 (0.8; 2.3)	0.862	1.4 (0.9; 2.4)	1.2 (0.7; 2.7)	0.625
aMCL (mm)	4.3 ± 1.4	4.1 ± 1.5	0.570	4.0 ± 1.4	3.8 ± 1.7	0.681
iMCL (mm)	3.8 ± 1.2	3.7 ± 1.3	0.693	3.5 ± 1.3	3.3 ± 1.4	0.693
pMCL (mm)	4.5 ± 1.3	4.4 ± 1.4	0.907	4.1 ± 1.5	4.0 ± 1.5	0.723
aDMCL (mm)	6.9 ± 2.1	6.8 ± 2.3	0.906	5.9 (4.7; 7.5)	5.4 (4.8; 7.3)	0.767
pDMCL (mm)	7.6 ± 2.2	7.9 ± 2.4	0.679	6.2 (5.3; 8.4)	6.5 (5.4; 7.7)	0.986
LCL (mm)	1.3 (1.0; 1.9)	1.7 (1.1; 2.7)	0.235	1.1 (0.8; 1.7)	1.1 (0.9; 2.0)	0.633

Values are expressed as average ± standard deviation or median (IQR) for parametric and non-parametric data respectively

Unable to genotype 1 participant for rs1138545

The rare TT (n = 1) genotype and the CT genotype were combined for the analysis

Table S17: The combined *COL1A1* rs1107946 (G/T) and *rs18000012* (G/ T) genotype effects on the absolute change in the calculated length of the anterior bundle of the ACL (aACL), posterior bundle of the ACL (pACL), anterior bundle of the PCL (aPCL), posterior bundle of the PCL (pPCL), anterior bundle of the superficial layer of the MCL (aMCL), inferior bundle of the superficial layer of the MCL (iMCL), posterior bundle of the superficial layer of the MCL (pMCL), anterior bundle of the deep layer of the MCL (aDMCL), posterior bundle of the deep layer of the MCL (pDMCL) and the LCL during internal to external tibial rotation of the uninjured dominant and non-dominant legs.

	<i>COL1A1</i> rs1107946 and rs1800012 GG Genotype ^a	<i>COL1A1</i> rs1107946 and/or rs1800012 GT or TT Genotypes ^b	P-value
	n = 27	n = 37	
aACL (mm)	1.1 (0.9; 2.0)	1.1 (0.9; 1.5)	0.508
pACL (mm)	3.3 ± 1.5	2.8 ± 1.4	0.172
aPCL (mm)	2.1 (1.5; 2.9)	1.9 (1.2; 3.3)	0.777
pPCL (mm)	1.2 (0.6; 2.2)	1.5 (0.9; 2.3)	0.171
aMCL (mm)	4.2 ± 1.4	4.2 ± 1.4	0.821
iMCL (mm)	3.7 ± 1.2	3.8 ± 1.2	0.698
pMCL (mm)	4.3 ± 1.2	4.5 ± 1.3	0.606
aDMCL (mm)	6.7 ± 2.1	6.8 ± 2.1	0.907
pDMCL (mm)	7.6 ± 2.2	7.7 ± 2.3	0.833
LCL (mm)	1.6 (1.0; 2.1)	1.4 (1.0; 1.8)	0.526

Values are expressed as average ± standard deviation or median (IQR) for parametric and non-parametric data respectively

^a both *COL1A1* variants had a GG genotype

^b one or neither *COL1A1* variants had a GG genotype

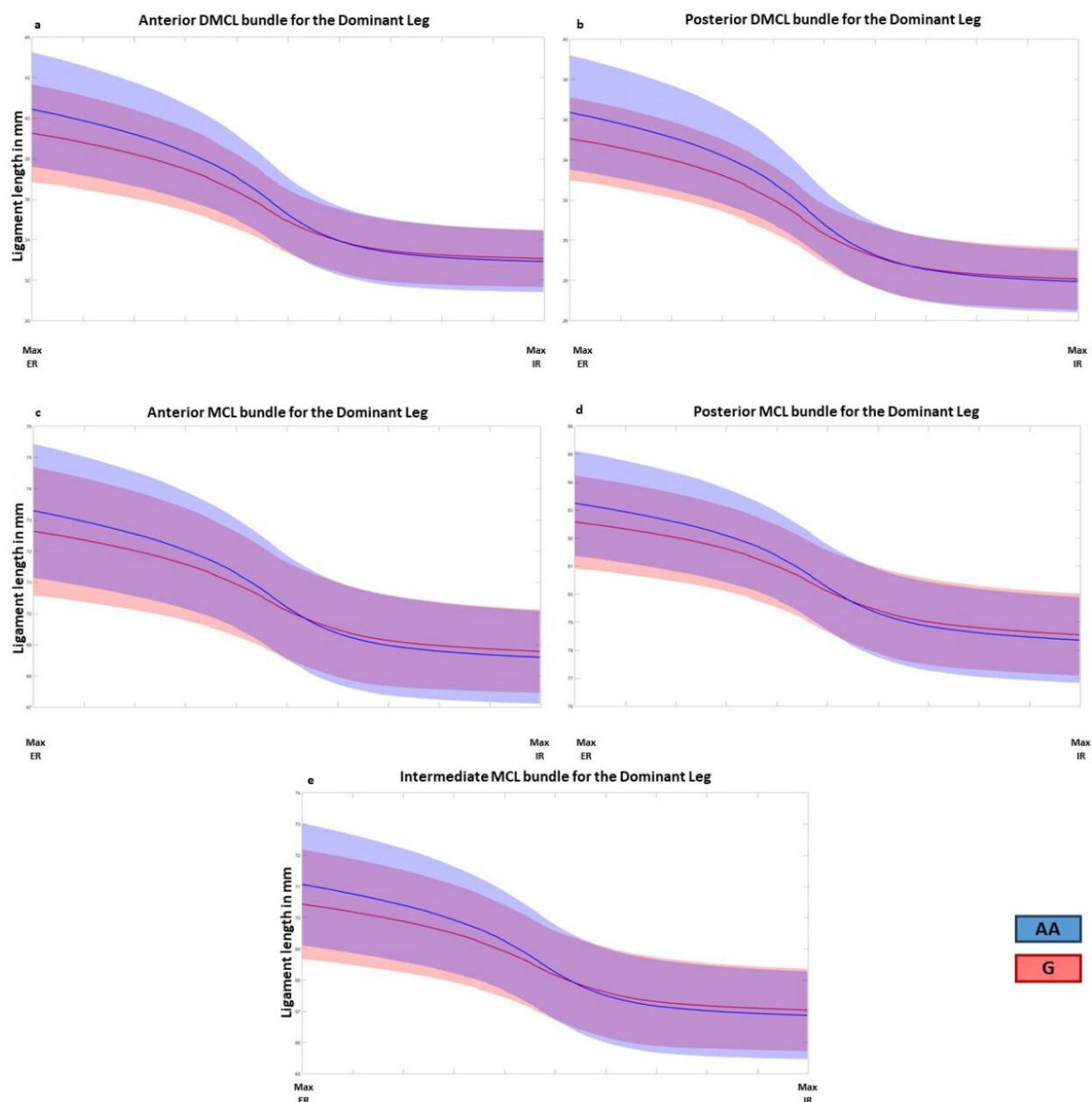


Figure S1

The *COL12A1* rs970547 (A/G) genotype effects on the five medial collateral ligament (MCL) bundle (anterior deep layer, posterior deep layer, anterior, posterior and intermediate) lengths within the dominant leg from maximum (Max) external (ER) at to maximum internal (IR) rotation. Ligament bundle lengths were calculated at every 0.02 Nm increments in applied torque during each participants' knee rotational angles from maximum external (-5 Nm torque) to maximum internal (5 Nm torque). The average (solid line) ligament length and standard deviations (shaded area) for the *COL12A1* rs970547 AA genotype (AA) and combined AG and GG genotypes (G) are should in blue and red, respectively, with areas of overlap represented in purple.

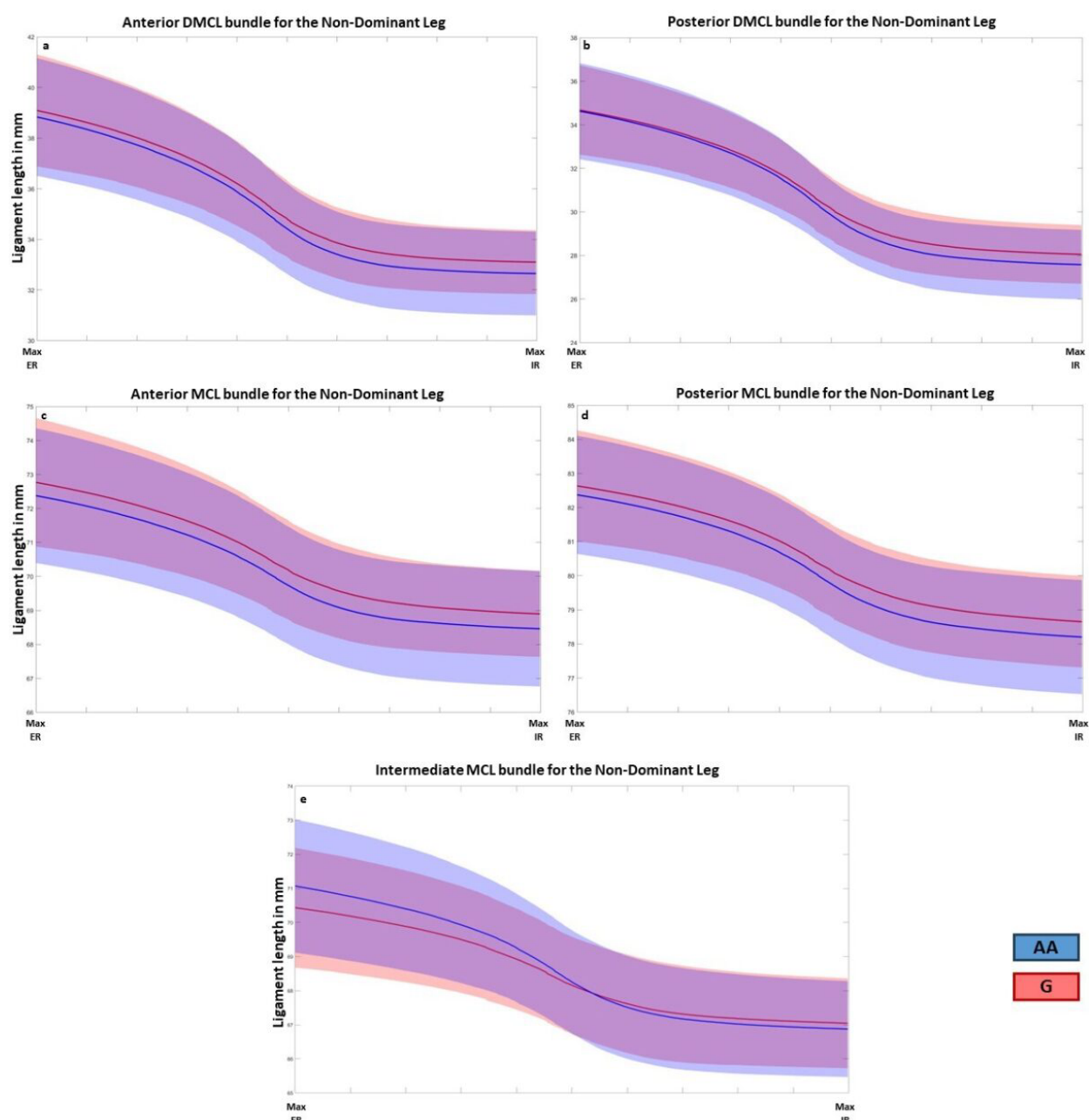


Figure S2

The *COL12A1* rs970547 (A/G) genotype effects on the five medial collateral ligament (MCL) bundle (anterior deep layer, posterior deep layer, anterior, posterior and intermediate) lengths within the non-dominant leg from maximum (Max) external (ER) at to maximum internal (IR) rotation. Ligament bundle lengths were calculated at every 0.02 Nm increments in applied torque during each participants' knee rotational angles from maximum external (-5 Nm torque) to maximum internal (5 Nm torque). The average (solid line) ligament length and standard deviations (shaded area) for the *COL12A1* rs970547 AA genotype (AA) and combined AG and GG genotypes (G) are should in blue and red, respectively, with areas of overlap represented in purple.

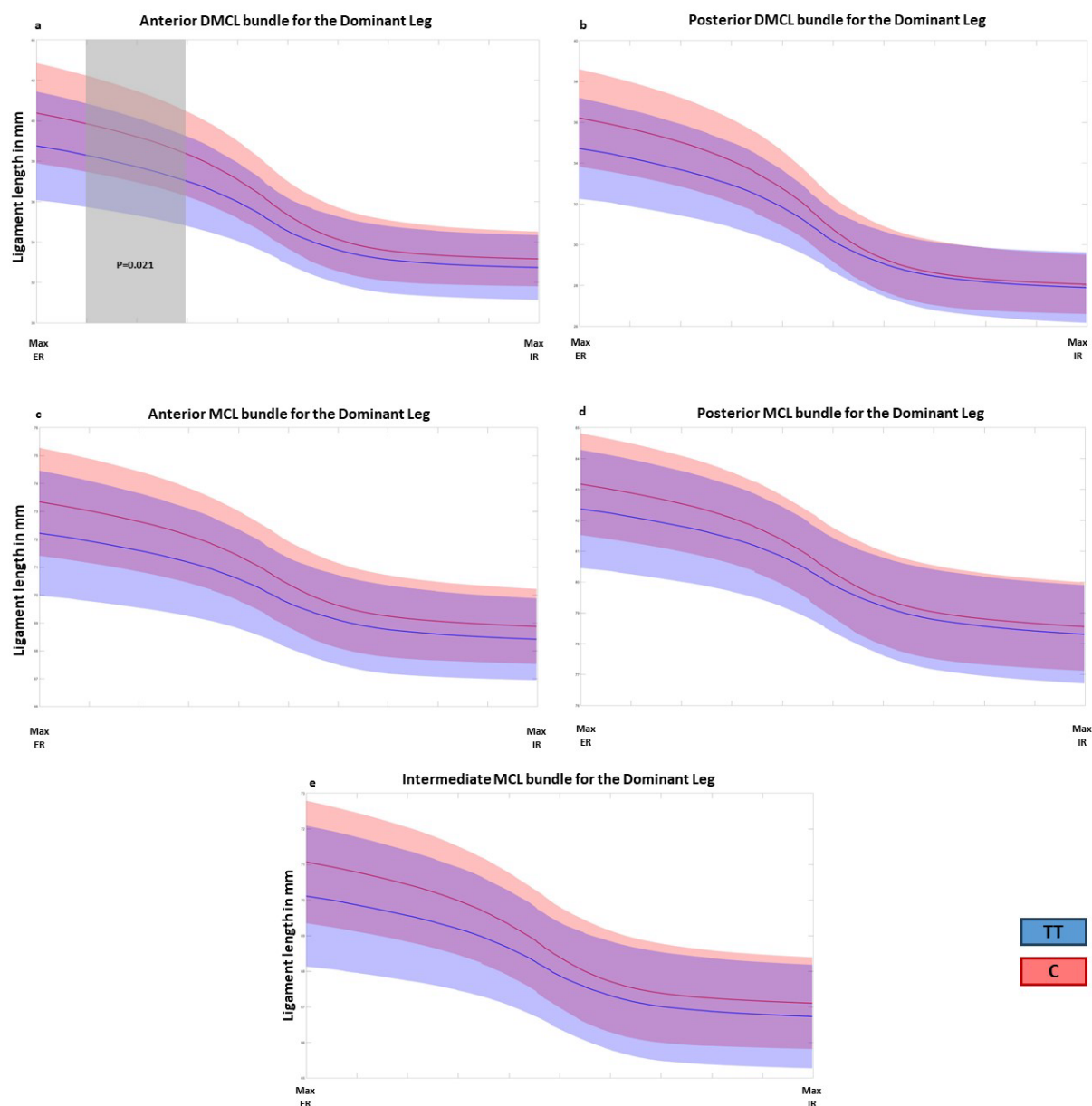


Figure S3

The *TNC* rs1061494 (T/C) genotype effects on the five medial collateral ligament (MCL) bundle (anterior deep layer, posterior deep layer, anterior, posterior and intermediate) lengths within the dominant leg from maximum (Max) external (ER) at to maximum internal (IR) rotation. Ligament bundle lengths were calculated at every 0.02 Nm increments in applied torque during each participants' knee rotational angles from maximum external (-5 Nm torque) to maximum internal (5 Nm torque). The average (solid line) ligament length and standard deviations (shaded area) for the *TNC* rs1061494 TT genotype (TT) and combined TC and CC genotypes (C) are should in blue and red, respectively, with areas of overlap represented in purple. The region of significant difference is highlighted in grey.

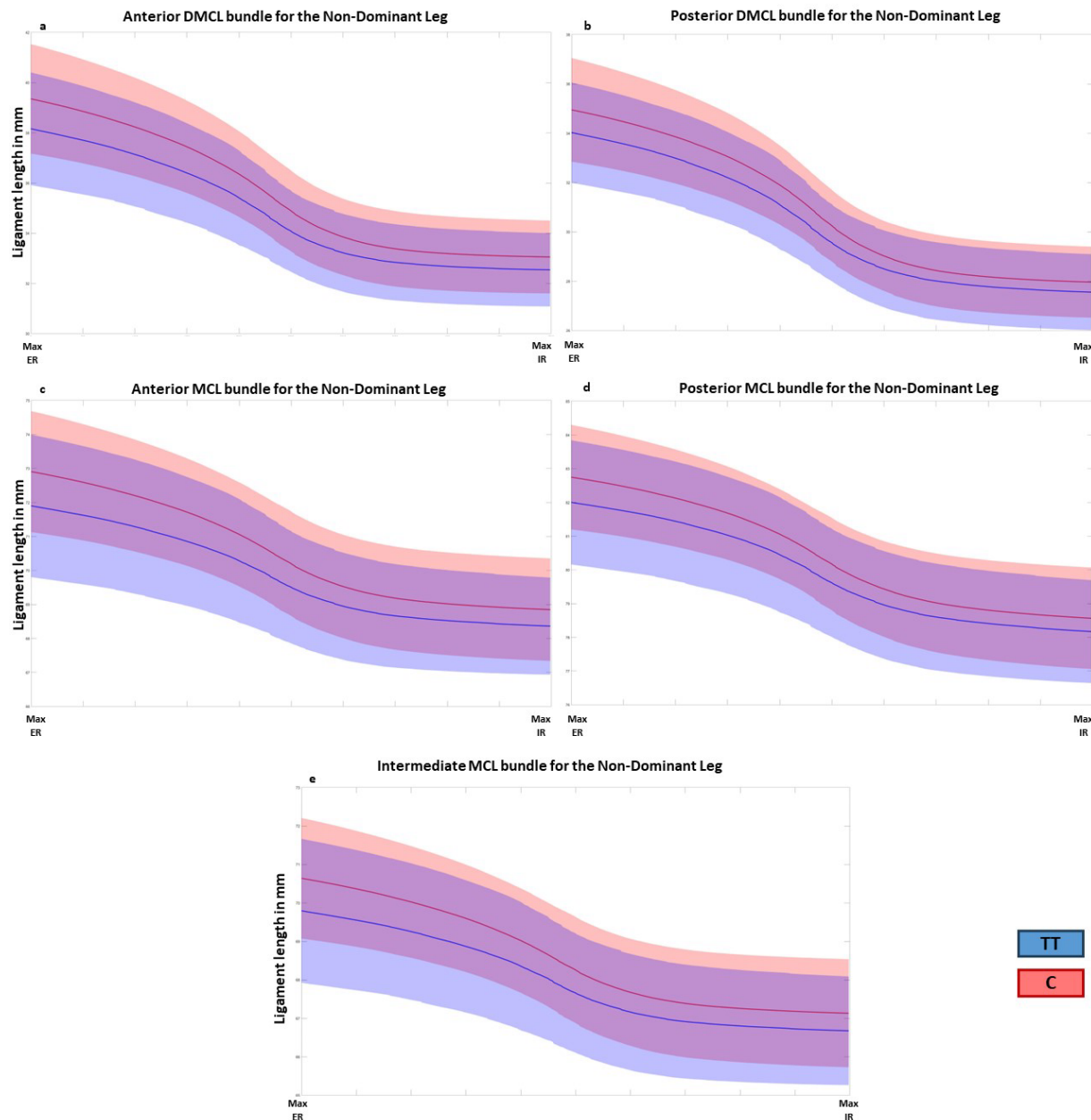


Figure S4

The *TNC* rs1061494 (T/C) genotype effects on the five medial collateral ligament (MCL) bundle (anterior deep layer, posterior deep layer, anterior, posterior and intermediate) lengths within the non-dominant leg from maximum (Max) external (ER) at to maximum internal (IR) rotation. Ligament bundle lengths were calculated at every 0.02 Nm increments in applied torque during each participants' knee rotational angles from maximum external (-5 Nm torque) to maximum internal (5 Nm torque). The average (solid line) ligament length and standard deviations (shaded area) for the *TNC* rs1061494 TT genotype (TT) and combined TC and CC genotypes (C) are should in blue and red, respectively, with areas of overlap represented in purple.

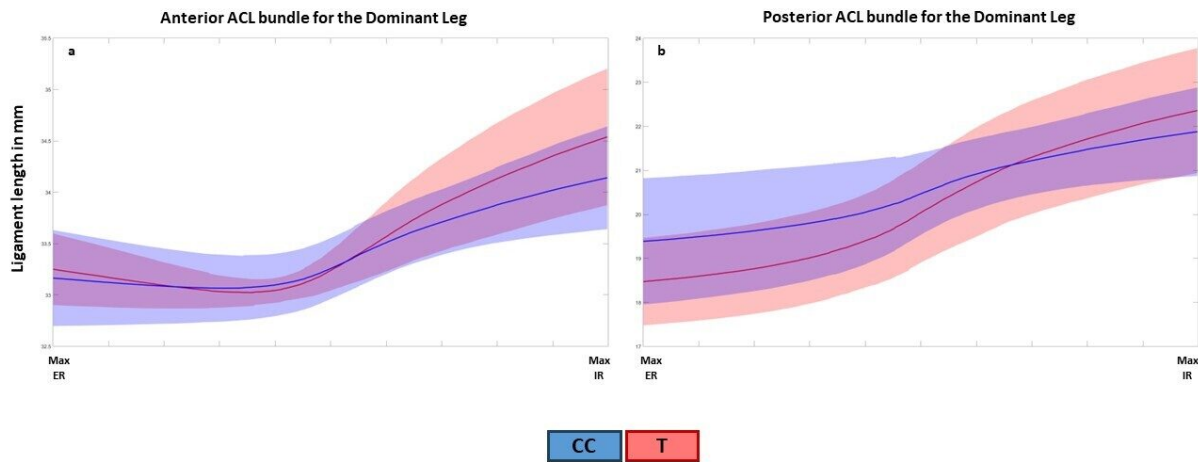


Figure S5

The *TNC* rs1061494 (T/C) genotype effects on the anterior and posterior ACL bundles lengths within the dominant leg from maximum (Max) external (ER) to maximum internal (IR) rotation. ACL bundle lengths were calculated at every 0.02 Nm increments in applied torque during each participants' knee rotational angles from maximum external (-5 Nm torque) to maximum internal (5 Nm torque). The average (solid line) ligament length and standard deviations (shaded area) for the *TNC* rs1061494 CC genotype (CC) and combined TC and TT genotypes (T) are shown in blue and red, respectively, with areas of overlap represented in purple.