

Additional file 8A. Individual data of the included studies for Q1 (mean±SD).

Study	Participants	Balance Test	Results					
Posturography								
Akhbari et al. [89]	15 PFP, 15 controls	Single-legged stance for 20 seconds					PFP	Control
				Static	Eyes open	Overall Stability Index	2.1 (1.1)	1.5 (0.5)
						Anterior/Posterior Index	1.6 (1.1)	1.3 (0.9)
						Medial/Lateral Index	1.0 (0.6)	0.9 (0.4)
					Eyes closed	Overall Stability Index	4.4 (1.9)	4.1 (1.6)
						Anterior/Posterior Index	3.6 (2.0)	3.2 (0.8)
						Medial/Lateral Index	1.9 (0.8)	1.6 (0.7)
							PFP	Control
				Dynamic	Eyes open	Overall Stability Index	2.7 (1.3)	2.2 (0.9)
						Anterior/Posterior Index	1.9 (1.2)	1.6 (1.1)
						Medial/Lateral Index	1.7 (0.7)	1.3 (0.6)
					Eyes closed	Overall Stability Index	5.7 (1.7)	5.2 (1.5)
						Anterior/Posterior Index	4.6 (1.9)	4.1 (1.7)
						Medial/Lateral Index	2.6 (0.9)	2.3 (0.8)
Ibrahim et al. [86]	30 PFP, 30 controls	Single and double-legged stance for 20 seconds		Dynamic		PFP	Control	
				Overall Stability Index		4.9 (3.1)	2.2 (0.7)	
				Anterior/Posterior Index		3.3 (2.3)	1.3 (0.3)	
				Medial/Lateral Index		3.0 (1.8)	1.5 (0.6)	
Kim et al. [99]	19 PFP, 19 controls	Single-legged drop landing				PFP	Control	
				Anteroposterior stability index		0.007 (0.002)	0.005 (0.001)	
				Mediolateral stability index		0.012 (0.002)	0.013 (0.002)	
				Vertical stability index		0.017 (0.009)	0.019 (0.010)	
				Dynamic postural (Overall) stability index		0.035 (0.011)	0.037 (0.010)	
Negahban et al. [90]	15 PFP, 15 controls	Single-legged stance for 20 seconds (open eyes)		Dynamic		PFP	Control	
				Overall Stability Index		4.54 (1.77)	3.63 (1.35)	
				Anterior/Posterior Index		2.83 (1.47)	2.12 (0.88)	
				Medial/Lateral Index		3.07 (1.30)	2.45 (1.45)	

Yelvar et al. [102]	22 PFP, 22 controls	Posturographic assessment using a Tetrax system					PFP	Control
				Fourier spectral intensity	Standing straight	Eyes open	1.97 (0.66)	1.56 (0.65)
						Eyes closed	3.02 (1.46)	2.24 (1.11)
					On pillows	Eyes open	2.94 (1.15)	2.28 (1.16)
						Eyes closed	4.51 (1.45)	2.92 (0.98)
				Stability Index	Standing straight	Eyes open	12.16 (3.14)	11.09 (3.99)
						Eyes closed	17.44 (5.51)	16.13 (6.24)
					On pillows	Eyes open	15.48 (5.16)	13.62 (4.55)
						Eyes closed	26.30 (5.00)	19.30 (4.66)
				Weight Distribution Index	Standing straight	Eyes open	6.89 (2.56)	5.87 (2.17)
						Eyes closed	6.04 (3.03)	5.25 (2.17)
					On pillows	Eyes open	9.95 (3.15)	8.01 (4.08)
Eyes closed	8.16 (3.19)	7.25 (3.41)						

Center of Pressure (CoP) Behaviour								
Carry et al. [57]	7 PFP, 7 controls	Single-legged squat					**PFP**	**Control**
CoP Mean distance (mm)		22.62 (3.84)	24.79 (2.13)					
CoP Root-mean square (mm)		25.09 (4.38)	27.56 (2.28)					
CoP range (mm)		78.87 (10.67)	86.36 (7.38)					
CoP area (mm²)		5459.89 (1627.74)	6131.39 (1240.87)					
Carvalho-e-Silva et al. [87]	25 PFP, 25 controls	Step task					**PFP**	**Control**
CoP total displacement (cm)		888.7 (76.1)	812.9 (69.2)					
CoP AP displacement (mm)		61.0 (5.9)	60.7 (6.0)					
CoP ML displacement (mm)		32.3 (5.5)	21.7 (2.7)					
CoP total velocity (m/s)		45.5 (2.9)	44.4 (2.1)					
CoP AP velocity (m/s)		36.7 (2.9)	35.3 (1.8)					
CoP ML velocity (m/s)		22.2 (2.0)	17.0 (1.6)					

Felicio et al. [88]	15 PFP, 15 controls	Single-legged stance for 30 seconds (closed eyes)		
Gwynne [58]	30 PFP, 30 controls	Single-legged squats		
Lee et al. [29]	20 PFP, 19 controls	Step-down task		
Manojlovic et al. [100]	18 PFP, 37 controls	Single-legged stance for 30 seconds (open eyes)		
Motealleh et al. [92]	21 PFP, 21 controls	Seated balance for 7 seconds (open eyes)		

Nasab et al. [91]	15 PFP, 15 controls	Double-legged stance for 60 seconds (open eyes)					
					PFP	Control	
			CoP AP displacement (mm)		0.22 (0.14)	0.15 (0.09)	
			CoP ML displacement (mm)		0.34 (0.21)	0.14 (0.05)	
			CoP AP sum of displacement (mm)		562.14 (155.14)	502.24 (113.63)	
			CoP ML sum of displacement (mm)		699.29 (219.19)	567.26 (124.67)	
			CoP AP velocity (mm/s)		1124.3 (310.29)	1004.5 (227.25)	
CoP ML velocity (mm/s)		1398.6 (438.38)	1202.4 (367.50)				
Naserpour et al. [103]	34 PFP, 34 controls	Step-down task					
					PFP	Control	
			Time to CoP stabilization for AP direction (s)		9.09 (0.82)	8.43 (0.79)	
Time to CoP stabilization for ML direction (s)		7.15 (2.11)	5.56 (1.95)				
Saad et al. [27]	15 PFP, 15 controls	Stair negotiation	CoP área (cm²)		PFP	Control	
				Step up	69.28 (33.36)	42.96 (10.22)	
				Step down	56.63 (24.56)	36.34 (10.92)	
Silva et al. [26]	29 PFP, 25 controls	Stair climbing					
			CoP area (cm²)		PFP	Control	
			26.4 (7.5)	43.1 (10.2)			
Stensdotter et al. [97]	17 PFP, 17 controls	Double-legged stance on sliding platform for 7 seconds (open eyes)					
			CoM AP displacement for anterior translation (cm)		PFP	Control	
			CoM AP displacement for posterior translation (cm)		not informed		
			CoM AP velocity for anterior translation (m/s)		0.21 (0.03)	0.21 (0.02)	
			CoM AP velocity for posterior translation (m/s)		0.20 (0.04)	0.20 (0.02)	
Stensdotter et al. [104]	17 PFP, 17 controls	Double-legged stance on sliding platform for 7 seconds (open eyes)					
			CoM Lateral displacement for anterior translation (mm)		CoM Lateral displacement for posterior translation (mm)		
			Perturbation	PFP	Control	PFP	Control
			Before	not informed			
			During				
After							
Zamboti et al. [95]	10 PFP, 10 controls	Single-legged stance for 30 seconds (open eyes)					
			CoP área (cm²)		PFP	Control	
			CoP ML velocity (cm/s)		7.93 (2.98)	6.41 (1.5)	
			3.01 (0.9)	2.4 (0.53)			

Zeinalzadeh et al. [24]	28 PFP, 28 controls	Single-legged stance for 30 seconds				PFP	Control
				<i>CoP area (cm²)</i>	<i>Eyes open</i>	40.36 (19.29)	37.69 (28.44)
					<i>Eyes closed</i>	131.67 (89.58)	82.37 (48.92)
				<i>CoP AP displacement (cm)</i>	<i>Eyes open</i>	3.59 (0.97)	3.29 (1.17)
					<i>Eyes closed</i>	15.52 (7.98)	8.87 (5.35)
				<i>CoP ML displacement (cm)</i>	<i>Eyes open</i>	2.89 (1.06)	2.54 (0.55)
					<i>Eyes closed</i>	13.97 (10.34)	7.02 (5.05)
				<i>CoP velocity (cm/s)</i>	<i>Eyes open</i>	0.65 (0.10)	0.45 (0.05)
<i>Eyes closed</i>	1.15 (0.55)	0.80 (0.40)					
Star Excursion Balance Test (SEBT) and related tests							
Aminaka et al. [30]	20 PFP, 20 controls	Anterior direction of SEBT			PFP	Control	
				<i>SEBT anterior (%)</i>	62.8 (1.2)	65.6 (1.2)	
Arun et al. [96]	10 PFP, 10 controls	SEBT		<i>SEBT (inches)</i>	PFP	Control	
				<i>Anterior</i>	48.5 (1.51)	53.9 (0.88)	
				<i>Anteromedial</i>	45.5 (1.51)	53.3 (1.49)	
				<i>Anterolateral</i>	43.0 (1.63)	52.5 (2.12)	
				<i>Posterior</i>	40.2 (1.87)	45.3 (1.77)	
				<i>Posteromedial</i>	35.4 (1.51)	46.9 (3.18)	
				<i>Posterolateral</i>	34.5 (2.46)	42.3 (1.16)	
				<i>Medial</i>	46.8 (1.55)	54.0 (1.33)	
				<i>Lateral</i>	46.1 (0.99)	52.7 (2.0)	
Coelho et al. [98]	48 PFP, 48 controls	Y-balance test			PFP	Control	
				<i>SEBT Anterior (%)</i>	58.6 (6.6)	61.7 (5.9)	
				<i>SEBT Posteromedial (%)</i>	94.2 (13.2)	96.6 (9.3)	
				<i>SEBT Posterolateral (%)</i>	98.5 (12.6)	100.1 (8.6)	
				<i>SEBT composite score</i>	83.8 (9.3)	86.1 (6.5)	
Goto et al. [25]	14 PFP, 14 controls	Anterior direction of SEBT			PFP	Control	
				<i>SEBT anterior (%)</i>	66.17 (4.99)	70.84 (4.39)	
Loudon et al. [93]	29 PFP, 11 controls	Anterior reach for 30 seconds “SEBT”			PFP	Control	
				<i>Balance and reach (rep)</i>	17.93 (1.03)	16.65 (1.45)	
				<i>Anterior reach (cm)</i>	40.8 (9.1)	53.5 (6.7)	
Priore et al. [101]	55 PFP, 40 controls	SEBT			PFP	Control	
				<i>Mean of directions (%)</i>	78 (8)	84 (8)	

Steinberg et al. [85]	83 PFP, 49 controls	Y-balance test		Difference between limbs	PFP	Control
				<i>Anterior Y-test (cm)</i>	4.1 (3.3)	2.4 (2.0)
				<i>Posteromedial Y-test (cm)</i>	6.0 (4.3)	4.6 (3.9)
				<i>Posterolateral Y-test (cm)</i>	6.2 (5.1)	5.4 (6.0)
Song et al. [94]	16 PFP, 8 controls	Anterior direction of SEBT			PFP	Control
				<i>SEBT anterior (%)</i>	65.57 (4.83)	63.54 (8.10)
Zamboti et al. [95]	10 PFP, 10 controls	SEBT			PFP	Control
				<i>SEBT Anterior (%)</i>	80.55 (4.72)	81.05 (4.58)
				<i>SEBT Posteromedial (%)</i>	69.6 (9.94)	73.9 (6.94)
				<i>SEBT Posterolateral (%)</i>	76.25 (8.81)	80.8 (6.05)
				<i>SEBT index</i>	88.07 (7.68)	91.0 (5.78)

Abbreviations: PFP = patellofemoral pain, CoP = centre of pressure, AP = anteroposterior, ML = mediolateral, CoM = centre of mass, SEBT = Star Excursion Balance Test

Additional file 8B. Individual data of the included studies for Q2 (mean±SD).

Study	Interventions	Balance Test	Results									
Posturography												
Ahmadi et al. [111]	Neurofeedback training x No intervention	Double-legged stance for 30 seconds (closed eyes)		Static	Training (n=16)		No intervention (n=16)					
					<i>Pre</i>	<i>12 weeks</i>	<i>Pre</i>	<i>12 weeks</i>				
				Anterior/Posterior index	1.46 (0.25)	1.40 (0.25)	1.34 (0.23)	1.39 (0.20)				
				Medial/Lateral index	1.66 (0.20)	1.68 (0.17)	1.41 (0.17)	1.52 (0.22)				
				Overall stability	1.51 (0.21)	1.49 (0.17)	1.30 (0.36)	1.46 (0.27)				
Aytar et al. [115]	Knee kinesiotaping (KT) x Sham tape	Posturographic assessment using Kinesthetic Ability Trainer (open eye)			KT (n=12)		Sham (n=10)					
					<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>				
				Static balance score	167.58 (80.05)	128.08 (52.44)	148.40 (62.92)	139.40 (63.62)				
				Dynamic balance score	2702.16 (1101.59)	2428.41 (959.76)	1912.30 (701.85)	1834.90 (674.40)				
* Immediate effect												
Mahmoud and Kamel [114]	Hip and balance exercise x Hip exercise	Single-legged stance for 30 seconds			Balance (n=30)		Control (n=30)					
					<i>Pre</i>	<i>4 weeks</i>	<i>Pre</i>	<i>4 weeks</i>				
				Overall stability index	14.51 (2.1)	11.38 (1.1)	15.17 (2.6)	14.76 (2.5)				
Center of Pressure (CoP) Behaviour												
Ferreira et al. [109]	McConnell patellar tape x Sham tape	Single-legged squat and stance for 30 seconds			McConnell (n=20)				Sham (n=20)			
					<i>Stance</i>		<i>Squat</i>		<i>Stance</i>		<i>Squat</i>	
					<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>
				CoP area (cm²)	6.83 (3.10)	6.81 (3.00)	13.34 (7.16)	13.69 (7.09)	6.99 (2.17)	6.90 (2.20)	14.35 (6.13)	14.06 (5.10)
				CoP AP amplitude (cm)	3.77 (1.25)	3.63 (0.90)	5.69 (1.93)	5.79 (2.10)	3.57 (0.66)	3.62 (0.72)	6.04 (1.80)	6.09 (1.62)
				CoP ML amplitude (cm)	2.79 (0.48)	2.65 (0.44)	3.36 (0.64)	3.25 (0.50)	2.86 (0.37)	2.77 (0.38)	3.39 (0.38)	3.25 (0.47)
				CoP AP velocity (cm/s)	2.16 (0.60)	2.00 (0.48)	3.61 (0.88)	3.33 (0.74)	2.09 (0.44)	1.97 (0.47)	3.59 (0.70)	3.38 (0.66)
				CoP ML velocity (cm/s)	2.50 (0.56)	2.27 (0.46)	3.37 (0.66)	2.95 (0.49)	2.43 (0.44)	2.26 (0.44)	3.29 (0.58)	3.09 (0.67)
				AP Frequency (Hz)	0.54 (0.09)	0.52 (0.14)	0.67 (0.17)	0.57 (0.15)	0.54 (0.15)	0.52 (0.13)	0.61 (0.21)	0.53 (0.15)
				ML Frequency (Hz)	0.78 (0.13)	0.74 (0.12)	0.90 (0.14)	0.80 (0.11)	0.73 (0.13)	0.69 (0.14)	0.83 (0.15)	0.81 (0.13)
* Immediate effect												

[illegible]

Motealleh et al. [62]	Physical therapy and Core neuromuscular training x Physical therapy	Y-balance test	<table><tr><td></td><td colspan="2">Core training (n=14)</td><td colspan="2">Control (n=14)</td></tr><tr><td></td><td><i>Pre</i></td><td><i>4 weeks</i></td><td><i>Pre</i></td><td><i>4 weeks</i></td></tr><tr><td><i>Anterior (%)</i></td><td>0.62 (0.14)</td><td>0.70 (0.11)</td><td>0.63 (0.13)</td><td>0.71 (0.17)</td></tr><tr><td><i>Posteromedial (%)</i></td><td>0.68 (0.16)</td><td>0.85 (0.13)</td><td>0.75 (0.19)</td><td>0.78 (0.22)</td></tr><tr><td><i>Posterolateral (%)</i></td><td>0.66 (0.14)</td><td>0.81 (0.14)</td><td>0.65 (0.16)</td><td>0.77 (0.20)</td></tr></table>		Core training (n=14)		Control (n=14)			<i>Pre</i>	<i>4 weeks</i>	<i>Pre</i>	<i>4 weeks</i>	<i>Anterior (%)</i>	0.62 (0.14)	0.70 (0.11)	0.63 (0.13)	0.71 (0.17)	<i>Posteromedial (%)</i>	0.68 (0.16)	0.85 (0.13)	0.75 (0.19)	0.78 (0.22)	<i>Posterolateral (%)</i>	0.66 (0.14)	0.81 (0.14)	0.65 (0.16)	0.77 (0.20)																																																															
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Motealleh et al. [108]	Lumbopelvic manipulation x Sham manipulation	SEBT	<table><tr><td></td><td colspan="2">Manipulation (n=22)</td><td colspan="2">Sham (n=22)</td></tr><tr><td></td><td><i>Pre</i></td><td><i>Post</i></td><td><i>Pre</i></td><td><i>Post</i></td></tr><tr><td><i>Anterior (%)</i></td><td>67.09 (7.01)</td><td>69.22 (7.39)</td><td>66.59 (7.09)</td><td>65.81 (7.85)</td></tr><tr><td><i>Posteromedial (%)</i></td><td>71.04 (7.16)</td><td>71.40 (7.37)</td><td>71.81 (6.89)</td><td>71.36 (6.75)</td></tr><tr><td><i>Posterolateral (%)</i></td><td>70.45 (6.91)</td><td>71.09 (7.20)</td><td>70.95 (7.24)</td><td>70.77 (7.53)</td></tr></table> * Immediate effect		Manipulation (n=22)		Sham (n=22)			<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>	<i>Anterior (%)</i>	67.09 (7.01)	69.22 (7.39)	66.59 (7.09)	65.81 (7.85)	<i>Posteromedial (%)</i>	71.04 (7.16)	71.40 (7.37)	71.81 (6.89)	71.36 (6.75)	<i>Posterolateral (%)</i>	70.45 (6.91)	71.09 (7.20)	70.95 (7.24)	70.77 (7.53)																																																															
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<i>Posteromedial (%)</i>	71.04 (7.16)	71.40 (7.37)	71.81 (6.89)	71.36 (6.75)																																																																																							
<i>Posterolateral (%)</i>	70.45 (6.91)	71.09 (7.20)	70.95 (7.24)	70.77 (7.53)																																																																																							
Ojaghi et al. [119]	McConnell tape x Elastic bandage	SEBT and single- legged stance for 20 seconds	<table><tr><td rowspan="2">Mean only</td><td colspan="3">McConnell (n=17)</td><td colspan="3">Elastic bandage (n=17)</td></tr><tr><td><i>Pre</i></td><td><i>Post</i></td><td><i>Change</i></td><td><i>Pre</i></td><td><i>Post</i></td><td><i>Change</i></td></tr><tr><td><i>SEBT Anterior (cm)</i></td><td>99.95</td><td>103.82</td><td>3.876 (6.018)</td><td>98.74</td><td>99.82</td><td>1.088 (5.524)</td></tr><tr><td><i>SEBT Anteromedial (cm)</i></td><td>99.2</td><td>101.33</td><td>2.142 (5.322)</td><td>97.94</td><td>99.06</td><td>1.123 (5.630)</td></tr><tr><td><i>SEBT Medial (cm)</i></td><td>89.53</td><td>93.04</td><td>3.506 (7.529)</td><td>88.25</td><td>91.99</td><td>3.735 (7.072)</td></tr><tr><td><i>SEBT Posteromedial (cm)</i></td><td>84.35</td><td>87.41</td><td>3.059 (6.496)</td><td>81.90</td><td>86.61</td><td>4.713 (6.810)</td></tr><tr><td><i>SEBT Posterior (cm)</i></td><td>77.25</td><td>81.54</td><td>4.282 (5.677)</td><td>76.48</td><td>81.22</td><td>4.747 (5.826)</td></tr><tr><td><i>SEBT Posterolateral (cm)</i></td><td>75.91</td><td>79.05</td><td>3.142 (6.882)</td><td>75.36</td><td>78.10</td><td>2.739 (7.582)</td></tr><tr><td><i>SEBT Lateral (cm)</i></td><td>70.24</td><td>74.24</td><td>4.000 (7.131)</td><td>73.08</td><td>77.09</td><td>4.018 (8.169)</td></tr><tr><td><i>SEBT Anterolateral (cm)</i></td><td>86.62</td><td>89.92</td><td>3.302 (5.637)</td><td>86.54</td><td>87.66</td><td>1.114 (7.318)</td></tr><tr><td><i>CoP AP velocity (mm/s)</i></td><td>73.992</td><td>63.947</td><td>10.045 (18.458)</td><td colspan="3" rowspan="4">not informed</td></tr><tr><td><i>CoP ML velocity (mm/s)</i></td><td>60.004</td><td>57.584</td><td>2.420 (6.118)</td></tr><tr><td><i>CoP AP displacement (mm)</i></td><td>57.096</td><td>57.425</td><td>-0.328 (6.943)</td></tr><tr><td><i>CoP ML displacement (mm)</i></td><td>44.312</td><td>42.658</td><td>1.653 (7.469)</td></tr></table> * Immediate effect	Mean only	McConnell (n=17)			Elastic bandage (n=17)			<i>Pre</i>	<i>Post</i>	<i>Change</i>	<i>Pre</i>	<i>Post</i>	<i>Change</i>	<i>SEBT Anterior (cm)</i>	99.95	103.82	3.876 (6.018)	98.74	99.82	1.088 (5.524)	<i>SEBT Anteromedial (cm)</i>	99.2	101.33	2.142 (5.322)	97.94	99.06	1.123 (5.630)	<i>SEBT Medial (cm)</i>	89.53	93.04	3.506 (7.529)	88.25	91.99	3.735 (7.072)	<i>SEBT Posteromedial (cm)</i>	84.35	87.41	3.059 (6.496)	81.90	86.61	4.713 (6.810)	<i>SEBT Posterior (cm)</i>	77.25	81.54	4.282 (5.677)	76.48	81.22	4.747 (5.826)	<i>SEBT Posterolateral (cm)</i>	75.91	79.05	3.142 (6.882)	75.36	78.10	2.739 (7.582)	<i>SEBT Lateral (cm)</i>	70.24	74.24	4.000 (7.131)	73.08	77.09	4.018 (8.169)	<i>SEBT Anterolateral (cm)</i>	86.62	89.92	3.302 (5.637)	86.54	87.66	1.114 (7.318)	<i>CoP AP velocity (mm/s)</i>	73.992	63.947	10.045 (18.458)	not informed			<i>CoP ML velocity (mm/s)</i>	60.004	57.584	2.420 (6.118)	<i>CoP AP displacement (mm)</i>	57.096	57.425	-0.328 (6.943)	<i>CoP ML displacement (mm)</i>	44.312	42.658	1.653 (7.469)
Mean only	McConnell (n=17)				Elastic bandage (n=17)																																																																																						
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Steinberg et al. [107]	Isometric exercises x Somatosensory training x Control	SEBT			Isometric (n=41)		Somatosensory (n=28)		Control (n=29)	
					Pre	12 weeks	Pre	12 weeks	Pre	12 weeks
				SEBT anterior (%)	57.3 (5.7)	55.8 (5.6)	58.1 (5.5)	59.8 (5.5)	54.6 (6.3)	54.8 (5.3)
				SEBT posteromedial (%)	85.3 (8.5)	85.0 (8.1)	86.6 (8.1)	91.9 (9.2)	86.0 (8.8)	87.9 (9.1)
				SEBT posterolateral (%)	84.3 (9.8)	83.8 (10.0)	86.4 (8.9)	91.4 (8.9)	88.2 (9.2)	87.5 (9.2)
				SEBT index (%)	89.2 (8.1)	87.8 (8.2)	92.5 (7.6)	95.4 (6.5)	91.7 (9.6)	90.7 (8.0)

Sinaei et al. [120]	Facilitatory Kinesio taping x Inhibitory Kinesio taping	SEBT			Facilitatory (n=16)		Inhibitory (n=16)			
					Pre	Post	Pre	Post		
				Anterior (cm)	82.49 (13.94)	89.58 (14.07)	80.57 (10.27)	83.87 (12.32)		
				Posteromedial (cm)	84.44 (14.51)	92.73 (18.73)	83.80 (11.31)	87.18 (11.83)		
				Posterolateral (cm)	80.36 (15.88)	86.93 (16.32)	77.88 (11.80)	83.75 (12.16)		
				Composite (cm)	82.43 (14.27)	89.75 (16.06)	80.75 (10.98)	84.93 (11.77)		

Song et al. [94]	Femoral tape x Controls	Anterior direction of SEBT		n=16	Tape	Sham	No tape
				SEBT anterior (%)	66.15 (4.64)	67.18 (3.74)	65.57 (4.83)
* Immediate effect							

Zarei et al. [110]	Dry needling and exercise x Exercise only	SEBT			Dry needling (n=20)			Control (n=20)		
					Pre	4 weeks	6 weeks follow-up	Pre	4 weeks	6 weeks follow-up
				Anterior (cm/cm)	0.76 (0.12)	0.89 (0.11)	0.90 (0.11)	0.76 (0.14)	0.81 (0.14)	0.81 (0.13)
				Posterolateral (cm/cm)	0.74 (0.12)	0.83 (0.11)	0.85 (0.11)	0.74 (0.12)	0.78 (0.12)	0.77 (0.11)
				Posteromedial (cm/cm)	0.67 (0.11)	0.77 (0.10)	0.78 (0.10)	0.66 (0.10)	0.69 (0.10)	0.70 (0.10)

Abbreviations: KT = kinesiotaping, CoP = centre of pressure, AP = anteroposterior, ML = mediolateral, SEBT = Star Excursion Balance Test.

Supplementary material 8C. Individual data of the included studies for Q3 (mean±SD).

Study	Interventions	Balance Intervention	Results																	
Boitrago et al. [61]	Strength and Proprioceptive exercises x Education	Single-legged stance on stable and unstable surfaces			Exercise (n=30)			Education (n=30)												
					Pre		6 weeks	Pre		6 weeks										
			NPRS (cm)		6.7 (1.7)		1.9 (1.8)	6.67 (2.3)		6.07 (2.2)										
			AKPS (points)		67.6 (15.2)		85.8 (12.3)	71.6 (1.11)		71.83 (11.8)										
			KOS-ADLS (points)		59.2 (14.2)		83 (15.5)	62.27 (19.9)		62 (18.9)										
Clark et al. [124]	Exercise, taping and education x Exercise and education x Taping and Education x Education only	Balance exercises using a trampet			Exercise + tape (n=20)			Exercise (n=20)			Tape (n=19)			Education (n=21)						
					Pre		3 mo	12 mo	Pre		3 mo	12 mo	Pre		3 mo	12 mo				
			VAS (mm)		75.6 (32.6)		35.9 (28.7)	35.1 (45.1)	77.1 (44.4)		30.0 (39.9)	37.8 (43.4)	83.9 (39.8)		57.8 (38.7)	77.3 (62.8)	76.99 (41.8)		41.8 (40.6)	51.9 (53.8)
			WOMAC (points)		25.2 (12.5)		11.5 (10.5)	14.8 (18.0)	23.7 (12.9)		10.0 (11.8)	15.6 (16.2)	33.4 (16.8)		20.9 (15.5)	27.6 (22.7)	28.7 (15.4)		13.8 (15.8)	22.0 (21.3)
* Interventions lasted 3 months																				
Ebrahimi et al. [113]	Virtual reality training x Written education	Virtual games requiring single-legged stance			Virtual reality (n=12)			Control (n=12)												
					Pre		8 weeks	Pre		8 weeks										
			VAS (mm)		5.786 (1.626)			1.714 (1.383)		5.929 (1.639)			3.071 (1.817)							
			AKPS (points)		68.929 (5.771)			88.357 (6.033)		69.786 (9.513)			83.000 (10.459)							
			Step-down test (rep)		9.691 (3.385)			15.119 (4.282)		9.857 (3.384)			13.357 (4.284)							
Emamvirdi et al. [125]	Exercise with valgus control instruction x Written instructions	Single-legged stance on stable and unstable surfaces			Exercise (n=32)			Control (n=32)												
					Pre		6 weeks	Pre		6 weeks										
			VAS (cm)		6.1 (1.18)			3.1 (1.61)		6.0 (1.35)		6.1 (1.12)								
			Single hop test (cm)		112.43 (9.60)			140.12 (11.50)		118.60 (14.01)		117.50 (13.05)								
			Triple hop test (cm)		308.31 (58.44)			381.54 (33.40)		343.18 (42.66)		324.12 (35.22)								
			Crossover hop test (cm)		301.25 (14.63)			340.06 (18.95)		306.37 (40.47)		299.62 (36.25)								
			6m hop test (sec)		10.90 (0.60)			10.09 (0.62)		10.16 (0.44)		10.29 (0.67)								
Ferber et al. [122]	Hip and core exercises x Knee exercises	Double and single-legged stance on unstable surfaces			Hip/Core (n=111)			Knee (n=88)												
					Pre		6 weeks	Pre		6 weeks										
			VAS (cm)		5.12 (1.66)			1.96 (1.92)		4.96 (1.66)		1.99 (2.05)								
			AKPS (points)		75.00 (9.74)			87.95 (11.26)		75.62 (9.81)		87.67 (10.53)								

Rabelo et al. [32]	Strength exercises x Strength and motor control exercises	Single-legged stance	<table><tr><td></td><td colspan="4">Strengthening (n=17)</td><td colspan="4">Motor Control (n=17)</td></tr><tr><td></td><td><i>Pre</i></td><td><i>4 weeks</i></td><td><i>3 mo</i></td><td><i>12 mo</i></td><td><i>Pre</i></td><td><i>4 weeks</i></td><td><i>3 mo</i></td><td><i>12 mo</i></td></tr><tr><td><i>NPRS (cm)</i></td><td>6.6 (1.0)</td><td>2.2 (1.6)</td><td>3.0 (2.4)</td><td>2.2 (1.6)</td><td>6.1 (1.4)</td><td>2.0 (1.7)</td><td>1.7 (1.6)</td><td>1.3 (1.8)</td></tr><tr><td><i>AKPS (points)</i></td><td>67.5 (11.3)</td><td>83.7 (8.3)</td><td>83.3 (12.0)</td><td>84.8 (9.8)</td><td>67.1 (7.6)</td><td>85.8 (9.2)</td><td>91.4 (7.0)</td><td>89.0 (8.2)</td></tr></table>									Strengthening (n=17)				Motor Control (n=17)					<i>Pre</i>	<i>4 weeks</i>	<i>3 mo</i>	<i>12 mo</i>	<i>Pre</i>	<i>4 weeks</i>	<i>3 mo</i>	<i>12 mo</i>	<i>NPRS (cm)</i>	6.6 (1.0)	2.2 (1.6)	3.0 (2.4)	2.2 (1.6)	6.1 (1.4)	2.0 (1.7)	1.7 (1.6)	1.3 (1.8)	<i>AKPS (points)</i>	67.5 (11.3)	83.7 (8.3)	83.3 (12.0)	84.8 (9.8)	67.1 (7.6)	85.8 (9.2)	91.4 (7.0)	89.0 (8.2)
				Strengthening (n=17)				Motor Control (n=17)																																						
				<i>Pre</i>	<i>4 weeks</i>	<i>3 mo</i>	<i>12 mo</i>	<i>Pre</i>	<i>4 weeks</i>	<i>3 mo</i>	<i>12 mo</i>																																			
			<i>NPRS (cm)</i>	6.6 (1.0)	2.2 (1.6)	3.0 (2.4)	2.2 (1.6)	6.1 (1.4)	2.0 (1.7)	1.7 (1.6)	1.3 (1.8)																																			
			<i>AKPS (points)</i>	67.5 (11.3)	83.7 (8.3)	83.3 (12.0)	84.8 (9.8)	67.1 (7.6)	85.8 (9.2)	91.4 (7.0)	89.0 (8.2)																																			
* Interventions lasted 4 weeks																																														
Shadloo et al. [126]	Vibration training x Conventional training	Single-legged stance exercises in stable and unstable surfaces with open and closed eyes	<table><tr><td></td><td colspan="3">Vibration (n=15)</td><td colspan="3">Control (n=15)</td></tr><tr><td></td><td><i>Pre</i></td><td><i>4 weeks</i></td><td><i>6 weeks</i></td><td><i>Pre</i></td><td><i>4 weeks</i></td><td><i>6 weeks</i></td></tr><tr><td><i>VAS (cm)</i></td><td>7.53 (2.13)</td><td>2.00 (1.66)</td><td>1.20 (0.94)</td><td>7.53 (1.45)</td><td>2.00 (1.54)</td><td>1.40 (1.50)</td></tr><tr><td><i>AKPS (points)</i></td><td>62.46 (8.25)</td><td>88.06 (3.12)</td><td>88.86 (3.56)</td><td>64.53 (7.49)</td><td>88.66 (3.01)</td><td>88.73 (3.03)</td></tr><tr><td><i>Leg press (rep)</i></td><td>10.8 (1.01)</td><td>17.6 (1.80)</td><td>18.8 (0.94)</td><td>11.07 (0.88)</td><td>17.26 (1.53)</td><td>19.13 (0.91)</td></tr></table>								Vibration (n=15)			Control (n=15)				<i>Pre</i>	<i>4 weeks</i>	<i>6 weeks</i>	<i>Pre</i>	<i>4 weeks</i>	<i>6 weeks</i>	<i>VAS (cm)</i>	7.53 (2.13)	2.00 (1.66)	1.20 (0.94)	7.53 (1.45)	2.00 (1.54)	1.40 (1.50)	<i>AKPS (points)</i>	62.46 (8.25)	88.06 (3.12)	88.86 (3.56)	64.53 (7.49)	88.66 (3.01)	88.73 (3.03)	<i>Leg press (rep)</i>	10.8 (1.01)	17.6 (1.80)	18.8 (0.94)	11.07 (0.88)	17.26 (1.53)	19.13 (0.91)		
				Vibration (n=15)			Control (n=15)																																							
				<i>Pre</i>	<i>4 weeks</i>	<i>6 weeks</i>	<i>Pre</i>	<i>4 weeks</i>	<i>6 weeks</i>																																					
			<i>VAS (cm)</i>	7.53 (2.13)	2.00 (1.66)	1.20 (0.94)	7.53 (1.45)	2.00 (1.54)	1.40 (1.50)																																					
			<i>AKPS (points)</i>	62.46 (8.25)	88.06 (3.12)	88.86 (3.56)	64.53 (7.49)	88.66 (3.01)	88.73 (3.03)																																					
<i>Leg press (rep)</i>	10.8 (1.01)	17.6 (1.80)	18.8 (0.94)	11.07 (0.88)	17.26 (1.53)	19.13 (0.91)																																								
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Steinberg et al. [107]	Isometric exercises x Somatosensory training x Control	Single-legged stance exercises in stable and unstable surfaces with open and closed eyes	<table><tr><td></td><td colspan="2">Isometric (n=41)</td><td colspan="2">Somatosensory (n=28)</td><td colspan="2">Control (n=29)</td></tr><tr><td></td><td><i>Pre</i></td><td><i>12 weeks</i></td><td><i>Pre</i></td><td><i>12 weeks</i></td><td><i>Pre</i></td><td><i>12 weeks</i></td></tr><tr><td><i>VAS (cm)</i></td><td>4.56 (1.79)</td><td>4.03 (2.73)</td><td>5.04 (2.13)</td><td>4.45 (2.18)</td><td>5.36 (1.98)</td><td>5.00 (2.23)</td></tr><tr><td><i>VAS PIT (cm)</i></td><td>4.64 (2.22)</td><td>3.36 (2.24)</td><td>4.83 (2.24)</td><td>3.17 (2.76)</td><td>4.51 (2.16)</td><td>6.15 (1.73)</td></tr></table>							Isometric (n=41)		Somatosensory (n=28)		Control (n=29)			<i>Pre</i>	<i>12 weeks</i>	<i>Pre</i>	<i>12 weeks</i>	<i>Pre</i>	<i>12 weeks</i>	<i>VAS (cm)</i>	4.56 (1.79)	4.03 (2.73)	5.04 (2.13)	4.45 (2.18)	5.36 (1.98)	5.00 (2.23)	<i>VAS PIT (cm)</i>	4.64 (2.22)	3.36 (2.24)	4.83 (2.24)	3.17 (2.76)	4.51 (2.16)	6.15 (1.73)										
				Isometric (n=41)		Somatosensory (n=28)		Control (n=29)																																						
				<i>Pre</i>	<i>12 weeks</i>	<i>Pre</i>	<i>12 weeks</i>	<i>Pre</i>	<i>12 weeks</i>																																					
			<i>VAS (cm)</i>	4.56 (1.79)	4.03 (2.73)	5.04 (2.13)	4.45 (2.18)	5.36 (1.98)	5.00 (2.23)																																					
<i>VAS PIT (cm)</i>	4.64 (2.22)	3.36 (2.24)	4.83 (2.24)	3.17 (2.76)	4.51 (2.16)	6.15 (1.73)																																								
van Linschoten et al. [123]	Exercise therapy x Usual care	Balance exercises	<table><tr><td></td><td colspan="3">Exercise (n=65)</td><td colspan="3">Usual care (n=66)</td></tr><tr><td></td><td><i>Pre</i></td><td><i>3 months</i></td><td><i>12 months</i></td><td><i>Pre</i></td><td><i>3 months</i></td><td><i>12 months</i></td></tr><tr><td><i>NRS rest (cm)</i></td><td>4.14 (2.3)</td><td>2.30 (2.5)</td><td>1.43 (2.2)</td><td>4.03 (2.3)</td><td>3.22 (2.8)</td><td>2.61 (2.9)</td></tr><tr><td><i>NRS activity (cm)</i></td><td>6.32 (2.2)</td><td>3.81 (2.9)</td><td>2.57 (2.9)</td><td>5.97 (2.3)</td><td>4.60 (3.0)</td><td>3.54 (3.38)</td></tr><tr><td><i>AKPS (points)</i></td><td>64.4 (13.9)</td><td>78.8 (15.5)</td><td>83.2 (14.8)</td><td>65.9 (15.2)</td><td>74.9 (17.6)</td><td>79.8 (17.5)</td></tr></table>								Exercise (n=65)			Usual care (n=66)				<i>Pre</i>	<i>3 months</i>	<i>12 months</i>	<i>Pre</i>	<i>3 months</i>	<i>12 months</i>	<i>NRS rest (cm)</i>	4.14 (2.3)	2.30 (2.5)	1.43 (2.2)	4.03 (2.3)	3.22 (2.8)	2.61 (2.9)	<i>NRS activity (cm)</i>	6.32 (2.2)	3.81 (2.9)	2.57 (2.9)	5.97 (2.3)	4.60 (3.0)	3.54 (3.38)	<i>AKPS (points)</i>	64.4 (13.9)	78.8 (15.5)	83.2 (14.8)	65.9 (15.2)	74.9 (17.6)	79.8 (17.5)		
				Exercise (n=65)			Usual care (n=66)																																							
				<i>Pre</i>	<i>3 months</i>	<i>12 months</i>	<i>Pre</i>	<i>3 months</i>	<i>12 months</i>																																					
			<i>NRS rest (cm)</i>	4.14 (2.3)	2.30 (2.5)	1.43 (2.2)	4.03 (2.3)	3.22 (2.8)	2.61 (2.9)																																					
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* Interventions lasted 3 months																																														
Yalfani et al. [128]	Sensorimotor exercise x No intervention	Single-legged stance exercises in stable and unstable surfaces with open and closed eyes	<table><tr><td></td><td colspan="2">Sensoriomotor (n=16)</td><td colspan="2">No intervention (n=16)</td></tr><tr><td></td><td><i>Pre</i></td><td><i>12 weeks</i></td><td><i>Pre</i></td><td><i>12 weeks</i></td></tr><tr><td><i>Pain (cm)</i></td><td>6.00 (1.13)</td><td>2.66 (1.17)</td><td>7.00 (1.85)</td><td>6.53 (1.35)</td></tr></table>					Sensoriomotor (n=16)		No intervention (n=16)			<i>Pre</i>	<i>12 weeks</i>	<i>Pre</i>	<i>12 weeks</i>	<i>Pain (cm)</i>	6.00 (1.13)	2.66 (1.17)	7.00 (1.85)	6.53 (1.35)																									
				Sensoriomotor (n=16)		No intervention (n=16)																																								
				<i>Pre</i>	<i>12 weeks</i>	<i>Pre</i>	<i>12 weeks</i>																																							
<i>Pain (cm)</i>	6.00 (1.13)	2.66 (1.17)	7.00 (1.85)	6.53 (1.35)																																										

Abbreviations: NRS = numeric pain scale, AKPS = Anterior Knee Pain Scale, VAS = visual analogue scale, WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index, KOOS = Knee injury and Osteoarthritis Outcome Score, ADL = Activities of Daily Living, KOS-ADLS = Knee Outcome Survey - Activities of Daily Living Scale.

*Interventions in bold indicate the group that applied balance exercises