

**Appendix Table 2**  
**Characteristics of included studies (n=64)**

	Study design	Number of patients (used for analysis)	Age at start study, years	Sex, % male	Follow-up time	OA outcome	Knee compartment	Definition OA	RBA
Aglietti 1994 (54)	retrospective study	57	not reported	not reported	meniscus repair group: mean 55 (range 36-71) months; meniscectomy group: mean 52 (range 36-90) months; normal meniscus group: mean 57 (range 37-77) months	radiographic: the Hospital for Special Surgery(HSS) radiographic score	tibiofemoral (medial and lateral) and patellofemoral	< 26 points	HR
Aglietti 1997 (55)	retrospective study	77	mean 23 (range 15-40)	81	mean 7 (range 5.4-8.6) years	radiographic: JSN (no specific definition)	not reported	not reported	HR
Ahlden 2009 (18)	RCT	44	BPTB group: median 26 (range 14-48); hamstring group: median 29 (range 15-40)	68	BPTB group: median 89 (range 77-110) months hamstring group: median 86 (range 69-109) months	radiographic: Ahlbäck and Fairbank score / presence of osteophytes	tibiofemoral (medial and lateral) and patellofemoral	not reported	HR
Ahn 2012 (56)	retrospective study	117	mean 29.2 (SD 8.8)	75.2	mean 10.3 (SD 1) years	radiographic: IKDC grading system	tibiofemoral (medial and lateral) and patellofemoral	grade C and D	LR
Cohen 2007 (57)	retrospective study	62	mean 27 (range 15-46)	76	mean 11 years 2 months (range 10-15 years)	radiographic; Fairbank score	tibiofemoral (medial and lateral)	not reported	HR
Fink 2001 (30)	prospective follow-up study	84	ACL reconstruction group: mean 33.6 (SD 8.0); non-operative group: mean 32.3 (SD 9.9)	ACL reconstruction group: 80; non-operative group: 72	ACL reconstruction group: mean 74.2 months; non-operative group: mean 84.2 months	radiographic: modified Fairbank score	tibiofemoral	not reported	HR
Fithian 2005 (31)	prospective follow-up study	209	mean 39 (range 16 - 69)*	48	mean 6.6 (range 3 - 10) years	radiographic: IKDC grading system	tibiofemoral (medial and lateral) and	not reported	HR

										patellofemoral
Frobell 2013 (19)	RCT	113	early ACL reconstruction group: mean 26.4 (SD 5.1); delayed optional ACL reconstruction group: mean 25.8 (SD 4.7)	early ACL reconstruction group: 80; delayed optional ACL reconstruction group: 66	early ACL reconstruction group: mean 60 (95% CI 59 to 61) months; delayed ACL reconstruction group: mean 59 (95% CI 57 to 60) months; rehabilitation alone group: mean 58 (95% CI 55 to 61) months	radiographic: grading according to atlas of OARSI	tibiofemoral and patellofemoral	JSN $\geq 2$ in compartment, a sum of osteophyte grades $\geq 2$ in the same compartment or grade 1 JSN combined with grade 1 osteophyte in same compartment	HR	
Gerhard 2013 (58)	retrospective study	63	mean 27 (SD 7)	86	mean 16 (SD 1) years	radiographic: Kellgren and Lawrence score	not reported	not reported	HR	
Giron 2005 (32)	prospective follow-up study	38	mean 29 (range 17-53)	79	5 years†	radiographic: IKDC grading system	not reported	not reported	HR	
Hanypsiak 2008 (33)	prospective follow-up study	44	39*	70	mean 12.7 (range 11.8-13.8) years	radiographic: Rosenberg	not reported	JSN $\geq 2$ mm compared to uninjured contralateral compartment	HR	
Harilainen 2006 (20)	RCT	71	not reported	not reported	median 5 years (range 3 years 11 months-6 years 7 months)	radiographic: IKDC grading system	tibiofemoral (medial and lateral)	not reported	HR	
Hart 2005 (59)	retrospective study	31	mean: 27.8 (range 18-47)	68	mean 10 years (range 9-13)	radiographic: Ahlbäck score	tibiofemoral (medial and lateral) and patellofemoral	Ahlbäck grade $\geq 1$	HR	
Holm 2010 (21)	RCT	57	hamstring group: mean 27 (SD 9); BPTB group: 25 (SD 7)	hamstring group 52; BPTB group: 64	hamstring group: mean 10.7 (SD 0.4) years; BPTB group: 10.2 (SD 0.4) years	radiographic: Kellgren and Lawrence score	tibiofemoral	Kellgren & Lawrence score $\geq 2$	HR	

Hui 2011 (34)	prospective follow-up study	59	mean 25 (range 15-42)	51	mean 184 (range 169-199) months	radiographic: IKDC grading system	not reported	not reported	HR
Ichiba 2009 (60)	retrospective study	46	mean 26 (range 13-39)	26	mean 3.9 (range 2-8) years	radiographic: Kawakubo method	tibiofemoral	Increase OA score: differences between preoperative OA score and at follow-up	HR
Janssen 2013 (35)	prospective follow-up study	86	mean 31.2 (SD 8.0)	66	mean 10 ( SD 0.7) years	radiographic: Ahlbäck and Kellgren and Lawrence score	not reported	Ahlbäck grade 1 and Kellgren and Lawrence grade 3	LR
Jarvela 1999 (61)	retrospective study	91	early reconstruction group: 32 (range 15-61); late reconstruction group: 30 (range 16-46)	69	mean 7 (range early reconstruction group 5.9-8.5; late reconstruction group range 4.6-8.8) years	radiographic: IKDC grading system	medial tibiofemoral	IKDC grade ≥ nearly normal <sup>‡</sup>	HR
Jarvela 2001 (62)	retrospective study	86	mean 31 (range 15-61)	70	mean 7 (range 4.6-8.8) years	radiographic: IKDC grading system	patellofemoral	IKDC evaluation system ≥ mild	HR
Jarvela 2001 (63)	retrospective study	72	isolated ACL rupture group: mean 29 (SD 9); ACL tear accompanying injuries group: mean 34 (SD 12)	67	isolated ACL rupture group: mean 7.1 (SD 0.7) years; ACL tear accompanying injuries group: mean 6.9 (SD 0.7) years	radiographic: IKDC grading system	tibiofemoral and patellofemoral	not reported	HR
Jomha 1999 (36)	prospective follow-up study	53	acute ACL tears group: mean 27; chronic ACL tear group: mean 28	70	7 years <sup>†</sup>	radiographic: IKDC grading system	not reported	presence of osteophytes, subchondral sclerosis, change of articular surface, or JSN	HR

Kannus 1989 (64)	retrospective study	77	mean 30 (SD 11)*	75.3	mean 7.8 (SD 2.0) years	radiographic: classification according to Kannus (0-100 point scale)	tibiofemoral (medial and lateral) and patellofemoral	score 95-99: good; score 90-94: fair; ≤ 89: poor	HR
Keays 2010 (37)	prospective follow-up study	56	mean 27 (range 18-38)	71	6 years†	radiographic: modified Kellgren and Lawrence score (grade 0-3)	tibiofemoral and patellofemoral	Modified Kellgren & Lawrence score ≥ 1	HR
Kessler 2008 (65)	retrospective study	109	mean 30.7 (range 12.5- 54.0)	62.4	mean 11.1 (range 7.5-16.3) years	radiographic: Kellgren and Lawrence score	not reported	Kellgren & Lawrence score > 1	HR
Lebel 2008 (66)	retrospective study	98	mean 28.8 (SD 8.3)	77	mean 11.6 (SD 0.8) years	radiographic: IKDC grading system	tibiofemoral	not reported	HR
Leiter 2013 (67)	retrospective study	68	mean 31.2 (SD 9.1)	63	mean 14.6 (SD 1.9) years	radiographic: Kellgren and Lawrence score	not reported	not reported	HR
Leys 2012 (38)	prospective follow-up study	109	BPTB group: median 25 (range 15-42); hamstring group: median 24 (range 13-52)	53	15 years†	radiographic: IKDC grading system	tibiofemoral (medial and lateral) and patellofemoral	not reported	HR
Li 2011 (68)	retrospective study	249	mean 26.4 (SD 10.2)	61.4	mean 7.9 (range 2.1-20.3) years	radiographic: Kellgren and Lawrence score	not reported	2 grade difference between index and contralateral in at least 2 compartments or 1 grade difference between knees in at least 2 compartments	HR

Liden 2008 (69)	retrospective study	113	median 28 (range 15-59)	69	median 86 (range 67-111) months	radiographic: Ahlbäck and Fairbank score / unknown system	tibiofemoral and patellofemoral	not reported	HR
Lohmander 2004 (70)	retrospective study	67	mean 19 (range 14-28)	0	12 years†	radiographic: grading according to atlas of OARSI	tibiofemoral and patellofemoral	JSN grade of ≥ 2 or a sum of ≥ 2 for the 2 marginal osteophyte grades from the same compartment, or a JSN grade of at least 1 in combination with an osteophyte grade of at least 1 in the same compartment	HR
Mascarenhas 2012 (52)	matched case control study	46	mean 18 (SD 3)	43	BPTB group: mean 5 (SD 2) years; hamstring group: mean 4 (SD 2) years	radiographic: Kellgren and Lawrence score	tibiofemoral (medial and lateral) and patellofemoral	not reported	HR
Menke 1990 (71)	retrospective study	90	not reported	94	5 to 12 years	radiographic: Tapper and Hoover grading system	not reported	not reported	HR
Meuffels 2009 (53)	matched case control study	50	operative group: mean 37.6 (SD 6.2 ); non-operative group: mean 37.8 (SD 6.8 )*	76	10 years†	radiographic: Kellgren and Lawrence score	tibiofemoral	Kellgren & Lawrence score ≥ 2	HR
Meunier 2007 (22)	RCT	36	non-operative group: mean 21 (range 14-30)	62.5	mean 15 (SD 1) years	radiographic: Ahlbäck and Fairbank score	not reported	Ahlbäck and Fairbank grade > 0	HR

Mihelic 2011 (72)	retrospective study	54	reconstruction group: mean 25.3; non-operative group: mean 25.5	81	range 17-20 years	radiographic: IKDC grading system	not reported	not reported	HR
Moisala 2007 (39)	prospective follow-up study	66	mean 34 (range 16-64)	64	mean 57 months (range 3-8 years)	radiographic: IKDC grading system	not reported	IKDC grading system > A	HR
Murray 2012 (73)	retrospective study	83	mean 30 (SD 10)	not reported	mean 13 years	radiographic: IKDC grading system	not reported	IKDC grade C and D	HR
Neuman 2008 (40)	prospective follow-up study	79	mean 26 (SD 8)	58	mean 15.7 (SD 1.4) years	radiographic: grading according to atlas of OARSI	tibiofemoral	JSN $\geq$ grade 2, sum of the 2 marginal osteophyte scores from the same compartment $\geq$ 2, or grade 1 JSN in combination with grade 1 osteophyte in the same compartment.	HR
Neuman 2009 (41)	prospective follow-up study	75	mean 26 (SD 8)	58	mean 15.7 (SD 1.4) years	radiographic: grading according to atlas of OARSI	patellofemoral	JSN of grade 2 or higher in either the medial or lateral compartment, sum of marginal osteophyte grades $\geq$ 2, or grade 1 JSN in combination with a grade 1 marginal osteophyte.	HR

Oiestad 2013 (42)	prospective follow-up study	181	mean 39.1 (SD 8.7)*	58	mean 12.3 (SD 1.2) years	radiographic: Kellgren and Lawrence score	patellofemoral	Kellgren and Lawrence grade $\geq 2$	HR
Oiestad 2010 (43)	prospective follow-up study	164	mean 27.4 (SD 8.5)	57	mean 12.1 (SD 1.4) years	radiographic: Kellgren and Lawrence score	tibiofemoral	Kellgren & Lawrence score $\geq 2$	HR
Oiestad 2010 (44)	prospective follow-up study	181	mean 39.5 (8.6) *	57	mean 12.4 (SD 1.2) years	radiographic: Kellgren and Lawrence score	tibiofemoral	Kellgren & Lawrence score $\geq 2$	HR
O'Neill 2001 (23)	RCT	225	not reported	not reported	mean 102 months (range 6-11 years)	radiographic: IKDC grading system	not reported	not reported	HR
Otto 1998 (74)	retrospective study	62	mean 27 (range 15-46)	72	minimum 5 years	radiographic: IKDC grading system	not reported	not reported	HR
Pinczewski 2007 (45)	prospective follow-up study	128	BPTB group median 25 (range 15-42); hamstring group: median 24 (range 13-52)	not reported	10 years <sup>†</sup>	radiographic: IKDC grading system	not reported	not reported	HR
Pinczewski 2008 (46)	prospective follow-up study	184	not reported	not reported	7 years <sup>†</sup>	radiographic: IKDC grading system	not reported	not reported	HR
Potter 2012 (47)	prospective follow-up study	40	mean 37.2 (SD 9.1)	40	maximum 11 years	MRI: modified Outerbridge assessment	tibiofemoral (medial and lateral) and patellofemoral	not reported	HR
Ruiz 2002 (48)	prospective follow-up study	30	not reported	93	mean 7 years (range 64-114 months)	radiographic: JSN	tibiofemoral	not reported	HR
Sajovic 2011 (24)	RCT	52	hamstring group: mean 36 (range 25-54); BPTB group: mean 38 (range 27-58)*	58	11 years <sup>†</sup>	radiographic: IKDC grading system	not reported	worst grading compartment was used as overall grade	HR
Salmon 2006 (75)	retrospective study	43	median 27(95% CI 25-28)	70	minimum 13 years	radiographic: IKDC grading system	not reported	not reported	HR

Segawa 2001 (76)	retrospective study	70	mean 22.8 (range 12-50)	40	mean 11.6 (range 5-27) years	radiographic: Kellgren and Lawrence score	not reported	Kellgren & Lawrence score $\geq 1$	HR
Seitz 1994 (77)	retrospective study	87	operative group: mean 27 (range 15-42); non-operative group: mean 28 (range 18-56)	51	mean 8.5 (range 5-12) years	radiographic: Jäger and Wirth grading system	not reported	not reported	HR
Seon 2006 (78)	retrospective study	58	mean 30.4 (range 18-58)*	95	mean 11.2 (range 8.6-13.8) years	radiographic: Kellgren and Lawrence score	not reported	Kellgren and Lawrence > 2	HR
Shelbourne 2000 (49)	prospective follow-up study	range 45-282	women: mean 21 (range 13.2-50.1); men: mean 23.7 (range 11.8-53)	73	mean 7.6 (SD 2.3) years	radiographic: IKDC grading system	not reported	IKDC grade $\geq$ nearly normal‡	HR
Shelbourne 2012 (50)	prospective follow-up study	780	mean 25.4 (SD 9.2)	not reported	mean 10.5 (SD 4.5) years	radiographic: IKDC grading system	tibiofemoral (medial and lateral) and patellofemoral	IKDC evaluation system > grade A	HR
Song 2013 (25)	RCT	112	DB group: mean 30.3 (range 17-50); SB group: mean 35.5 (range 19-58)	DB group: 85; SB group: 63	DB group: mean 5.3 (range 4.1-6.1) years; SB group: mean 5.7 (range 4.1-6.2) years	radiographic: Kellgren and Lawrence score	not reported	$\geq 1$ grade progression compared with pre-operative condition	HR
Streich 2011 (79)	retrospective study	80	mean 25.8 (range 17-39)	70	operative group: mean 15.4 (SD 0.8) years; non-operative group: mean 15.2 (SD 0.7) years	radiographic: IKDC grading system	not reported	IKDC evaluation system > grade A	HR
Sun 2009 (26)	RCT	156	autograft group: mean 31.7 (SD 6.3); allograft group: mean 32.8 (SD 7.1)*	79	mean 5.6 (autograft group: SD 1.2; allograft group: SD 1.3) years	radiographic: Kellgren and Lawrence score	not reported	not reported	HR
Suomalainen 2012 (27)	RCT	65	Double-bundle with bioabsorbable screw group: mean 34 (SD 10); single-bundle with bioabsorbable screw	Double-bundle with bioabsorbable screw group: 30;	5 years†	radiographic: Kellgren and Lawrence score	tibiofemoral and patellofemoral	not reported	HR



			group: mean 30 (SD 8); single-bundle with metallic screw group: mean 33 (SD 10)	single-bundle with bioabsorbable screw group: 30; single-bundle with metallic screw group: 37					
von Porat 2004 (80)	retrospective study	122	mean 38 (SD 5.2)	100	14 years <sup>†</sup>	radiographic: Kellgren and Lawrence score	tibiofemoral	Kellgren & Lawrence score $\geq 2$	HR
Wang 2004 (81)	retrospective study	44	mean 31 (range 19-57)	73	mean 70 (range 46-86) months	radiographic: Ahlbäck rating system	tibiofemoral	not reported	HR
Wipfler 2011 (28)	RCT	54	BPTB: mean 29.87 (range 25 to 55); HT: 34.23 (range 26 to 64)	BPTB: 62; HT: 60	mean 8.8 (SD 0.55) years	MRI: International Cartilage Repair Society evaluation	not reported	not reported	HR
Wu 2002 (51)	prospective follow-up study	34	mean 24 (15-45)	57	mean 10.4 (range 9-13) years	radiographic: Fairbank system	not reported	not reported	HR
Zaffagnini 2011 (29)	RCT	79	BPTB group: mean 26 (SD 9.5); hamstring group: mean 27 (SD 9)	53	mean 8.6 (range 8-10) years	radiographic: IKDC grading system	not reported	not reported	HR

\*Age at follow-up

<sup>†</sup>Median or mean of follow-up time not reported

<sup>‡</sup>For calculation of the relationship between determinant and OA development, we chose a cut-off point.

Abbreviations: BPTB, bone-patellar tendon-bone; CI, confidence interval; HR, high-risk of bias; IKDC, International Knee Documentation Committee; JSN, joint space narrowing; LR, low-risk of bias; OARSI, Osteoarthritis Research Society International; RBA, risk of bias assessment; RCT, Randomized Controlled Trial; SD, standard deviation; WOMBS, Whole Organ Magnetic Resonance Imaging Score.