

TABLE E-1 Nonoperative Treatment of Early Stage Osteonecrosis of the Hip

Author	Year	Treatment	Number of Hips	Mean Months of Follow-up (range)	Clinical Failure (%)
Pritchett ³¹	2001	Lipid-lowering drugs	284	90 (60-132)	1*
Agarwala et al. ⁴⁸	2005	Bisphosphonates	60	12 (3-60)	10
Lai et al. ⁴⁹	2005	Bisphosphonates	29	Minimum 24	7
Ramachandran et al. ⁵⁰	2007	Bisphosphonates	29	38 (25-58)	0
Disch et al. ⁵¹	2005	Prostacyclin analogs	17	25 (11-37)	0
Glueck et al. ⁵²	2005	Anticoagulants	20	161 (108-216)	5
Wang et al. ³³	2005	Extracorporeal shock wave therapy	29	25 (24-38)	14
Ludwig et al. ³²	2001	Extracorporeal shock wave therapy	22	12	32
Massari et al. ³⁵	2006	Pulsed electromagnetic field therapy	76	28 (12-108)	20
Aaron et al. ³⁴	1989	Electrical stimulation	56	35	32
Trancik et al. ³⁷	1990	Electrical stimulation	11	45 (24-60)	100
Steinberg et al. ³⁶	1990	Electrical stimulation	20	31 (24-48)	58
Neumayr et al. ⁵³	2006	Physical therapy	21	36	14
Musso et al. ⁵⁴	1986	No intervention	50	30	94
Steinberg et al. ⁵⁵	1989	No intervention	55	21 (6-120)	84
Churchill and Spencer ⁵⁶	1991	No intervention	18	60	50
Stulberg et al. ⁵⁷	1991	No intervention	22	27	91
Robinson and Springer ⁵⁸	1993	No intervention	16	39 (24-61)	44
Bradway and Morrey ⁵⁹	1993	No intervention	15	23 (3-66)	100
Jergesen and Khan ⁶⁰	1997	No intervention	19	111 (51-81)	74
Lai et al. ⁴⁹	2005	No intervention	25	24	68
Hernigou et al. ⁶¹	2006	No intervention	121	168 (120-240)	91
Min et al. ³	2008	No intervention	81	100 (60-192)	38

*Reported prevalence of osteonecrosis in patients who were taking statins and corticosteroids.

TABLE E-2 Variations of the Core-Decompression Technique

Author	Year	Treatment	Number of Hips	Mean Months of Follow-up (range)	Clinical Failure (%)
Hernigou et al. ⁶²	2002	Core decompression and biologics	189	84 (60-132)	18
Gangji et al. ⁶³	2004	Core decompression and biologics	10	24	0
Lieberman et al. ⁶⁴	2004	Core decompression and biologics	17	53 (26-94)	18
Song et al. ⁶	2007	Small-diameter multiple drilling	163	87 (60-134)	34
Marker et al. ⁸	2008	Small-diameter multiple drilling	79	65 (36-81)	38
Veillette et al. ⁴³	2006	Tantalum	58	24 (6-52)	16
Shuler et al. ⁶⁵	2007	Tantalum	22	39 (27-59)	14

TABLE E-3 Reported Outcomes of Nonvascularized Bone-Grafting

Author	Year	Technique	Number of Hips	Mean Months of Follow-up (range)	Clinical Failure (%)
Ko et al. ⁶⁶	1995	Trapdoor technique and/or osteotomies	14	53 (24-108)	15
Steinberg et al. ⁶⁷	2001	Phemister technique	312	63 (23-146)	36
Plakseychuk et al. ⁶⁸	2003	Phemister technique	50	60 (36-96)	64
Rijken et al. ⁶⁹	2003	Phemister technique	28	50 (24-119)	29
Lieberman et al. ⁶⁴	2004	Phemister technique	17	53 (26-94)	18
Kim et al. ⁷⁰	2005	Phemister technique	30	50 (36-67)	65
Israelite et al. ⁷	2005	Phemister technique	276	(24-145)	38
Wang et al. ³³	2005	Phemister technique	28	26 (24-39)	35
Keizer et al. ⁷¹	2006	Phemister technique	80	84 (36-NA*)	69
Saito et al. ⁷²	1988	Light-bulb technique	18	48 (24-168)	28
Scher and Jakim ⁷³	1999	Light-bulb technique	50	96 (36-168)	14
Rosenwasser et al. ⁷⁴	1994	Light-bulb technique	15	138 (108-180)	13
Seyler et al. ⁷⁵	2008	Light-bulb technique	47	28 (12-50)	32

*NA = not available.

TABLE E-4 Literature Review of Vascularized Bone-Grafting Techniques*

Author	Year	Graft Source	Age (range)	Mean Months of Follow-up (range)	Additional Surgery (%)	Radiographic Progression (%)
Richards ⁷⁶	1991	Fibula	33 (18-52)	33 (24-54)	4 (10)	5 (13)
Yoo et al. ⁷⁷	1992	Fibula	36 (19-67)	62 (36-128)	NA	9 (11)
Malizos et al. ⁷⁸	1995	Fibula	33 (16-50)	32 (20-66)	3 (8)	5 (13)
Kane et al. ⁷⁹	1996	Fibula	42 (26-48)	(24-60)	NA	18 (46)
Sotereanos et al. ⁸⁰	1997	Fibula	37 (20-52)	66 (36-84)	20 (23)	37 (42)
Urbaniak and Harvey ⁸¹	1998	Fibula	33	(12-204)	112 (17)	NA
Scully et al. ⁸²	1998	Fibula	35 (18-60)	(21-50)	107 (17)	NA
Montella et al. ⁸³	1999	Fibula	32 (25-41)	35 (minimum 24)	2 (13)	2 (13)
Dean et al. ⁸⁴	2001	Fibula	15 (9-18)	52 (24-120)	8 (15)	18 (33)
Judet and Gilbert ⁸⁵	2001	Fibula	35 (20-64)	216 (180-264)	18 (25)	33 (48)
Soucacos et al. ⁸⁶	2001	Fibula	32 (16-54)	56 (12-120)	14 (8)	83 (45)
Plakseychuk et al. ⁶⁸	2003	Fibula	44 (23-52)	60 (36-96)	NA	21 (42)
Berend et al. ⁸⁷	2003	Fibula	34 (9-57)	52 (24-144)	73 (33)	73 (33)
Rizzo et al. ⁸⁸	2004	Fibula	NA	NA	2 (6)	NA
Le Nen et al. ^{89,90}	2004	Fibula	39	42 (minimum 15)	NA	13 (81)
Garberina et al. ⁹⁰	2004	Fibula	34	58 (minimum 24)	8 (24)	8 (24)
Zhang et al. ⁹¹	2004	Fibula	NA	12 (6-18)	NA	1 (4)
Kim et al. ⁷⁰	2005	Fibula	43 (24-52)	50 (36-66)	3 (13)	13 (57)
Marciniak et al. ⁹²	2005	Fibula	34 (16-61)	96 (60-180)	57 (56)	59 (58)
Stubbs et al. ⁹³	2005	Fibula	13 (9-20)	47 (36-75)	0 (0)	0 (0)
Yen et al. ⁴⁴	2006	Fibula	38 (28-52)	(minimum 36)	2 (9)	4 (18)
Roush et al. ⁹⁴	2006	Fibula	34 (15-48)	90 (79-100)	48 (24)	62 (31)
Iwata et al. ⁹⁵	1992	Ilium	39 (25-53)	36 (12-72)	NA	9 (39)
Leung ⁹⁶	1996	Ilium	32 (24-52)	(48-144)	NA	10 (48)
Wassenaar et al. ⁹⁷	1996	Ilium	38 (14-54)	50	1 (8)	7 (58)
Hasegawa et al. ⁹⁸	1997	Ilium	38 (25-53)	96 (60-132)	1 (32)	11 (35)
Ishizaka et al. ⁹⁹	1997	Ilium	33 (15-66)	72 (24-132)	3 (10)	15 (48)
Kern et al. ¹⁰⁰	1998	Ilium	42 (34-55)	67 (24-110)	NA	34 (37)
Feng et al. ¹⁰¹	1998	Ilium	38	68	NA	14 (88)
Pavlovic et al. ¹⁰²	1999	Ilium	38 (25-55)	146 (108-168)	14 (58)	14 (58)
Eisenschenk et al. ¹⁰³	2001	Ilium	NA	60 (6-120)	8 (9)	44 (54)
Noguchi et al. ¹⁰⁴	2001	Ilium	40 (21-55)	52 (18-81)	2 (11)	5 (28)
Zhang et al. ¹⁰⁵	2003	Ilium	36 (16-57)	NA	NA	2 (1)
Fuchs et al. ¹⁰⁶	2003	Ilium	34 (16-51)	162 (60-240)	15 (34)	35 (8)
Nagoya et al. ¹⁰⁷	2004	Ilium	35 (17-62)	103 (36-204)	NA	19 (54)
Matsusaki et al. ¹⁰⁸	2005	Ilium	38 (21-51)	51 (18-133)	3 (18)	5 (29)
Nakamura et al. ¹⁰⁹	2005	Ilium	28 (16-45)	81 (36-180)	1 (8)	2 (17)
Yen et al. ⁴⁴	2006	Ilium	40 (26-63)	(minimum 48)	4 (10)	17 (44)

*NA = not available.

TABLE E-5 Reports of Osteotomy for the Treatment of Osteonecrosis of the Femoral Head

Author	Year	Type of Osteotomy	Number of Hips	Mean Months of Follow-up (range)	Success Rate (%)
Hisatome et al. ¹¹⁰	2004	Anterior rotational	25	77 (41-149)	60
Matsusaki et al. ¹⁰⁸	2005	Anterior rotational plus vascularized bone graft	17	51 (18-133)	71
Sakano et al. ¹¹¹	2004	Curved intertrochanteric varus	20	48 (8-149)	90
Jacobs et al. ¹¹²	1989	Intertrochanteric	22	63 (30-120)	73
Mont et al. ¹¹³	1996	Intertrochanteric	37	138 (60-216)	76
Simank et al. ¹¹⁴	2001	Intertrochanteric	75	72 (18-228)	75
Scher and Jakim ¹¹⁵	1993	Intertrochanteric plus vascularized bone graft	45	65 (36-126)	87
Scher and Jakim ⁷³	1999	Intertrochanteric plus vascularized bone graft	50	96 (36-168)	86
Pavlovic and Dolinar ¹¹⁶	2002	Intertrochanteric plus cancellous bone graft	32	204 (108-312)	72
Gallinaro and Masse ¹¹⁷	2001	Intertrochanteric flexion	24	122 (48-144)	63
Schneider et al. ¹¹⁸	2002	Intertrochanteric flexion	63	50 (31-161)	7
		Rotational	29	97 (79-295)	43
Drescher et al. ¹¹⁹	2003	Intertrochanteric flexion	70	125 (36-244)	73
Fuchs et al. ¹⁰⁶	2003	Intertrochanteric flexion plus vascularized bone graft	44	162 (60-240)	66
Ito et al. ¹²⁰	1999	Intertrochanteric valgus	26		85
Sugano et al. ¹²¹	1992	Rotational	41	76 (36-132)	56
Sugioka et al. ¹²²	1992	Rotational	474	(36-192)	78
Dean and Cabanela ⁴⁵	1993	Rotational	18	60 (3-106)	6
Belal and Reichelt ¹²³	1996	Rotational	7	84	14
Grigoris et al. ¹²⁴	1996	Rotational	20	85 (18-162)	25
Langlais and Fourastier ¹²⁵	1997	Rotational	20	78 (24-120)	65
Iwasada et al. ¹²⁶	1997	Rotational	48	55 (36-85)	62
Atsumi and Kuroki ¹²⁷	1997	Rotational	18	42 (24-94)	94
Inao et al. ¹²⁸	1999	Rotational	14	125 (60-212)	73
Koo et al. ¹²⁹	2001	Rotational	17	54 (42-78)	100
Hasegawa et al. ¹³⁰	2003	Rotational	77	84 (60-132)	78
Zhang et al. ¹³¹	2004	Rotational	23	54	73
Chen et al. ¹³²	2004	Rotational	20	23 (5-46)	63
Onodera et al. ¹³³	2005	Rotational	38	48 (25-84)	58
Rijnen et al. ¹³⁴	2005	Rotational	26	104 (79-120)	35

Nakamura et al. ¹⁰⁹	2005	Rotational plus vascularized bone graft	12	81 (36-180)	83
Ikemura et al. ¹³⁵	2007	Anterior rotational	44	34 (17-55)	100
Yoon et al. ¹³⁶	2008	Modified rotational	43	37 (24-52)	93
Sugioka and Yamamoto ¹³⁷	2008	Posterior rotational	46	144 (14-252)	65