Health Technology Assessment

HTA Final Appendices

Hip Resurfacing

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Health Technology Assessment Program
676 Woodland Square Loop SE
P.O. Box 42712
Olympia, WA 98504-2712
http://www.hta.hca.wa.gov

Hip Resurfacing: Detailed Data Tables

Provided by:

Spectrum Research, Inc.

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Table 1. Hip Resurfacing Demographic Table, Comparative Studies

Author (Year)	Study Type Study Period	No. of patients No. of hips	Mean age (years) (range) Sex	Preop diagnosis (N, %)	Intervention	Mean F/U Time	Conflict of interest
Garbuz (2009)	Randomized control trial 2005–2008 (patient recruitment period)	N = 107 patients (N = 104 underwent surgery) (number of hips NR)	Mean age: 51.8 (range NR) (inclusion criteria: 19–70 years) 89.4% male	NR	HR [Durom femoral component and acetabular cup (fixation NR)] (n = 48, 46.2%); LDH THA [Durom femoral component and M/L Taper stem with Metasul large femoral head (fixation NR)] (n = 56, 53.8%)	Mean F/U: NR Functional outcomes F/U: 1 year Safety outcomes F/U: 1 and 2 years 68% complete F/U • 8/107 patients lost to F/U, 3 of which did not undergo surgery • 23 patients had not reached 1-yr F/U at time of publication	The institution of one or more of the authors has received funding from Zimmer, Inc. (Warsaw, IN)
Lavigne (2009)	Randomized control trial 2006–2007	N = 48 patients with 48 hips	Mean age: 49.7 (33–63) 60.4% male	Osteoarthritis (n = 37, 77.1%), mild developmental dysplasia of the hip (n = 3, 6.3%), protrusion acetabuli (n = 2, 4.2%), posttraumatic osteoarthritis (n = 1, 2.1%), avascular necrosis of the femoral head (n = 3, 6.3%), postseptic arthritis (n = 1, 2.1%), rheumatoid arthritis (n = 1, 2.1%)	HR [Durom femoral component (cemented) and acetabular cup* (fixation NR)] (n = 24, 50%); LDH THA [CLS femoral stem, Durom acetabular cup*, fixation NR] (n = 24, 50%);	Mean F/U: 1.2 years F/U range: 1 to 1.5 years 87.5% complete F/U rate • Lost to F/U (radiographic analysis): n = 0 (0%) • Lost to F/U (gait analysis)†: HR group (n = 3, 12.5%), THR group (n = 3, 12.5%)	One or more of the authors have received funding from Zimmer, Inc. (Warsaw, IN)

Table 1. Hip Resurfacing Demographic Table, Comparative Studies

Author (Year)	Study Type Study Period	No. of patients No. of hips	Mean age (years) (range) Sex	Preop diagnosis (N, %)	Intervention	Mean F/U Time	Conflict of interest
Rama (2009) (Same patient population as Vendittoli (2006))	Randomized control trial 2003–2005 (randomization period)	N = 192 patients with 209 hips‡	See Vendittoli (2006)	See Vendittoli (2006)	See Vendittoli (2006)	Mean F/U: NR F/U range: ≥ 1 year (range NR) 95.2% complete F/U rate (of hips)	Authors state that "no benefits or funds were received in support of the study"
Vendittoli (2006) (heterotopic ossification reported for this patient population in Rama (2009))	Randomized control trial 2003–2006 (randomization period)	N = 191 patients with 210 hips‡	Mean age: 49.8 (23–65) 65.2% male	Osteoarthritis (159 hips, 75.7%), Perthes (6 hips, 2.9%), hip dysplasia (17 hips, 8.1%), osteonecrosis (5 hips, 2.4%), posttrauma (5 hips, 2.4%), inflammatory arthritis (16 hips, 7.6%), post septic arthritis (2 hips, 1.0%)	HR [Durom hybrid resurfacing system] (107 hips, 51.0%) THA [CLS uncemented femoral component with Zimmer femoral head, Allofit uncemented acetabular component] (103 hips, 49.0%)	Mean F/U: 1 year F/U range: 1 year 97.6% complete F/U rate	Unknown

Table 1. Hip Resurfacing Demographic Table, Comparative Studies

Author (Year)	Study Type Study Period	No. of patients No. of hips	Mean age (years) (range) Sex	Preop diagnosis (N, %)	Intervention	Mean F/U Time	Conflict of interest
Fowble (2009)	Prospective cohort study NR	N = 85 patients with 94 hips	Mean age: 49.7 (27–75) 53.4% male	Osteoarthritis (88 hips, 93.6%), osteonecrosis (4 hips, 4.3%), other (not specified) (2 hips, 2.1%)	HR [Conserve Plus (fixation NR)] (n = 50 patients with 50 hips, 58.8%); THA [Summit and Pinnacle femoral and acetabular components with cementless fixation; cross-linked poly bearing (30 hips) or metal bearing (14 hips)] (n = 35 patients with 44 hips, 41.2%)	Mean F/U: 2.9 years F/U range: 2.0–4.2 years 94.1% complete F/U rate (1 HR patient had revision and not included in F/U)	Financial support for this study was provided by Wright Medical Technology and the Los Angeles Orthopaedic Hospital Foundation. Thomas P. Schmalzried, M.D., has a financial interest in the total hip replacement prostheses used in this research study (DePuy Pinnacle™, Summit™, and Ultamet™)
Li (2009)	Retrospective cohort study 2005–2007	N = 49 patients with 80 hips	Mean age: 30.9 (20–47) 81.2% male	Ankylosing spondylitis (100%)	HR [Durom resurfacing system with cementless acetabular and cemented femoral fixation] (n = 24 patients with 39 hips); THA [Secur-Fit HA ceramic-on-ceramic system with cementless acetabular and femoral fixation] (n = 25 patients with 41 hips)	Mean F/U: NR F/U range: NR 100% complete F/U rate	Authors state that "no benefits or funds were received in support of the study"

Table 1. Hip Resurfacing Demographic Table, Comparative Studies

Author (Year)	Study Type Study Period	No. of patients No. of hips	Mean age (years) (range) Sex	Preop diagnosis (N, %)	Intervention	Mean F/U Time	Conflict of interest
Li (2008)	Retrospective cohort study 2005–2007	N = 42 patients with 52 hips	Mean age: 47.4 (37–64) 71.4% female	Developmental dysplasia of the hip: Crowe type I (n = 38 hips, 73.1%), Crowe type II (14 hips, 26.9%)	HR [Durom resurfacing system with cementless acetabular and cemented femoral fixation] (n = 21 patients with 26 hips, 50%); THA [Secur-Fit HA ceramic-on-ceramic total hip system with cementless acetabular and femoral fixation] (n = 21 matched patients with 26 hips, 50%)	Mean F/U: 2.2 years F/U range: 1.3–3.1 years 100% complete F/U rate	Unknown
Mont (2009)	Retrospective cohort study 2002–2005	N = 108 patients with 108 hips	Mean age: 55 (35–79) 66.7% male	Osteoarthritis, osteonecrosis, or hip dysplasia (n = NR)	HR [Conserve Plus prosthesis with press-fitted acetabular and cemented femoral fixation] (n = 54 patients with 54 hips, 50%); THA [Stryker Howmedica Osteonics Trident cup with Accolade femoral component (fixation details NR) and press-fitted femoral fixation] (n = 54 matched patients with 54 hips, 50%)	Mean F/U: 3.3 years F/U range: 2–5 years 92.6% complete F/U rate††	Primary author is a consultant for and has received funding from Stryker Orthopaedics (Mahwah, NJ) and Wright Medical Technology (Arlington, TN)

Table 1. Hip Resurfacing Demographic Table, Comparative Studies

Author (Year)	Study Type Study Period	No. of patients No. of hips	Mean age (years) (range) Sex	Preop diagnosis (N, %)	Intervention	Mean F/U Time	Conflict of interest
Mont (2006)	Retrospective cohort study 2000–2003	N = 78 patients with 85 hips	Mean age: 42 (18-64) ‡‡ 68.8% male‡‡	Osteonecrosis of the femoral head (n = 37 patients with 43 hips); Osteoarthritis (n = 41 matched patients with 42 hips)	HR [Conserve Plus prosthesis with cementless press-fitted acetabular and cemented femoral fixation] (n = 78 patients with 85 hips, 100%)	Mean F/U: 3.4 years‡‡ F/U range: 2.0–5.1 years‡‡ 98.7% complete F/U rate	One or more of the authors received grants or outside funding from Wright Medical Technology, Inc. as well as payments or other benefits or a commitment or agreement to provide such benefits from a commercial entity (Wright Medical Technology, Inc.)
Pattyn (2008)	Retrospective cohort study 1998–2003	N = 440 patients (number of hips NR)	Mean age: 48.3 years Age range: 14–78 years 63.0% male	Osteoarthritis (70.1%), avascular necrosis (17.0%), rheumatoid arthritis (4.5%), and trauma (1.9%)‡‡	HR [Birmingham metal-on-metal, fixation NR] (n = 250, 56.8%); THA [Ancafit ceramic-on-ceramic, fixation details NR] (n = 190, 43.2%)	Mean F/U: NR F/U range: 36–72 months 99.5% complete F/U rate	Authors state that there are "no relevant financial relationships to disclose"
Pollard (2006)	Retrospective cohort study 1996–2001	N = 113 patients with 117 hips***	Mean age: 50.1 years††† Age range: 18–67††† 76.9% male†††	Osteoarthritis (82 hips, 75.9%), avascular necrosis (11 hips, 10.2%), developmental dysplasia (6 hips, 5.6%), rheumatoid arthritis (1 hip, 0.9%), other (slipped capital femoral epiphysis, Perthes' disease, ankylosing spondylitis, post-traumatic osteoarthritis (8 hips, 7.4%)†††	HR [Birmingham prosthesis with cemented femoral and uncemented acetabular fixation] (n = 51 patients with 54 hips, 49%)††† THA [cemented femoral stem, uncemented acetabular component and a press-fit polyethylene liner] (n = 53 matched patients with 54 hips, 51%)†††	Mean F/U: 70.7 months F/U range: 42–120 months 88.5% complete F/U rate ***	Authors state that "no benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article"

Table 1. Hip Resurfacing Demographic Table, Comparative Studies

Author (Year)	Study Type Study Period	No. of patients No. of hips	Mean age (years) (range) Sex	Preop diagnosis (N, %)	Intervention	Mean F/U Time	Conflict of interest
Stulberg (2008)	Retrospective cohort study (historical control) 1996–2003 (dates of enrollment)	N = 603 patients with 603 hips	Mean age: 51.5 years Age range: NR‡‡‡ 65.2% male	Osteoarthritis (84.9%), osteonecrosis (14.5%), rheumatoid arthritis (0.7%)	HR [Cormet 2000 Hip Resurfacing System with cemented femoral fixation and uncemented acetabular fixation] (n = 337 patients with 337 hips, 55.9%); THA (historical control) [ceramic-on-ceramic Osteonics ABC System I or II; fixation NR] (n = 266 patients with 266 hips, 44.1%)	Mean F/U: NR F/U range: NR (>24 months) 90.8% complete F/U rate	One or more of the authors received outside funding or grants from Stryker Orthopaedics. In addition, one or more of the authors or a member of his or her immediate family received payments or other benefits, or a commitment or agreement to provide such benefits from a commercial entity (Corin, Tampa, Florida).
Vail (2006)	Retrospective cohort study 2000–2003	N = 231 patients with 261 hips	Mean age: 53.2 years ****,†††† Age range: (17–92) ****,†††† 52.9% female ****,††††	Osteoarthritis (n = 110, 79.1%), osteonecrosis (n = 25, 18.0%), developmental dysplasia (n = 6, 4.3%), posttraumatic arthritis (n = 3, 2.2%), rheumatoid arthritis (n = 6, 4.3%)****	HR [Conserve Plus prosthesis system with press-fit acetabular fixation and cemented femoral fixation] (n = 55 patients with 57 hips, 39.6%); THA [press-fit femoral stem fixation (acetabular fixation NR)] (n = 84 patients with 93 hips, 60.4%)****	Mean F/U: 36 months F/U range: 24–48 months 59.6% complete F/U rate	Each author certifies that he has or may receive payments or benefits from a commercial entity related to this work (Wright Medical Technology, Inc).

Table 1. Hip Resurfacing Demographic Table, Comparative Studies

Author (Year)	Study Type Study Period	No. of patients No. of hips	Mean age (years) (range) Sex	Preop diagnosis (N, %)	Intervention	Mean F/U Time	Conflict of interest
Zywiel (2009)	Retrospective cohort study 2002–2005	N = 66 patients with 66 hips	Mean age: 53 years Age range: 37–79 years 69.7% male	NR	HR [Conserve Plus prosthesis system (fixation NR)] (n = 33 patients with 33 hips); THA [Stryker acetabular cup and Acclade stem and either ceramic or metal femoral head (fixation NR)] (n = 33 matched patients with 33 hips)	Mean F/U: 43.5 months F/U range: 24–68 months Complete F/U: NR	MA. Mont, M.D., is a consultant for Stryker Orthopedics and Wright Medical Technology. None of the other authors have a financial or proprietary interest in the subject matter or materials discussed

HR: hip resurfacing
LDH: large diameter head
THA: total hip arthroplasty
* Lavigne (2009): "Worldwide" version, not the FDA-approved version, of the Durom acetabular cup was used.
† Lavigne (2009): Authors excluded these patients from gait analysis.
‡ Vendittoli (2006) and Rama (2009) report on the same patient population, but there is a discrepancy in the number of patients and hips reported.
** McGrath (2008): Data excludes the 9 patients (with 9 hips) lost to follow-up and consequently excluded from the study.
†† Mont (2009): Reported that no patients were lost to follow-up, but patient satisfaction scores were reported for only 100 of 108 patients.
‡‡ Pattyn (2008): Reported preoperative diagnoses only account for 93.5% of patients.
*** Pollard (2006): Nine patients with nine hips (all HR) were excluded: six were lost to follow-up and three had femoral neck fractures requiring revision; after excluding these patients, 104 patients with 108 hips remained. All nine patients are considered for our purposes to be lost to follow-up. (In addition, 4 patients were later lost to follow-up.)
††† Pollard (2006): reflects data after initial loss to follow-up (9 patients with 9 hips in the HR group, none in the THA group).
‡‡‡ Stulberg (2008): THA group limited patients to those between 21–75 years of age.
**** Vail (2006): Data reported after loss to follow-up (92 patients with 111 hips lost to follow-up in the control group).
†††† Vail (2006): HR group (mean age: 47 (22–64 years) 74.5% male); THA group: (mean age: 57 (17–92) years, 72.6% female).

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes	Functional and clinical outcomes			Motion	Gait
Garbuz (2009)	NR	NR		**Preop** Mean (SD) N = 73 (group NR)	**1 year F/U** Mean (SD) N = 73 (group NR)	NR	NR
			UCLA activity	HR: 4.9 (NR) THA: 4.7 (NR) (NS)	HR: 6.8 (NR) THA: 6.3 (NR) (NS)		
			SF-36 (mental)	HR: 46.6 (NR) THA: 50.7 (NR)	HR: 53.9 (NR) THA: 55.1 (NR) (NS)		
			SF-36 (physical)	HR: 32.7 (NR) THA: 33.6 (NR)	HR: 51.2 (NR) THA: 51.3 (NR) (NS)		
			WOMAC*	HR: 51.1* (NR) THA: 52.6* (NR)	HR: 90.4* (NR) THA: 90.2* (NR) (NS)		
			WOMAC* (pain)	HR: 48.9* (NR) THA: 52.4* (NR)	HR: 91.5* (NR) THA: 90.0* (NR) (NS)		
			WOMAC* (stiffness)	HR: 47.1* (NR) THA: 43.9* (NR)	HR: 85.6 *(NR) THA: 83.1* (NR) (NS)		

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes			Functional and clinical outcomes			Motion			Gait		
					WOMAC* (function)	HR: 52.2* (NR) THA: 53.7* (NR)	HR: 90.6* (NR) THA: 91.1* (NR) (NS)						
Lavigne (2009)	NR		**Preop** Mean (SD), (range) HR (n = 24) THA (n = 24)	**Latest F/U** Mean (SD), (range) HR (n = 24) THA (n = 24)		**Preop** Mean (SD) HR (n = 24) THA (n = 24)	**Latest F/U** Mean (SD) HR (n = 24) THA (n = 24)		**Preop** Mean (SD) HR (n = 12) THA (n = 8)	**Latest F/U** Mean (SD) HR (n = 21) THA (n = 21)	**Normal walking**	**Preop** Mean (SD) HR (n = 12) THA (n = 8)	**Latest F/U** Mean (SD) HR (n = 21) THA (n = 21)
		Femoral offset diff. (mm)	NR	HR: -3.3 (4.8), (-12.5 to 7.0) THA: 0.9 (6.3), (-11.6 to 10.9) (*P* = .013)	UCLA activity	NR	HR: 8.0 (1.5), (5–10) THA: 8.3 (1.7), (6–10) (NS)	Functional reach (cm)	HR: 37.2 (5.2) THA: 36.1 (3.9) (NS)	HR: 39.2 (5.8) THA: 34.6 (4.3) (*P* = .001)	Speed (m/sec)	HR: 1.19 (0.29) THA: 0.64 (0.20) (*P* < .05)	HR: 1.44 (0.19) THA: 1.46 (0.18) (NS)
		Pts with femoral offset within 4 mm	NR	HR: n = 14 (58%) THA: n = 9 (38%) (NS)	MA	HR: 11.0 (2.8), (7–16) THA: 10.5 (2.3), (5–16) (NS)	HR: 17.9 (0.4), (16–18) THA: 18.0 (0.0), (18–18) (NS)	Timed up and go (seconds)	HR: 7.60 (1.70) THA: 8.00 (1.04) (NS)	HR: 6.73 (1.00) THA: 7.07 (0.78) (NS)	Step length (m)	HR: 0.64 (0.08) THA: 0.58 (0.58) (*P* < .05)	HR: 0.68 (0.07) THA: 0.69 (0.06) (NS)
		Leg length inequality (mm)	NR	HR: -0.4 (2.8), (-5.8 to 4.8) THA: -0.1 (4.3), (-9.2 to 6.4) (NS)	SF-36 (mental)	HR: 34.3 (8.1), (17–52) THA: 35.1 (7.2), (18–45) (NS)	HR: 51.9 (7.2), (45–60) THA: 52.1 (10.9), (36–65) (NS)	Steps (seconds)	NR	HR: 18.12 (3.57) THA: 15.00 (3.10) (*P* = .001)	Cadence (steps/min)	HR: 110.1 (16.2) THA: 106.8 (11.5) (NS)	HR: 125.6 (7.5) THA: 126.2 (8.7) (NS)

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes			Functional and clinical outcomes			Motion			Gait		
Lavigne (2009)		Pts with leg length inequality within 4 mm	NR	HR: n = 21 (88%) THA: n = 17 71% (NS)	SF-36 (physical)	HR: 47.7 (10.1), (30–64) THA: 46.8 (12.1), (27–68) (NS)	HR: 55.2 (5.1), (48–62) THA: 53.3 (8.7), (53–70) (NS)	Hip flexor strength ratio (%)	HR: 77.0 (16.4) THA: 81.3 (27.6) (NS)	HR: 91.5 (15.3) THA: 92.1 (7.5) (NS)	**Fast walking**	**Preop** Mean (SD)	**Latest F/U** Mean (SD)
					WOMAC	HR: 46.5 (14.9), (26–79) THA: 54.3 (14.5), (30–80) (NS)	HR: 3.0 (8.4), (0–12) THA: 2.7 (8.5), (0–16) (NS)	Abductor strength ratio (%)	HR: 82.7 (22.1) THA: 82.1 (17.4) (NS)	HR: 92.6 (9.9) THA: 89.4 (16.2) (NS)	Speed (m/sec)	HR: 1.58 (0.29) THA: 1.50 (0.22) (NS)	HR: 1.82 (0.24) THA: 1.73 (0.18) (NS)
					Percep-tion of the postopera tive hip	**Preop** % (n) HR (n = 24) THA (n = 24)	**Latest F/U** % HR (n = 24) THA (n = 24) (n)	Hop on one leg (# of hops)	NR	HR: 20.7 (3.3) THA: 21.2 (3.3) (NS)	**Postural balance**	**Preop** Mean (SD)	**Latest F/U** Mean (SD)
					Natural hip	NA	HR: n = 15 62% THA: n = 14 58% (NS)				Total path length of the center of pressure	HR: 113.8 (32.9) THA: 124.8 (20.7) (NS)	HR: 108.1 (20.8) THA: 112.3 (24.0) (NS)
					Artificial hip, no limitation	NA	HR: n = 5 (21%) THA: n = 7 (29%) (NS)						

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes			Functional and clinical outcomes			Motion	Gait
Lavigne (2009)					Artificial hip, minimal limitation	NA	HR: n = 4 (17%) THA: n = 3 (13%) (NS)		
					Artificial hip, significant limitation	NA	HR: n = 0 (0%) THA: n = 0 (0%) (NS)		
					Thigh pain	NR	HR: n = 0 (0%) THA: n = 0 (0%)		
Venditoli (2009)	NR		**Preop** Mean (range) HR (103 hips) THA (102 hips)	**Latest F/U** Mean (range) HR (103 hips) THA (102 hips)		**Preop** Mean (SD) HR (103 hips) THA (102 hips)	**Latest F/U** Mean (SD) HR (103 hips) THA (102 hips)	NR	NR
		Acetabul-ar vertical angle (degrees)	NA	HR: 47.3 (31–64) THA: 45.3 (30–55) (*P* = .05)	WOMAC	HR: 52.6 (NR) THA: 54.8 (NR) (NS)	HR: 9.2 (NR) THA: 11.7 (NR) (NS)		

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes			Functional and clinical outcomes			Motion	Gait
Vendittoli (2009)		SRA femoral compon-ent CCD angle (degrees)	NA	HR: 142.6 (130–157) THA: NA	MA	HR: 10.8 (NR) THA: 10.2 (NR) (NS)	HR: 16.7 (NR) THA: 16.6 (NR) (NS)		
		SRA CCD angle modifica-tion from pre-op value (degrees)	NA	HR: 7.8 (-6 to 19)	UCLA activity	NR	HR: 6.3 (NR) THA: 7.1 (NR) (*P* = .037)		
		Leg length discrep-ancy (mm)	HR: -1.6 (-14.6 to 4.0) THA: -1.3 (-15.5 to 9.7) (NS)	HR: -1.8 (SD = 2.6) (-9.9 to 5.9) THA: 3.0 (SD = 3.6) (-6.0 to 12.9) (*P* < .001)		**Preop** % HR (103 hips) THA (102 hips)	**Latest F/U** % HR (103 hips) THA (102 hips)		
		Leg length discrep-ancy correction (mm)	NA	HR: 0.1 (-5.8 to 5.5) THA: 1.8 (-12.3 to 10.7) (*P* = .001)	Patient satisfac-tion (very satistifed or satisfied)	NA	HR: 98% THA: 98%		

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes			Functional and clinical outcomes			Motion	Gait
Vendittoli (2009)		Femoral offset (mm)	HR: 33.7 (17.1–51.9) THA: 34.5 (12.7–47.9) (NS)	HR: 33.8 (10.2–47.0) THA: 39.0 (26.2–54.0) (P < .001)	Return to work	NA	HR: 26/27 (96%) THA: 14/21 (66%) (P = .02)		
		Femoral offset correction (mm)	NA	HR: -2.8 (SD = 3.3) (-13.9 to 6.7) THA: 4.2 (SD = 4.0) (-6.9 to 11.6) (P < .001)	Thigh pain	NR	HR: n= 0 (0%) THA: n= 0 (0%)		
					Patient activity level %				
					Heavy/ sport OR moderate/ recreation -al	NR	HR: 72% THA: 39% (P = .007)		
					Mild/ walking OR sedentary	NR	HR: 28% THA: 61%		

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes	Functional and clinical outcomes			Motion			Gait
Fowble (2009)	NR	NR		**Preop** Mean (SD) HR (50 patients, 50 hips) THA (35 patients, 44 hips)	**Latest F/U** Mean (SD) (49 patients, 49 hips) THA (31 patients, 40 hips)		**Preop** Mean (SD) HR (50 patients, 50 hips) THA (35 patients, 44 hips)	**Latest F/U** Mean (SD) (49 patients, 49 hips) THA (31 patients, 40 hips)	NR
			Harris Hip Score	HR: 46 (9) THA: 52 (11) (*P* = .005)	HR: 97 (4) THA: 96 (7) (*P* = .4)	Flexion (degrees)	HR: 95 (15) THA: 80 (23) (*P* = .0001)	HR: 116 (14) THA: 119 (18) (NS)	
			UCLA activity	HR: 4.2 (1.1) THA: 3.6 (1.4) (*P* = .02)	HR: 8.2 (1.6) THA: 5.9 (1.7) (*P* = .0001)	Extension (degrees)	HR: -9 (7) THA: -5 (10) (*P* = .03)	HR: 6 (14) THA: 1 (7) (NS)	
			SF-12 (mental)	HR: 44.2 (12.8) THA: 35.2 (15.8) (NS)	HR: 54.6 (6.7) THA: 52.5 (9.1) (NS)	Abduc-tion (degrees)	HR: 27 (11) THA: 15 (15) (*P* = .0001)	HR: 46 (10) THA: 45 (12) (NS)	
Fowble (2009)			SF-12 (physical)	HR: 33.6 (8.4) THA: 25.8 (1.6) (NS)	HR: 53.6 (5.9) THA: 47.0 (13.1) (*P* = .002)	Adduc-tion (degrees)	HR: 8 (10) THA: 2 (5) (*P* = .0003)	HR: 22 (10) THA: 19 (10) (NS)	
			Function†	HR: 27.3 (8.3) THA: 29.9 (7.4) (NS)	HR: 46.4 (1.4) THA: 44.9 (3.3) (*P* = .007)	Internal rotation (degrees)	HR: -4 (14) THA: -2 (12) (NS)	HR: 27 (16) THA: 25 (16) (NS)	

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes	Functional and clinical outcomes			Motion			Gait
Fowble (2009)			**Pain**			External rotation (degrees)	HR: 25 (10) THA: 20 (12) (*P* = .03)	HR: 42 (12) THA: 41 (11) (NS)	
			No pain	HR: n = 0 (0%) THA: n = 0 (0%)	HR: n = 28 (57%) THA: n = 32 (80%)				
			Slight pain	HR: n = 0 (0%) THA: n = 0 (0%)	HR: n = 18 37%) THA: n = 6 (15%)				
			Mild pain	HR: n = 0 (0%) THA: n = 0 (0%)	HR: n = 3 (6%) THA: n = 0 (0%)				
			Moderate pain	HR: n = 3 (6%) THA: n = 17 (42%)	HR: n = 0 (0%) THA: n = 2 (5%)				
			Marked pain	HR: n = 47 (94%) THA: n = 23 (58%)	HR: n = 0 (0%) THA: n = 0 (0%)				

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes			Functional and clinical outcomes			Motion			Gait
					P-value for pain (all)	(*P* = .0001)	(*P* = .007)				
Li (2009)	NR		**Preop** NA	**Latest F/U** (time NR) Mean (range) HR (23 patients with 38 hips) THA (25 patients with 41 hips)		**Preop** Mean (SD) HR (23 patients with 38 hips) THA (25 patients with 41 hips)	**Latest F/U** (time NR) Mean (SD) HR (23 patients with 38 hips) THA (25 patients with 41 hips)		**Preop** Mean (SD) HR (23 patients with 38 hips) THA (25 patients with 41 hips)	**Latest F/U** (time NR) Mean (SD) HR (23 patients with 38 hips) THA (25 patients with 41 hips)	NR
Li (2009)		Outer diameter of acetabular cup (mm)	NA	HR: 55.2 (50–58) THA: 51.2 (50–54)	Harris Hip Score	HR: 50.6 (6.1) THA: 50.3 (6.0) (NR)	HR: 91.0 (3.4) THA: 89.7 (3.3) (NR) HR: Excellent: 35 hips (92%) Good: 3 hips (8%) THA: Excellent: 36 hips (88%), Good: 5 hips (12%)	ROM (degrees)	HR: 54.7 (49.1) THA: 49.4 (49.7) (NR)	HR: 202.5 (27.5) THA: 162.4 (28.9) (NR)	

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes			Functional and clinical outcomes			Motion			Gait
Li (2009)		Abduc-tion angle (degrees)	NA	HR: 47.3 (33–55) THA: 46.5 (37–52)	UCLA activity	HR: 2.4 (1.0) THA: 2.5 (1.2) (NR)	HR: 6.1 (0.7) THA: 3.6 (0.7) (NR)	Flexion – extension (degrees)	HR: 30.4 (34.1) THA: 22.0 (36.2) (NR)	HR: 118.4 (16.9) THA: 93.4 (14.9) (NR)	
		Diameter of femoral head (mm)	NA	HR: 49.2 (44–52) THA: 30.4 (28, 32)	Hip pain (VAS)	HR: 4.3 (2.2) THA: 3.8 (2.8) (NR)	HR: 0.9 (0.9) THA: 0.7 (0.9) (NR)	Abduc-tion – Adduc-tion	HR: 11.5 (12.5) THA: 11.6 (12.4) (NR)	HR: 43.6 (7.3) THA: 37.4 (8.5) (NR)	
								Rotation	HR: 8.7 (9.7) THA: 9.2 (10.6)	HR: 40.5 (7.1) THA: 31.6 (8.0) (NR)	
Li (2008)	Mean survival: NR Range: NR		**Preop** Mean (range)	**Latest F/U** Mean (range) HR (n = 21 with 26 hips) THA (n = 21 with 26 hips)		**Preop** Mean (range)	**Latest F/U** Mean (range) HR (26 hips) THA (26 hips)		**Preop** Mean (range)	**Postop F/U** (time NR) Mean (range) HR (26 hips) THA (26 hips)	NR

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes			Functional and clinical outcomes			Motion			Gait
Li (2008)		Outer diameter of the cup (mm)	NR	HR: 52 (48–58) THA: 52 (46–58)	Harris Hip Score	NR	HR: 93 THA: 91 (NS) HR: Excellent: 20 hips (77%), Good: 6 hips (23%) THA: Excellent: 18 hips (69%), Good: 8 hips (31%)	Flexion	NR	HR: 131.7˚ (90–170˚) THA: 105.5˚ (70–140˚) (*P* = .05)	
		Abduc-tion angle	NR	HR: 46.9˚ (33–55˚) THA: 45.2˚ (37–52˚)	Hip pain (VAS)	NR	HR: < 2 (mean NR) THA: < 2 (mean NR)	Extension	NR	HR: 7.2˚ (0–15˚) THA: 0.9˚ (0–5˚) (*P* = .05)	
		Coverage of the acetabular prosthesis	NR	HR: > 80% (mean NR) THA: > 80% (mean NR)	**Limb length** (postop vs preop (F/U NR)) HR (n = 21) THA (n = 21)			Abduc-tion‡	NR	HR: 45.4˚ (30–50˚) THA: 32.5˚ (25–35˚) (*P* = .05)	

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes	Functional and clinical outcomes			Motion			Gait
Li (2008)			Equal limb length (same leg)	NR	HR: n = 12 (57.1%) THA: n = 15 (71.4%)	Adduc-tion‡	NR	HR: 27.6˚ (25–35˚) THA: 16.3˚ (10–20˚) (*P* = .05)	
			< 1 cm change in limb length (same leg)	NR	HR: n = 4 (19.0%) THA: n = 6 (28.6%)	Rotation arc‡	NR	HR: 86.2˚ (50–120˚) THA: 66.1˚ (30–90˚) (*P* = .05)	
			> 1 cm change in limb length (same leg)	NR	HR: n = 5 (23.8%) THA: n = 0 (0%)				
			Limb length discrepancies HR (n = 21) THA (n = 21)						
				Preop	**Postop F/U** (time NR)				
			Equal limb length (opposite legs)	NR	HR: n = 21 (100%) THA: n = 21 (100%)				

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes			Functional and clinical outcomes			Motion	Gait
					< 1 cm change in limb length (opposite legs)	NR	HR: n = 0 (0%) THA: n = 0 (0%)		
					> 1 cm change in limb length (opposite legs)	NR	HR: n = 0 (0%) THA: n = 0 (0%)		
Mont (2009)	NR		**Preop** Mean (range)	**Latest F/U** Mean (range) HR (n = 54) THA (n = 54)		**Preop** Mean (range) HR (n = 54) THA (n = 54)	**Latest F/U** Mean (range) HR (n = 54) THA (n = 54)	NR	NR
		Femoral component angles (on antero-posterior radio-graphs)	NR	HR: 140˚ (126–155˚) THA: NR	Harris Hip Score	HR: 39 (24–60) THA: 39 (24–56) (NS)	HR: 90 (50–100) THA: 91 (62–100) (NS)		
		Femoral component angles (on lateral radio-graphs)	NR	HR: 166˚ (145–182˚) THA: NR	Activity score**	HR: 3 (0–15) THA: 2 (0–6) (*P* = .01)	HR: 11.5 (0–32) THA: 7 (0–21) (*P* = .0004)		

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes			Functional and clinical outcomes			Motion	Gait
Mont (2009)		Acetabular cup inclination angles	NR	HR: 38˚ (25–60˚) THA: NR	Change in activity score (preop vs postop)	NR	HR: 8 (0–17) THA: 5 (0–15) (*P* = .0004)		
					Satis-faction score††	NA	HR: 9.2 (2–10) THA: 8.8 (0–10) (NS) [HR: 96% (48/50) had scores of ≥ 7 points; THA: 92% (46/50) had scores of ≥ 7 points]		
					Pain score††	NR	HR: 1.4 (0–6) THA: 1.6 (0–9) (NS)		

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes	Functional and clinical outcomes			Motion	Gait
Pattyn (2008)	NR	NR		**Preop** Mean (range) HR (n = 250) THA (n = 190)	**Latest F/U** Mean (range) HR (n = 250) THA (n = 190)	NR	NR
			Harris Hip Score	< 50 (all patients) (mean NR)	HR: 97.9 (NR) THA: 92.1 (NR) (*P* NR) HR: Excellent: 77.4% Good: 22.0% Fair: 0.5% Poor: 0% THA: Excellent: 43.6% Good: 46.5% Fair: 5.0% Poor: 5.0%		

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes	Functional and clinical outcomes			Motion	Gait
Pattyn (2008)			**Activity**	**Preop** % HR (n = 250) THA (n = 190)	**Latest F/U** % HR (n = 250) THA (n = 190)		
			Activities of daily living	NR	HR: 38.2% THA: 59.1%		
			Indepen-dent	NR	HR: 1.0% THA: 9.6%		
			Depend-ent	NR	HR: 0% THA: 0.9%		
			Strenuous (all patients)	NR	HR: 60.7% THA: 30.4%		
			Strenuous (Charnley A only: all diagnoses)	NR	HR: 63.4% THA: 36.8%		
			Strenuous (Charnley A: osteoarth-ritis only)	NR	HR: 63.1% THA: 21.3%		

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes			Functional and clinical outcomes			Motion	Gait
					Limb lengthe-ning	NR	HR: mean NR (0–2 cm) THA: mean NR (0–2 cm)		
Pollard (2006)	NR		**Preop** Mean (range) HR (54 hips) THA (54 hips)	**Latest F/U** Mean (range) HR (53 hips) THA (51 hips)		**Preop** Mean (range) HR (54 hips) THA (54 hips)	**Latest F/U** Mean (range) HR (53 hips) THA (54 hips)	NR	NR
		Abduct-ion angle	NR	HR: 42° (30–56°) THA: NR	Oxford hip score‡‡	NR	HR: 15.9 (12–42) THA: 18.5 (12–41) (NS)		
		Stem/ shaft angle	HR: 7° valus to 23° valgus THA: NR	HR: 6.6° valgus relative to preop THA: NR	UCLA (activity) ***	HR: 9.0 (6–10) THA: 8.9 (6–10) (NR)	HR: 8.4 (4–10) THA: 6.8 (3–10) ($P < .001$)		
			Preop n (%) HR (n = 53) THA (n = 51)	**Latest F/U** mean (range) HR (n = 50) THA (n = 50)	EQ-5D (QoL)	NR	HR: 0.9 (0.08–1.00) THA: 0.78 (0.06–1.00) ($P = .003$)		

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes			Functional and clinical outcomes			Motion	Gait
Pollard (2006)		Surface arthro-plasty risk index	NA	HR: 2.56 (0–6) THA: NR	EQ-VAS (QoL)	NR	HR: 82.3 (20–100) THA: 69.3 (15–100) (P = .001)		
		Radiological Appearance††† (HR only)			Patient activities (in 4 weeks prior to review)	**Preop** n (%) HR (n = 53) THA (n = 51)	**Latest F/U** n (%) HR (n = 53) THA (n = 53)		
			Preop n (%) HR (n = 53) THA NR	**Latest F/U** n (%) HR (55 hips) ‡‡‡ THA NR	Running	NR	HR: n = 31 (58.5%) THA: n = 7 (13.2%) (P < .001)		
		Type 0	NR	HR: n = 16 (29.1%) THA: NR	Played a sport	NR	HR: n = 39 (73.6%) THA: n = 17 (32.1%) (P < .001)		
		Type 1a	NR	HR: n = 6 (10.9%) THA: NR	Perf-ormed heavy manual work	NR	HR: n = 32 (60.4%) THA: n = 20 (37.7%) (P = .049)		

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes			Functional and clinical outcomes			Motion	Gait
Pollard (2006)		Type 1b	NR	HR: n = 16 (29.1%) THA: NR					
		Type 1c	NR	HR: n = 9 (16.4%) THA: NR					
		Type 2	NR	HR: n = 5 (9.1%) THA: NR					
		Type 3 ‡‡‡	NR	HR: n = 3 (5.5%) THA: NR					
Stulberg (2008)	NR	NR				**Preop** Mean (SD) HR (337 hips) THA (252 hips)	**Latest F/U** Mean (SD) HR (283 hips) THA (253 hips)	NR	NR

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes	Functional and clinical outcomes			Motion	Gait
Stulberg (2008)			Harris Hip Score	HR: 50.1 (11.6) THA: 49.7 (11.3) (NS)	HR: 96.7 (7.5) THA: 96.2 (7.7) HR: 96.1% scored "excellent" or "good" THA: 95.3% scored scored "excellent" or "good"		
				Preop n (%) (NR)	**Latest F/U** n (%) HR (n = 292) THA (n = 256)		

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes	Functional and clinical outcomes			Motion			Gait
Stulberg (2008)			Composite Clinical Success ††††	NA	HR: n = 251 (86.0%) THA: n = 224 (87.5%) Non-inferiority test: Difference: -0.015 Lower bound of 1-sided 95% CI: -0.063				
Vail (2006)	NR	NR		**Preop** Mean (range) HR (n = 55) THA (n = 84)	**2-yr F/U** Mean (range) HR (n = 55) THA (n = 84)		**Preop** Mean (range) HR (n = 55) THA (n = 84)	**2-yr F/U** Mean (range) HR (n = 55) THA (n = 84)	NR
			Harris Hip Score	HR: 48.5 (NR) THA: 42.0 ($P < .001$)	HR: 98.1 (NR) THA: 92.6 (NR) (NS)‡‡‡‡	ROM	HR: 83.4 (NR) THA: 84.7 (NR)	HR: 99.1 (NR) THA: 96.6 (NR) ($P < .001$) ‡‡‡‡	

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes	Functional and clinical outcomes			Motion			Gait
Vail (2006)			Harris Hip Score (pain)	HR: 11.3 (NR) THA: 10.9 (NR)	HR: 42.9 (NR) THA: 41.8 (NR) (NS)‡‡‡‡	Abduc-tion	HR: 23.0 (NR) THA: 23.2 (NR)	HR: 41.6 (NR) THA: 38.3 (NR) (NS)‡‡‡‡	
			Harris Hip Score (function)	HR: 28.8 (NR) THA: 23.2 (NR) ($P < .001$)	HR: 46.2 (NR) THA: 42.1 (NR) (NS)‡‡‡‡	Adduc-tion	HR: 12.6 (NR) THA: 12.1 (NR)	HR: 21.2 (NR) THA: 21.0 (NR) (NS)‡‡‡‡	
			Activity *****	HR: 8.5 (NR) THA: 7.7 (NR) ($P = .035$)	HR: 14.0 (NR) THA: 12.7 (NR) ($P = .028$) ‡‡‡‡	Flexion	HR: 86.4 (NR) THA: 82.2 (NR)	HR: 110.9 (NR) THA: 99.1 (NR) ($P < .001$) ‡‡‡‡	
				Preop n (%) HR (n = 55) THA (n = 84)	**2-yr F/U** n (%) HR (n = 55) THA (n = 84)	External rotation	HR: 17.3 (NR) THA: 15.6 (NR)	HR: 41.6 (NR) THA: 37.1 (NR) (NS)‡‡‡‡	

Table 2. Hip Resurfacing Clinical Data Table, Comparative Studies

Author (Year)	Survival (mean time)	Radiographic outcomes	Functional and clinical outcomes			Motion	Gait
Vail (2006)			Limitations in walking distance	NR	HR: n = NR (5%) THA: n = NR (34%)		
Zywiel (2009)	NR	NR		**Preop** Mean (range) HR (n = 33) THA (n = 33)	**Latest F/U** Mean (range) HR (n = 33) THA (n = 33)	NR	NR
			Harris Hip Score	HR: 52 (28–71) THA: 49 (20–69) (NS)	HR: 91 (32–100) THA: 90 (50–100) (NS)		
			Activity score**	HR: 2.1 (0–6.0) THA: 2.3 (0–6.0) (NS)	HR: 10.0 (1.0–27.5) THA: 5.3 (0–12.0) ($P < .001$)		
			Satisfaction score††	NA	HR: 9.1 (5–10) THA: 9.1 (2–10) (NS)		
			Pain score††	NR	HR: 1.3 (0–10) THA: 1.2 (0–5) (NS)		

CI: confidence interval

EQ: EuroQol (European quality of life scoring tool)
F/U: follow-up
HR: hip resurfacing
MA: Merle D'Aubigné
NS: difference not statistically significant ($P \geq .05$)
SD: standard deviation
THA: total hip arthroplasty
UCLA: University of California, Los Angeles

* Garbuz (2009) reported WOMAC scores normalized to a scale of 0–100, with higher scores indicating better function. Normally, WOMAC is reported on a scale of 0–96, with higher scores indicating lower function.
† Fowble (2009) function score was derived from subtracting the scores for pain, deformity, and ROM from the total Harris Hip score.
‡ Li (2008): Measurements taken during extension.
** Mont (2009), Zywiel (2009) activity score: used to evaluate the frequency, duration, competitiveness, level of exertion, and impact of patient activities. Weighted scores between 0–8 points indicated low activity; scores of ≥ 9 points indicated high-activity patients. Maximum possible score was not reported.
†† Mont (2009), Zywiel (2009): Pain and satisfaction scores ranged from 0 (no pain/ completely dissatisfied) to 10 (worst pain imaginable/ completely satisfied).
‡‡ Pollard (2006): The median Oxford hip (12.5) and UCLA activity scores (8) of the 6 HR patients lost to follow-up were available. These numbers were not included in the group outcomes.
*** Pollard (2006): UCLA activity score modified for British population (ref 11 in study). Scores range from 12 (asymptomatic) to 60 (severe).
††† Pollard (2006): Radiological classifications (corresponding indication): Type 0 ("no change"); Type 1 ("pedestal sign but no migration"); Type 1a ("sclerotic line confined to curved tip of stem"); Type 1b ("sclerotic line confined to distal 1 cm of shaft of stem"); Type 1c ("sclerotic line ± symmetrical lucent lines, extending proximally beyond 1 cm of shaft")' Type 2 ("migration, usually into varus with asymmetrical lucent lines"); Type 3 ("displaced fracture").
‡‡‡ Pollard (2006): 52 hips available for follow-up, but percentages also include the 3 type 3 (displaced) hips that were excluded from the study.
****Stulberg (2009): Differences in postoperative ROM between groups was not believed to be clinically significant because all the individual components of ROM flexion, abduction, adduction, and internal rotation) were similar at two years.
†††† Stulberg (2008): Composite clinical score measures whether a procedure was successful based on four components: Harris Hip score of ≥ 80 points, radiographic evidence of success, no device-related adverse events, and no revision.
‡‡‡‡ Vail (2006): Adjusted P-value reported because there were extensive demographic differences between groups; adjusting controlled for age, gender, and other preoperative parameters.
*****Vail (2006): Activity scoring system NR. Authors determined outcomes by the HHS and SF-12 scoring system, but neither include activity scores.

Table 3. Hip Resurfacing Safety Table, Comparative Studies

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Garbuz (2009)	NR	NR	NR	NR	NR	NR	• Serum cobalt level (median): <u>1 year post-op:</u> HR: 0.51 µg/L THA: 5.09 µg/L (*P* = .0000) <u>2 years post-op:</u> HR: 0.54 µg/L THA: 5.38 µg/L (*P* = NR) • Serum chromium level (median): <u>1 year post-op:</u> HR: 0.81 µg/L THA: 2.14 µg/L (*P* = .023) <u>2 years post-op:</u> HR: 0.84 µg/L THA: 2.88 µg/L (*P* = NR)
Lavigne (2009)	NR	NR	NR	Loosening of acetabular component: HR: 0/24 hips (0%) THA: 0/24 hips (0%) Loosening of femoral component: HR: 0/24 hips (0%) THA: 0/24 hips (0%) Osteolysis:	NR	NR	• Intraoperative femoral calcar cracks: HR: 0/24 hips (0%) THA: 3/24 hips (12.5%) (treated with cerclage wiring) • Damage to obturator artery (ligated): HR: 1/24 hips (4.2%); THA: 0/24 hips (0%) • Myocardial infarction HR: n = 1 (4.2%); THA: n = 0 (0%)

Table 3. Hip Resurfacing Safety Table, Comparative Studies

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
				NR			

Table 3. Hip Resurfacing Safety Table, Comparative Studies

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Rama (2009)	See Vendittoli (2006)	See Vendittoli (2006)	See Vendittoli (2006)	See Vendittoli (2006)	HR: 44/103 hips (42.7%) <u>Brooker grade</u> I: 12/44 (27.3%) II: 19/44 (43.2%) III: 8/44 (18.2%) IV: 5/44 (11.4%) THA: 30/102 hips (29.4%) <u>Brooker grade</u> I: 15/44 (34.1%) II: 13/44 (29.5%) III: 2/44 (4.5%) IV: 0/44 (0%) Significantly higher rate of Brooker grade III/IV HO in HR compared to THA (P = .02). <u>Found in:</u> *Central region only:* HR: 27/44 (61.4%) THA: 21/30 (70.0%) *Central and lateral regions:* HR: 12/44 (27.3%) THA: 1/30 (3.3%) (P = .011) *Both above and below greater trochanter:* HR: 23/44 (52.3%) THA: 28/30 (93.3%) Significantly more severe HO in HR group using Della Valle (P = .008) or Schmidt and Hackenbrock (P = .032) severity grading systems (data NR). <u>Risk factors:</u> *Male sex:*	See Vendittoli (2006)	See Vendittoli (2006)

Table 3. Hip Resurfacing Safety Table, Comparative Studies

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Vendittoli (2006)	HR: 2/103 hips (1.9%) due to: Aseptic loosening of the femoral head (converted to THA) THA: 1/102 hips (1.0%) due to: Recurrent dislocations (caused by mispositioned acetabular component)	NR	NR	Loosening of femoral head: HR: 2/103 hips (1.9%) revision required THA: 0/102 hips (0%)	See Rama (2009)	NR	• Intraoperative conversion to THA (patients excluded): HR: 2/107 hips (1.9%) THA: NA • Intraoperative conversion to different type of fixation or component (patients excluded): HR: 2/107 hips (1.9%) THA: 1/103 hips (1.0%) • Dislocation HR: 0/103 hips (0%) THA: 3/102 hips (2.9%) (2/3 were traumatic; 1/3 was recurrent and required revision) • Deep infection: HR: 0/103 hips (0%) THA: 2/102 hips (2.0%) • Intra-operative acetabular fissure: HR: 2/103 hips (1.9%) THA: 0/102 hips (0%) (uneventful) • Intra-operative proximal femoral fissure: HR: 0/103 hips (0%) THA: 4/102 hips (3.9%) (uneventful) • Deep vein thrombosis: HR: 2/103 hips (1.9%) THA: 2/102 hips (2.0%) • Sciatic neurapraxia: HR: 1/103 hips (1.0%) THA: 2/102 hips (2.0%)

Table 3. Hip Resurfacing Safety Table, Comparative Studies

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Fowble (2009)	HR: 1/50 hips (2.0%) due to avasucular necrosis, patient excluded from other outcomes THA: 0/44 hips (0%)	NR	HR: 1/50 hips (2.0%) Revision required Patient excluded from other outcomes THA: 0/44 hips (0%)	Loosening: HR: 0/49 hips (0%) THA: 0/44 hips (0%) Osteolysis: NR	HR: 12/49 hips (24.5%) <u>Brooker grade</u> I: 10/12 (83.3%) II: 0/12 (0%) III: 2/12 (16.7%) THA: 4/44 hips (9.1%) <u>Brooker grade</u> I: 4/4 (100%) II: 0/4 (0%) III: 0/4 (0%) No negative sequelae	NR	• Fragment broken off acetabular component: HR: 1/49 hips (2.0%) THA: n = 0 (0%) (patient asymptomatic) • Scaitic nerve palsy: HR: n = 1 (2.0%) THA: n = 0 (0%) • Dislocation: HR: 1/49 hips (2.0%) THA: 1/44 hips (2.3%) Treated successfully with closed reduction
Li (2009)	HR: 1/39 hips (2.6%) due to femoral neck fracture (patient counted as failure and otherwise excluded) THA: 0/41 hips (0%)	HR: 1/39 hips (2.6%) required revision (patient counted as failure and otherwise excluded) THA: NA	NR	Migration: HR: 0/39 hips (0%) THA: 0/41 hips (0%) Loosening: NR	HR: 2/39 hips (5.1%) <u>Brooker grade</u> I: 2/2 (100%) II: 0/2 (0%) III: 0/2 (0%) THA: 6/41 hips (14.6%) <u>Brooker grade</u> I: 6/6 (100%) II: 0/6 (0%) III: 0/6 (0%)	NR	• Radiographic lucency: HR: 0/39 hips (0%) THA: 0/41 hips (0%)
Li (2008)	NR	NR	NR	Prosthesis migration: HR: 0/26 hips (0%) THA: 0/26 hips (0%)	HR: n = 0 (0%) THA: n = 0 (0%)	HR: 0/26 hips (0%) THA: 0/26 hips (0%)	• Radiographic lucency: HR: 0/26 hips (0%) THA: 0/26 hips (0%)

Table 3. Hip Resurfacing Safety Table, Comparative Studies

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Mont (2009)	HR: 2/54 hips (3.7%) due to: Femoral neck fracture (n = 1) Acetabular cup migration (n = 1) (two required conversion to THA (femoral neck fracture) THA: 2/54 hips (3.7%) due to: Acetabular cup migration (n = 1) (1.9%) Infection (n = 1)	HR: 1/54 hips (1.9%) (converted to THA) THA: NA	NR	Acetabular cup migration: HR: 1/54 hips (1.9%) THA: 1/54 hips (1.9%) (both required revision surgery) Osteolysis: NR	HR: 1/54 hips (1.9%) THA: 1/54 hips (1.9%) (both Brooker Class II) (associated with painless decreased ROM)	NR	• Progressive acetabular radiolucency: HR: 0/54 hips (0%) THA: 1/54 hips (1.9%) (patient also had acetabular cup migration and required revision) • Other progressive radiolucencies (details NR): HR: 0/54 hips (0%) THA: 0/54 hips (0%) • Other changes in prosthesis alignment: HR: 0/54 hips (0%) THA: 0/54 hips (0%) • Infection: HR: n = 0 (0%) THA: n = 1 (1.9%) (required two-stage revision)
Pattyn (2008)	HR: n = 0 (0%) (patients) THA: n = 3 (1.6%) (patients) due to: Recurrent dislocations (n = 1) Infection (n = 1) Periprosthetic fracture (n = 1)	HR: n = 1 (0.4%) THA: NA	HR: n = 1 (0.4%) THA: n = 0 (0%)	Subsidence of the femoral stem HR: n = 0 (0%) THA: n = 2 (1.1%) (caused leg shortening) Osteolysis: NR	NR	n = 2 (0.5%) (group NR) cause NR, unrelated to surgery	• Dislocation HR: n = 1 (0.4%) THA: n = 8 (4%) (THA: one patient had recurrent dislocations and required revision) • Infection HR: n = 1 (0.4%) THA: n = 1 (0.5%) (both low-grade) (THA: required revision) • Guide pin left in patient: HR: n = 1 (0.4%) THA: n = 0 (0%) • Acetabular component

Table 3. Hip Resurfacing Safety Table, Comparative Studies

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Pattyn (2008)							not bottomed out HR: n = 1 (0.4%) THA: n = 0 (0%) • Periprosthetic fracture: HR: n = 0 (0%) THA: n = 1 (0.5%) (required revision) • Ceramic component fracture: HR: NA THA: n = 0 (0%) • Leg shortening (causing discrepancy): HR: n = 0 (0%) THA: n = 2 (1.1%) (due to subsidence of the stem)
Pollard (2006)	HR: 4/56 hips* (7.1%)* due to: Femoral neck fracture (n = 3) (one was due to avascular necrosis) Femoral component failure (n = 1) (the three patients with femoral neck fractures were excluded from all clinical outcomes) THA: 4/51 revisions are planned (7.8% of hips)) due to: Osteolysis (n = 3) Recurrent dislocations (n = 1)	HR: 3/56 hips* (5.4%)* THA: NA (these patients were excluded from all clinical outcomes)	HR: 1/56 hips (1.8%) required revision THA: 0 hips (0%) (patient was excluded from all clinical outcomes)	Stem subsidence: (mm) Mean (range) HR: NA THA: 2 (0–5) Femoral component migration: (mm) Mean (range) HR: 5/53 hips (9.4%) THA: 0 hips	NR	HR: n = 0 (0%) THA: n = 3 (5.7%)	• Dislocations: HR: n = 0 hips (0%) THA: n = 4 hips (7.8%) • Intraoperative conversion: HR: n = 0 hips (0%) THA: NA • Femoral component radiolucency: HR: n = 5 hips (9.4%) THA: n = 2 hips (3.9%) (HR: all migrated; THA: none migrated) • Acetabular component radiolucency: HR: n = 0 hips (0%) THA: n = 4 hips (7.8%) • Linear wear of polyethylene liner: HR: NA THA: 29 hips (56.9%)

Table 3. Hip Resurfacing Safety Table, Comparative Studies

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Pollard (2006)				(0%) (HR: 5 had lucent lines; 4 migrated into varus and one into valgus; no infection; one required revision due to fracture) Acetabular component migration: (mm) Mean (range) HR: 0 hips (0%) THA: 0 hips (0%) Osteolysis: n (%) HR: 1/53 hips (1.9%) THA: 9/51 hips (17.6%) (THA: 3 revisions scheduled)			• Notching (intraoperative) HR: n = 5 hips (9.4%) THA: NA (HR: medial notching only) • Uncovered reamed bone: HR: n = 10 hips (18.9%) THA: NA • Superficial wound infections: HR: n = 1 hip (2.0%) THA: n = 3 hips (5.9%) • Deep-vein thrombosis: HR: n = 2 (4.0%) THA: n = 2 (4.0%) • Pulmonary embolism: HR: n = 1 (2.0%) THA: n = 1 (2.0%) • Sciatic nerve palsy (transient): HR: n = 0 (0%) THA: n = 1 (2.0%) • Trochanteric bursitis: HR: n = 0 (0%) THA: n = 2 (4.0%) (treated with steroid injections) • Psoas impingement: HR: n = 1 (2.0%) THA: n = 0 (0%)
Stulberg (2008)	HR: 24/320 hips (7.5%)	HR: 8/283 hips (2.8%)	NR	Acetabular component loosening:	NR	HR: n = 4 (1.2%)	• Femoral component radiolucency HR: 1/283 hips (0.4%)

Table 3. Hip Resurfacing Safety Table, Comparative Studies

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Stulberg (2008)	due to: Femoral neck fracture (n = 8) Acetabular component loosening (n = 4) Femoral component loosening (n = 11) Dislocation (n = 1) THA 5/259 hips (1.9%) due to: Femoral component loosening (n = 1) Dislocation (n = 1) Postop femoral fracture (n = 1) Deep joint infection (n = 1) Hip pain (n = 1)	THA: NA		HR: 4/283 hips (1.4%) THA: 0/253 hips (0%) (all required revision) Femoral component loosening: HR: 11/283 hips (3.9%) THA: 1/253 hips (0.4%) (all required revision) Instability of femoral component: HR: 10/283 hips (3.5%) THA: NR (HR: all 10 had femoral subsidence) Osteolysis: NR		THA: n = 3 (1.3%) (NS) (all deaths were considered unrelated)	THA: NR • Progressive radiolucency: HR: 0/283 hips (0%) THA: NR • Failure of acetabular component: HR: 0/283 hips (0%) THA: NR • Hip-related complications HR: n = 83 (24.9% of hips) THA: n = 81 (30.5% of hips) (NS) • Device-related complications HR: n = 32 (9.5% of hips) THA: n = 21 (7.9% of hips) (NS) • Dislocation (requiring revision): HR: 1/283 hips (0.3%) THA: 1/253 hips (0.4%) • Postoperative femoral fracture (requiring revision): HR: 0/283 hips (0%) THA: 1/253 hips (0.4%) • Deep joint infection (requiring revision): HR: 0/283 hips (0%) THA: 1/253 hips (0.4%) • Hip pain (requiring revision):

Table 3. Hip Resurfacing Safety Table, Comparative Studies

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
							HR: 0/283 hips (0%) THA: 1/253 hips (0.4%)
Vail (2006)	HR: 2/57 hips (3.5%) due to: Femoral neck fracture (n = 1) Deep joint infection/ acetabular loosening (n = 1) (both converted to THA) THA: 4/93 hips (4.3%) due to: Recurrent dislocations (n = 2) Aseptic loosening of the acetabular socket (n = 1) Loosening of the femoral component (n = 1)	HR: 1/57 hips (1.8%) (required revision) THA: NA	NR	Loosening of acetabular component: HR: 1/57 hips (1.8%) THA: 0/93 hips (0%) (associated with deep joint infection, required conversion) Loosening of femoral component: HR: 0/57 hips (0%) THA: 1/93 hips (1.1%) (led to femoral fracture and revision) Aseptic loosening of the acetabular socket HR: 0/57 hips (0%)	HR: 6/57 hips (10.5%) THA: 0/93 hips (0%) (asymptomatic)	HR: n = 1 (1.8%) THA: NR (pulmonary embolism)	• Pulmonary embolism: HR: n = 1 (1.8%) (fatal) THA: n = 2 (2.4%) • Deep vein thrombosis: HR: n = 0 (0%) THA: n = 1 (1.2%) • Deep joint infection HR: n = 1 (1.8%) THA: n = 0 (0%) (associated with acetabular loosening, required revision) THA: n = 0 (0%) • Other fracture: HR: 0/57 hips (0%) THA: 2/93 hips (2.2%) (One case associated with loose femoral component and required revision; the other case was treated with open reduction and internal fixation.) • Dislocation: HR: 0/57 hips (0%) THA: 4/93 hips (4.3%) (2 patients had recurrent dislocations that required revision, other 2 treated with closed reduction surgery) • Intraoperative calcar

Table 3. Hip Resurfacing Safety Table, Comparative Studies

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
				THA: 1/93 hips (1.1%) (required revision)			crack (stable): HR: NA THA: 3/93 hips (3.2%) • Acetabular radiolucency: HR: 1/57 hips (1.8%) THA: 0/93 hips (0%) • Femoral radiolucency: HR: 0/57 hips (0%) THA: 0/93 hips (0%)
Zywiel (2009)	HR: 0/33 hips (0%) THA: 0/33 hips (0%)	NR	NR	NR	NR	NR	• NR

HR: hip resurfacing
NA: not applicable
NR: not reported
THA: total hip arthroplasty

Table 4. Hip Resurfacing Demographic Table, Case Series

Author (Year)	Study Type Study Period	Number of patients Number of hips	Mean age Sex	Preop diagnosis (N, %)	Prosthesis	F/U Time
Amstutz (2005)	Retrospective case-series 1996-2002	N = 21 patients with 25 hips	Mean age: 38.1 years Age range: 18-58 years 90% male	Hips (n = 25): Osteoarthritis secondary to Legg-Calve-Perthes disease (LCP) (n = 14 hips, 56%) and slipped capital femoral epiphysis (SCFE) (n = 11, 44%)	Conserve Plus prosthesis (100%)	Mean F/U: 4.7 years F/U range: 2.7-8.1 years 92% complete F/U rate • Lost to F/U after 13 months n = 2 hips (8%)
Amstutz & Beaulé (2004)	Retrospective case-series November 1996-November 2000	N = 355 patients with 400 hips	Mean age: 48.2 years Age range: 15-77 years 73% male	Hips (n = 400): Osteoarthritis (n = 262, 66%) Osteonecrosis (n = 36, 9%) Developmental dysplasia (n = 43, 11%) Posttraumatic arthritis (n = 31, 8%) Legg-Calve-Perthes disease (n = 10, 2.5%) Slipped capital femoral epiphysis (n = 7, 2%) Rheumatoid arthritis (n = 6, 1.6%) Ankylosing spondylitis (n = 4, 1%)	Conserve Plus prosthesis (100%)	Mean F/U: 3.5 years F/U range: 2.2-6.2 years 94.4% complete patient F/U rate • Patient died n =2 • Lost to F/U n = 3 • Failed to provide radiographs n = 15 384/400 (96%) hips available for radiographic analysis ???

Table 4. Hip Resurfacing Demographic Table, Case Series

Author (Year)	Study Type Study Period	Number of patients Number of hips	Mean age Sex	Preop diagnosis (N, %)	Prosthesis	F/U Time
Back (2005)	Prospective case-series April 1999-June 2001	N = 213 consecutive patients with 230 hips	Mean age: 52.1 years Age range: 18-82 years 65% male	Hips (n = 230): Osteoarthritis (n = 203, 88%) Avascular necrosis (n = 12, 5.2%) Rheumatoid arthritis (n = 3, 1.2%) Neurometabolic (n = 2, 0.87%) Other (n = 10, 4.3%)	Birmingham hip resurfacing prosthesis in 230 hips (100%)	Mean F/U: 3.0 years F/U range: 2.0-4.4 years 88.7% complete F/U rate after 2 years • One patient died • One undergone revision for acatabular component loosening • 24 patients reviewed at minimum of 2 years
De Smet (2005)	Retrospective case-series September 1998-April 2004	N = 252 consecutive patients with 268 hips	Mean age: 49.7 years Age range: 16-75 years 69% male	Patients (n = 252): Osteoarthritis (n = 203, 81%) Necrosis (n = 22, 7%) Congenital dislocation of hip (n = 12, 4.8%) Rheumatoid arthritis (n = 9, 3.6%) Trauma (n = 3, 1.2%) Neurometabolic (n = 1, 0.4%) Other (n = 2, 0.8%)	"Normal" Birmingham hip resurfacing prosthesis in 237 cases (94%) Birmingham hip resurfacing prosthesis with dysplasia cup in 15 cases (6%)	Mean F/U: 2.8 years F/U range: 2-5 years 98.8% F/U rate (3 patients died)

Table 4. Hip Resurfacing Demographic Table, Case Series

Author (Year)	Study Type Study Period	Number of patients Number of hips	Mean age Sex	Preop diagnosis (N, %)	Prosthesis	F/U Time
Naal (2009)	Retrospective case-series April 2002-January 2005	N = 24 patients with 32 hips	Mean age: 44.2 years Age range: 30-57 years 25% male	Hips (n = 32): Osteoarthritis secondary to developmental dysplasia of the hip (n = 32, 100%)	Durom hip resurfacing prosthesis in 10 hips (31%) Birmingham hip resurfacing prosthesis in 22 hips (69%)	Mean F/U: 43 months F/U range: 28-60 months 100% F/U rate
Revell (2006)	Retrospective case-series June 1994-March 2004	N = 60 consecutive patients with 73 hips	Mean age: 43 years Age range: 19-69 years 70% male	Hips (n = 73): End-stage femoral head osteonecrosis caused by: • Alcohol: (n = 3, 4%) • Chemotherapy: (n = 2, 3%) • Idiopathic: (n = 34, 47%) • Sickle cell disease: (n = 1, 1%) • Corticosteroids: (n = 20, 27%) • Trauma: (n = 8, 11%) • Unknown: (n = 5, 7%)	Corin hip-resurfacing prosthesis in 18 hips (25%) Birmingham hip resurfacing prosthesis in 55 hips (75%)	Mean F/U: 6.1 years F/U range: 2-12 years 100% F/U rate
Treacy (2005)	Retrospective case-series August 1997-May 1998	N = 130 consecutive patients with 144 hips	Mean age: 52.1 years Age range: 17-76 years 74% male	Hips (n = 144): Osteoarthritis (n = 125, 87%) Avascular necrosis (n = 10, 7%) Developmental dysplagia (n = 3, 2%) Rheumatoid arthritis (n = 2, 1%) Other (n = 4, 3%)	Birmingham hip resurfacing prosthesis (100%)	Minimum F/U: 5 years 76.4% F/U rate

Table 4. Hip Resurfacing Demographic Table, Case Series

Author (Year)	Study Type Study Period	Number of patients Number of hips	Mean age Sex	Preop diagnosis (N, %)	Prosthesis	F/U Time
Li (2008)	Prospective cohort September 2005- May 2007	Resurfacing group: N = 21 consecutive patients with 26 hips THA group: N = 21 patients with 26 hips	Resurfacing group: Mean age: 46.5 years Age range: 37-59 years 29% male THA group: Mean age: 48.2 years Age range: 38-64 years 29% male	Resurfacing group: Osteoarthritis secondary to developmental dysplasia of hip (100%) THA group: Osteoarthritis secondary to developmental dysplasia of hip (100%)	Resurfacing group: Durom hip resurfacing prosthesis in 26 hips (100%) THA group: Secur-Fit HA ceramic-on-ceramic total hip system in 26 hips (100%)	Resurfacing group: Mean F/U: 27 months F/U range: 17-37 months 100% F/U rate at minimum of 17 Months THA group: Mean F/U: 26 months F/U range: 16-37 months
Steffen (2007)	Case-series June 1999- April 2006	N = 532 consecutive patients with 610 hips Sub-analysis: < 50 years, n = 231 ≥ 50 years, n = 379 "5-year group" n = 107 patients with 120 hips	Entire group: Mean age: 51.8 years Age range: 16-81 years 59% male Sub-analysis: < 50 years Mean age: 41.7 years Age range: 16-50 years Sex NR ≥ 50 years	See nested table below	Birmingham hip resurfacing prosthesis (100%)	**Entire group:** Mean F/U: 4.2 years F/U range: 2.0 to 7.6 years 99.6% F/U rate

Disease	Entire group (n=610)	Sub-analysis < 50 yrs (n=231)	Sub-analysis ≥ 50 yrs (n=379)	5-yr group (n=120)
Primary OA	519 (85%)	179 (78%)	340 (90%)	110 (92%)
Dys-plasia	57 (9.3%)	30 (13%)	27 (7.1%)	2 (1.7%)
AVN	18 (3%)	11 (4.8%)	7 (1.9%)	7 (5.8%)
Other*	16 (2.7%)	11 (4.8%)	5 (1.3%)	1 (0.8%)

Table 4. Hip Resurfacing Demographic Table, Case Series

Author (Year)	Study Type Study Period	Number of patients Number of hips	Mean age Sex	Preop diagnosis (N, %)	Prosthesis	F/U Time
			Mean age: 58.1 years Age range: 50-81 years Sex NR "5-year group" Mean age: 50.5 years Age range: 26-70 years 70% male	*Other includes osteoarthritis secondary to slipped upper femoral epiphysis, Perthes' disease and septic arthritis.		
Siebel (2006)	Prospective case-series August 2003-April 2005	N =300 patients with 300 hips	Mean age: 56.8 years Age range: 18-76 years 64% male	NR	ASR hip resurfacing system (100%)	Mean F/U: 202 days (SD, 155 days)
Lilikakis (2005)	Case-series June 2001-July 2002	N = 66 patients with 70 hips	Mean age: 51.5 years Age range: 23-72 years 59% male	Hips (n = 70): Osteoarthritis (n = 68, 97%) Osteonecrosis (n = 1, 1.4%) Chondrolysis (n = 1, 1.4%)	Corin hip-resurfacing prosthesis (100%)	Mean F/U: 28.5 months F/U range: 24-37.8 months

Table 4. Hip Resurfacing Demographic Table, Case Series

Author (Year)	Study Type Study Period	Number of patients Number of hips	Mean age Sex	Preop diagnosis (N, %)	Prosthesis	F/U Time
Daniel (2004)	Case-series 1994-1995 1996* July 1997-April 2000 * 186 patients operated on in 1996 were excluded due to unique pattern of failure in the implants attributed to the manufacturer	N = 384 patients with 446 hips	Mean age: 48.3 years Age range: 26-55 years 79% male	Osteoarthritis (100%)	McMinn hip resurfacing prosthesis in 43 hips (9.6%) used in 1994-1995 Birmingham hip resurfacing prosthesis in 403 hips (90%) used in 1997-2000	Mean F/U: 3.3 years F/U range: 1.1-8.2 years
Costi (2009)	Case-series June 1978-August 1983	N = 247 patients with 270 hips	Mean age: 63 years Age range: 22-89 years 51% male	Hips: Osteoarthritis (n = 232, 86%) Inflammatory arthritis (n = 21, 7.8%) Failed previous mold arthroplasty (n = 9, 3.3%) Avascular necrosis (n = 8, 3.0%)	Wagner hip resurfacing prosthesis (100%)	Latest F/U of 15 to 22 years 99.3% F/U rate • Two patients lost to F/U at 12 and 13 months 77.8% F/U rate • Including deaths (n = 53 patients with 58 hips) • Median time to death was 4 months-23 years

Table 4. Hip Resurfacing Demographic Table, Case Series

Author (Year)	Study Type Study Period	Number of patients Number of hips	Mean age Sex	Preop diagnosis (N, %)	Prosthesis	F/U Time
Beaulé and Dorey (2004)	Case-series Study period: NR	N = 83 patients with 94 hips	Mean age: 34.2 years Age range: 15-40 years 71% male	Hips: Osteoarthritis (n = 23, 24%) Trauma (n = 17, 18%) Osteonecrosis (n = 17, 18%) Developmental dysplasia of the hip (n = 18, 19%) Rheumatoid diseases (n = 6, 6%) Slipped capital femoral epiphysis (n = 4, 4%) Legg-Calve-Perthes disease (n = 6, 6%) Ankylosing spondylitis (n = 3, 3%)	Conserve Plus prosthesis (100%)	Mean F/U: 3 years F/U range: 2.0-5.6 years 97.6% F/U rate • Two patients lost to F/U
Beaulé and Le Duff (2004)	Case-series June 1993-August 1996	N = 39 patients with 42 hips	Mean age: 47.5 years Age range: 22-69 years 60% male	Hips: Osteoarthritis (n = 23, 55%) Osteonecrosis (n = 7, 17%) Developmental dysplasia of the hip (n = 4, 9.5%) Arthrokatadysis (n = 3, 7.1%) Rheumatoid diseases (n = 2, 4.8%) Slipped capital femoral epiphysis (n = 2, 4.8%) Legg-Calve-Perthes disease (n = 1, 2.4%)	McMinn prosthesis (100%)	Mean F/U: 8.7 years F/U range: 7.2-10.0 years 97.6% F/U rate • One patient died 18 months after surgery

Table 4. Hip Resurfacing Demographic Table, Case Series

Author (Year)	Study Type Study Period	Number of patients Number of hips	Mean age Sex	Preop diagnosis (N, %)	Prosthesis	F/U Time
McBryde (2008)	Cohort July 1997-July 2004	N = 790 consecutive patients with 909 hips Direct lateral approach n = 111 patients with 135 hips Posterolateral approach n = 679 patients with 774 hips	Overall population Mean age: NR 64% male Direct lateral approach Mean age: 53 years Age range: 27-72 years 65% male Posterolateral approach Mean age: 54 years Age range: 17-78 years 64% male	Osteoarthritis (100%)	Birmingham hip resurfacing prosthesis in 909 hips (100%)	Direct lateral approach: Mean F/U: 5.1 years F/U range: 2.0-9.4 years 96.3% F/U rate (n = 130) Posterolateral approach: Mean F/U: 5.5 years F/U range: 2.0-9.6 years 91.1% F/U rate (n = 705)
Boyd (2007)	Retrospective case-series June 2001-April 2004	N = 18 patients with 19 hips	Mean age: 33 years Age range: 18-54 years 56% male	Hips: Legg-Calve-Perthes disease (n = 19, 100%)	Conserve Plus prosthesis (100%)	Mean F/U: 51 months F/U range: 26-72 months 100% F/U rate

Table 4. Hip Resurfacing Demographic Table, Case Series

Author (Year)	Study Type Study Period	Number of patients Number of hips	Mean age Sex	Preop diagnosis (N, %)	Prosthesis	F/U Time
McMinn (2008)	Case-series 1997-2000	N = 103 consecutive patients with 110 hips	Mean age: 47.2 years Age range: 21-62 years 53% male	Severe acetabular insufficiency and end-stage arthritis (n = 110, 100%)	Birmingham hip resurfacing dysplasia component in 110 hips (100%)	Mean F/U: 7.8 years F/U range: 6.0-9.6 years 95.1% F/U rate (n = 98 patients)
Mont (2007)	Cohort First cohort: June 2000-October 2002 Investigational meeting October 30, 2002 Second cohort November 2002-November 2005	Entire study: N = 906 consecutive patients with 1016 hips Before (1st cohort) investigational meeting (BIM) N = 292 with 292 hips After (2nd cohort) investigational meeting (AIM) N = 614 with 724 hips	Entire study: Mean age: 50 years Age range: 15-81 years 28% male BIM Mean age: 49 years Age range: 22-72 years 31% male AIM Mean age: 50 years Age range: 15-81 years 26% male	Diagnosis / Entire study / BIM / AIM Osteo-arthritis: 782 (77%) / 230 (79%) / 552 (76%) Osteo-necrosis: 114 (11%) / 34 (12%) / 80 (11%) Hip Dysplasia: 68 (7%) / 15 (5%) / 53 (7%) Inflamm. arthritis: 5 (0.5%) / 0 (0%) / 5 (0.7%) Traumatic arthritis: 39 (3.8%) / 13 (4.5%) / 26 (4%) Rheuma. arthritis: 8 (0.8%) / 0 (0%) / 8 (1%)	Conserve Plus prosthesis (100%)	Mean F/U: 33 months F/U range: 24-60 months 94.0% F/U rate 54 patients lost to F/U
Amstutz (2007)	Retrospective case-series November 1996-February 2002	N = 51 patients with 59 hips	Mean age: 43.7 years Age range: 15-64 years 18% male	Osteoarthritis secondary to developmental dysplasia (100%) Hips: Crowe Type I (n = 52, 88%) Crowe Type II (n = 7, 12%)	Conserve Plus hip resurfacing system (100%)	Mean F/U: 6.0 years F/U range: 4.2 to 9.5 years

Table 4. Hip Resurfacing Demographic Table, Case Series

Author (Year)	Study Type Study Period	Number of patients Number of hips	Mean age Sex	Preop diagnosis (N, %)	Prosthesis	F/U Time
Ollivere (2009)	Prospective case-series June 2001-February 2004	N = 94 consecutive patients with 104 hips	Mean age: 56 years Age range: 36-68 years Sex: NR	NR	Birmingham hip resurfacing prosthesis in 94 hips (100%)	Mean F/U: 61.2 months 93.6% F/U rate 6 patients lost to F/U
Bergeron (2009)	Prospective case-series March 2004-May 2006	N = 209 consecutive patients with 228 hips	Mean age: 54 years Age range: 25-73 years 80% male	Hips: Osteoarthritis (n = 222, 97.4%) Ankylosing spondylitis (n = 2, 0.9%) Osteonecrosis (n = 2, 0.9%) Developmental hip dysplasia (n = 1, 0.4%) Rheumatoid arthritis (n = 1, 0.4%)	NR	Mean F/U: 35 months F/U range: 24-55 months 96.6% F/U rate 6 patients lost to F/U and 1 patient died
Beaulé (2009)	Prospective case-series August 2001-June 2007	N = 106 patients with 116 hips	Mean age: 46.5 years Age range: 19-62 years 81% male	Patients: Osteoarthritis (n = 86, 81.1%) Osteonecrosis (n = 6, 5.7%) Developmental hip dysplasia (n = 5, 4.7%) Postraumatic osteoarthritis (n = 4, 3.8%) Legg-Calve-Perthes disease (n = 2, 1.9%) Rheumatoid arthritis (n = 1, 0.9%) Inflammatory arthritis (n = 1, 0.9%) Slipped capital femoral epiphysis (n = 1, 0.9%)	Conserve Plus hip resurfacing system (100%) using the Ganz surgical dislocation approach	Mean F/U: 38.3 months F/U range: 12-84 months 97.2% F/U rate 2 patients lost to F/U and 1 patient died

Table 4. Hip Resurfacing Demographic Table, Case Series

Author (Year)	Study Type Study Period	Number of patients Number of hips	Mean age Sex	Preop diagnosis (N, %)	Prosthesis	F/U Time
Grammatopolous (2009)	Case-control Original resurfacing done December 1999-November 2006 Total hip controls done January 1999-July 2007	Original resurfacing: N = 1375 with n = 53 (study group) requiring revision at mean 1.59 years Age, gender, and diagnosis matched total hip replacement n = 103	Indication for revision in **study group**: Pseudotumor (n = 16): Mean age at primary surgery: 51.3 years 0% male Femoral neck fracture (n = 21): Mean age at primary surgery: 57.9 years 62% male Other (loosening, infection, AVN, recurrent dislocations (n = 16): Mean age at primary surgery: 50.5 years 38% male **Control group**: Pseudotumor (n = 32): Mean age at primary surgery: 51.8 years 0% male Femoral neck fracture (n = 41): Mean age at primary surgery: 58.6 years 63% male Other (loosening, infection, AVN, recurrent dislocations (n = 16): Mean age at primary surgery: 52.8 years 43% male	Diagnosis of study group hips: Osteoarthritis (n = 40, 75.5%) Developmental dysplasia, slipped upper femoral epiphysis and avascular necrosis (n = 13, 24.5%)	Original resurfacing: N = 1375 used four different implants: • Birmingham hip resurfacing prosthesis • Cormet • Conserve Plus • Re Cap Article does not report specific implants of study group Control group: Exeter implant (100%)	Mean F/U: 3 years F/U range: 0.8-7.2 years

Table 4. Hip Resurfacing Demographic Table, Case Series

Author (Year)	Study Type Study Period	Number of patients Number of hips	Mean age Sex	Preop diagnosis (N, %)	Prosthesis	F/U Time
Ollivere (2009)	Prospective case-series 2001-2007	N = 463 consecutive patients	Mean age: 56 years Age range: 20-70 years 66% male	Diagnosis only given for the 13 revised hips in 12 patients • Dislocation (n = 2) • AVN (n = 1) • Infection (n = 1) • Aseptic lymphocytic-vasculitis lesion (n = 9)	Birmingham hip resurfacing prosthesis (100%)	Mean F/U: 43 months F/U range: 6-90 months 98.9% F/U rate 3 patients lost to F/U and 2 patients died
O'Neill (2009)	Retrospective case-series Survey mailed between Aug and Dec 2007	N = 250* *The first 50 cases performed by 5 different surgeons	Mean age: 49.9 years 80% male	N = 250 patients Osteoarthritis (n = 205, 82%) Inflammatory (n = 3, 1%) Avascular necrosis (n = 12, 5%) Posttraumatic (n = 12, 5%) Dysplasia (n = 18, 7%)	Following hip systems used, but % used in each case not given: Conserve Plus prosthesis Birmingham hip resurfacing prosthesis Durom hip resurfacing prosthesis DePuy ASR™ articular surface replacement	Mean F/U: 2 years

Table 4. Hip Resurfacing Demographic Table, Case Series

Author (Year)	Study Type Study Period	Number of patients Number of hips	Mean age Sex	Preop diagnosis (N, %)	Prosthesis	F/U Time
Witzleb (2008)	Prospective case-series September 1998-March 2003	N = 263 consecutive patients with 300 hips	Mean age: 49 years Age range: 15-69 years 57% male	N = 300 hips Developmental dysplasia n = 177 (59%) • Crowe Class I (n = 141 (47%) • Crowe Class II (n = 36 (12%) Osteoarthritis n = 57 (19%) Osteonecrosis n = 27 (9%) Slipped capital femoral epiphysis n = 15 (5%) Protrusio acctabuli n = 12 (4%) Posttraumatic arthritis n = 8 (3%) Postinflammatoric arthritis n = 3 (1%) Arthritis after synovitis villonodosa n = 1 (0.3%)	Birmingham hip resurfacing prosthesis (100%)	Mean F/U: 24 months F/U range: 2-66 months 99.3% F/U rate 2 patients lost to F/U and 1 patient died
Sandri (2009)	Retrospective case-series October 2003-November 2007	N = 26 patients with 28 hips	Mean age: 58 years Age range: 26-72 years 69% male	N = 26 patients Osteoarthritis (n = 20, 76.9%) Avascular necrosis (n = 4, 15.4%) Acetabular dysplasia (n = 2, 7.8%)	Conserve Plus hip resurfacing system (100%) using an anterolateral Watson-Jones aproach	Mean F/U: 28 months F/U range: 12-61 months 100% F/U rate

Table 5. Hip Resurfacing Safety Table, Case Series

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Amstutz† (2005)	2 hips (8%) • Femoral component migration (both revised at 55 months)	0	0	0	0	0	• No hip dislocations occurred • Transient postoperative nerve palsy (n = 1)
Amstutz & Beaule (2004)	12 hips (3%) • Loosening of the femoral component (n = 7) • Femoral neck fracture (n = 3) • Recurrent subluxations (n = 1) • Late hematogenous infection (n = 1)	3 (0.75%) • 2 occurred in first 6 weeks • 1 occurred at 20 months	0	7 (1.75%) Time to first observation of radiolucency was 20 months (range, 12.5-36 months) Time to first symptoms was 27 months (range, 16-51 months) Time to revision was 35 months (range 23-61 months)	106 hips (26.5%) with evidence of HO Brooker Grade I or II HO in 78 hips (19.5%) Brooker Grade III or IV HO in 28 hips (7%) All Grade III and IV HO was in male population (10%)	2 (0.5%) patients with 3 hips, unrelated to resurfacing	• n = 4 hips required reoperation, including a cup exchange because of component mismatch, removal of heterotopic bone from 2 hips in one patient, and wire removal in 1 hip with trochanteric bursitis • Dislocations (n = 3, 0.75%)

Table 5. Hip Resurfacing Safety Table, Case Series

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Back (2005)	1 hip (0.4%) • Loose acetabular component	1 (0.4%) at 6 weeks that united unremarkably after period of non-weight bearing	0	0 femoral component 1 (0.4%) acatabular loosening	137 hips (59.6%) with evidence of HO Brooker Grade I HO in 88 hips (38.3%) Brooker Grade II HO in 31 hips (13.5%) Brooker Grade III HO in 18 hips (7.8%)	1 (0.4%) patient with 1 hip, unrelated to resurfacing	Postoperative medical complications: • Hypotension n = 14 (6.1%) • Urinary tract infection n = 9 (3.9%) • DVT n = 11 (4.8%) • PE n = 2 (0.8%) Operative complications: • Notched neck n = 5 (2.2%) • Wound infection n = 11 (4.8%) • Component mismatch n = 1 (0.4%) • Nerve palsy n = 5 (2.2%) • Acetabular wire breakage n = 4 (1.7%) • Retained guide wires n = 2 (0.8%)

Table 5. Hip Resurfacing Safety Table, Case Series

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
De Smet (2005)	3 hips (1.1%) • Femoral neck fracture (revised at 3 weeks) • AVN of femoral head (revised at 3 years, 7 months) • Low-grade infection	1 (0.4%) at 3 weeks	1 (0.4%) failed at 2 years, but changes seen at 1 year	2 (0.8%) Seen in only the infection and AVN revision cases	4 hips (1.5%) with evidence of HO Brooker Grade I HO in 3 hips (1.1%) Brooker Grade II HO in 1 hip (0.4%)	3, unrelated to resurfacing	• Sciatic nerve palsy with foot drop ((no recovery > 2 years) n = 2 (0.8%) • Guide pin left in femur in situ (in place > 4 years) n = 1 (0.4%) • DVT n = 1(0.4%) • Pulmonary embolism n = 1 (0.4%) • Hip dislocations (not recurrent), caused by fall in inebriated patient n = 2 (0.8%) • Infection n = 1 (0.4%)
Naal (2009)	2 hips (6.3%) • Femoral neck fracture (revised at 6 weeks) • Hip pain from inferior component impingement as a result of component malpositioning (revised at 6 months)	1 (3.1%) at 6 weeks	0	0	Evidence of Brooker Grade I HO in 2 hips (6.3%)	0	• Inferior component impingement (1, 3.1%) as a result of component malpositioning • Hematoma (no additional surgery required) • No infections, dislocations, nerve palsy, or iliopsoas irritation occurred

Table 5. Hip Resurfacing Safety Table, Case Series

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Revell (2006)	5 hips (6.8%) • Subtrochanteric fracture and failure of internal fixation (revised at 86 months) • Femoral head collapse (revised at 69 months) • Femoral loosening (revised at 48 months) • Acetabular fracture (revised at 3 months) • Hematogenous infection (still awaiting revision at press) Mean time to failure for these 5 hips was 57.5 months	0	0	Femoral loosening (n = 1, 1.4%)	At most recent F/U (N = 45 radiographs available) there were 7 hips (15.6%) with evidence of HO Brooker Grade I HO in 3 hips (6.7%) Brooker Grade II HO in 3 hips (6.7%) Brooker Grade III HO in 1 hip (2.2%)	3, unrelated to resurfacing	• One patient with DVT at 5 days postoperatively • Two broken guidewires which there were no clinical sequelae • There were no femoral neck fractures, dislocations, nerve palsies, or major leg length discrepancies

Table 5. Hip Resurfacing Safety Table, Case Series

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Treacy (2005)	3 hips (2.1%) • Deep infections in the first two years (n = 2) • Subcapital fracture that was avascular in origin at 9 months postop	2 (1.4%) • Both were subcapital fractures with one the result of deep infection and the other avascular in origin	1 (0.7%)	1 (0.7%)	At 5 year F/U (n = 107) there were 30 hips (28%) with evidence of HO Brooker Grade I HO 19 hips (17.8%) Brooker Grade II HO 7 hips (6.5%) Brooker Grade III HO 4 hips (3.7%)	4, unrelated to resurfacing	• Two patients sustained deep infections within first 2 years resulting in femoral loosening in one and subcapital fracture in the other • Nine months postop a patient had subcapital fracture that was avascular in origin • There were no dislocations, proven deep vein thromboses, or pulmonary emboli
Li (2008)	0	0	0	0	0	0	• No radiographic lucencies detected • No evidence of migration of acetabular and femoral components • No dislocations, infections, or DVTs

Table 5. Hip Resurfacing Safety Table, Case Series

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Steffen (2008)	23 hips (3.8%) • Femoral neck fracture (n = 12) • Aseptic loosening (n = 4) • Unexplained pain (n = 2) • Infection (n = 2) • Recurrent dislocations (n = 2) • Impingement (n = 1)	12 (2.0%)	10 (1.6%) The 10 non-intraoperative femoral neck fractures had evidence of extensive established AVN	4 (0.6%) • Acetabular component in 3 • Femoral component in 1	At 5 year F/U there were (n = 85) radiological exams available there were 26 hips (30.5%) with evidence of HO Brooker Grade I HO 19 hips (22.4%) Brooker Grade II HO 5 hips (5.9%) Brooker Grade III HO 2 hips (2.4%)	0	• There were no major medical complications • In 85 hips radioluncy around acetabular component (8.2%) and around femoral component (1.2%)
Siebel (2006)	8 hips (2.8%) • Femoral neck fracture (n = 5) • Incorrectly implanted cup (n = 1) • Postoperative luxation (n = 1) in non-compliant Parkinson's patient • Persistent pain (n = 1)	5 (1.7%) occurred within 4 months of surgery Two of these fractures occurred in a group of 7 that had definite notching of the femoral neck on postop X-rays	0	0	0	0	• There were no deep wound infections or DVTs • Notching: 8 • Dislocation:1

Table 5. Hip Resurfacing Safety Table, Case Series

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Lilikakis (2005)	2 hips (2.9%) • Deep infection • Aseptic loosening of acetabular component (revised at 15 months)	0	0	1 (1.4%) Aseptic loosening of acetabular component	At mean 28.5 month F/U there was 1 hip (1.4%) with evidence Brooker Grade II HO	1, unrelated to resurfacing	• One pulmonary embolism (1.4%) • One wound hematoma (1.4%) • One superficial wound infection (1.4%) • There were no dislocations
Daniel (2004)	1 hip (0.3%) • Avascular necrosis of the femoral head (revised at 8 months)	0	1 (0.3%)	0	0	6, unrelated to resurfacing died at 0.7-4.7 years after surgery	• One pulmonary embolism (0.3%) • No nerve palsy, wound dehiscence, deep infection, or dislocation

Table 5. Hip Resurfacing Safety Table, Case Series

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Costi (2009)	199 hips (73.7%) • Aseptic loosening of acetabular component only (n = 84, 31%) • Aseptic loosening of femoral component only (n = 31 11%) • Aseptic loosening of acetabular and femoral components (n = 58, 21%) • Femoral neck fracture (n = 6, 3%) • Pain in stable prosthesis (n = 6, 3%) • Sepsis (n = 2, 1%) • Acetabular cement fracture (n = 2, 1%) • Acetabular component wear in stable prosthesis (n = 1, 0.5%) • Psoas bursa (n = 1, 0.5%) • Cause of failure not properly documented (n = 8, 4%)	6 (3%) • Fracture at 2 months • Fracture at 2 years • Fracture at 4 years • Fracture at 6years • Fracture at 7 years • Fracture at 10 years	0	173 (64.1%) • Acetabular component only (n = 84, 31%) • Femoral component only (n = 31 11%) • Acetabular and femoral components (n = 58, 22%)	NR	53 patients (21.5%) with 58 hips died Median time to death after surgery was 10 years (4 months to 23 years)	NR

Table 5. Hip Resurfacing Safety Table, Case Series

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Beaulé and Dorey (2004)	3 hips (3.2%) converted to THR • Femoral neck fracture at 2 months • Femoral component loosening at 29 months • Persistent impingement and subluxation at 50 months	1 (1.1%) at 2 months	0	1 (1.1%) • Femoral component loosening at 29 months	NR	0	• No neurovascular injuries • One patient had socket exchange because of component mismatch • One patient had surgery to resolve a trochanteric bursitis
Beaulé and Le Duff (2004)	14 hips (34.1%) revised for aseptic failures at a mean 54.7 months (range 9.7-95.5) • Loosening of cemented acetabular socket (n = 9) • Loosening of cementless acetabular socket (n = 1) • Femoral neck fracture (n = 1) • Femoral component loosening (n = 2) • Late hematogenous sepsis secondary to pneumonia (n = 1)	1 (2.4%) at 9.7 months	0	12 (29.2%) • Cemented acetabular (n = 9) • Cementless acetabular (n = 1) • Femoral component (n = 2)	NR	1 (2.4%) at 18 months, unrelated to resurfacing	NR

Table 5. Hip Resurfacing Safety Table, Case Series

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
McBryde (2008)	Overall: 13 (1.4%) Direct lateral approach 2 (1.5%) • Acetabular component migration (revised at 0.8 years) • Aseptic loosening of acetabular component (revised at 4.3 years) Posterolateral approach 11 (1.4%) • Femoral neck fracture (revised at 0.3 years) • Femoral head collapse; osteonecrosis n = 2 (revised at 6.1 and 6.4 years) • Deep infection n = 3 (revised at 0.5, 1.8, and 2.4 years) • Acetabular component migration (revised at 0.5 years) • Aseptic loosening of acetabular component n = 2 (revised at 3.2 and 7.3 years) • Persistent pain; local inflammatory response; metal allergy n = 2 (revised at 2.2 and 3.3 years)	1 (0.11%)	2 (0.22%)	3 (0.33%)	NR	Overall 18 (2.3%)deaths (21 hips) Direct lateral approach 1 death (0.90%) (1 hip) Posterolateral approach 17 (2.5%)deaths (20 hips) One death in the posterolateral approach group was related to surgery. The patient developed sepsis with the 1° source of infection a deep infection of the hip.	Direct lateral approach: • DVT (n = 2) • Superficial wound infection (n = 1) • Sciatic nerve palsy (n = 1) • Washout of suspected deep infection (n = 1) Posterolateral approach Subgroup computer-based matching by gender and age of direct lateral group: • DVT (n = 2) • Superficial wound infection (n = 1) • Large wound hematome requiring drainage in OR

Table 5. Hip Resurfacing Safety Table, Case Series

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
Boyd (2007)	1 (5.3%) • Loosening of femoral component	0	0	1 (5.3%) • Loosening of femoral component	NR	0	• Greater trochanter pain associated with use of Dall-Miles clamp (n = 2) • Fixation of trochanter failed and was surgically refixed (n = 1)
McMinn (2008)	3 (2.7%) converted to THA at mean of 3.9 years (2 months-8.1 years) • Femoral neck fracture • Collapse of the femoral head • Deep infection	1 (0.91%) 2 months after surgery	0	0	NR	1 (0.91%) at 5 years, unrelated to resurfacing	• Non fatal pulmonary embolism (n = 1) • No case of wound dehiscence, neurovascular injury or dislocations
Mont (2007)	Entire group: 54 (5.3%) BIM 39 (13.4%) AIM 15 (2.0%)	Entire group: 27 (2.7%) BIM 21 (7.2%) AIM 6 (0.8%)	0	Acetabular cup loosening: Entire group: 24 (2.4%) BIM 10 (3.4%) AIM 4 (0.6%)	Entire group None: 868 (85.4%) 1: 71 (7.0%) 2: 32 (3.1%) 3: 18 (1.8%) 4: 5 (0.5%) NR: 22 (2.2%) BIM None: 248 (84.9%) 1: 23 (7.9%) 2: 9 (3.1%) 3: 6 (2.1%) 4: 1 (0.3%) NR: 5 (1.7%)	Entire group: 8 (0.8%) BIM 4 (1.4%) AIM 4 (0.6%)	Dislocation • Entire group n = 31 (3.1%) • BIM n = 12 (4.1%) • AIM n = 19 (2.6%) Hematoma • Entire group n = 41 (4.0%) • BIM n = 16 (5.5%) • AIM n = 25 (3.5%) Nerve palsy • Entire group n = 28 (2.8%)

Table 5. Hip Resurfacing Safety Table, Case Series

Author (Year)	Revision Reason for revision	Femoral neck fracture	Avascular necrosis (AVN)	Osteolysis or loosening	Heterotopic ossification	Death	Other complications
					AIM None: 620 (85.6%) 1: 48 (6.6%) 2: 23 (3.2%) 3: 12 (1.7%) 4: 4 (0.6%) NR: 17 (2.3%)		• BIM n = 12 (4.1%) • AIM n = 16 (2.2%) Pulmonary embolism • Entire group n = 7 (0.7%) • BIM n = 3 (1.0%) • AIM n = 4 (0.6%) Deep vein thrombosis • Entire group n = 24 (2.4%) • BIM n = 8 (2.7%) • AIM n = 16 (2.2%)

*Amstutz & Campbell (2004) excluded – reports on only 5 cases of femoral neck fracture after resurfacing

† Amstutz (2005) patients also included in Amstutz & Beaule study

Table 6. Hip Resurfacing Revision, Demographics

Author (year)	Study design (LoE)	Demographics	Follow-up	Characteristics	Interventions
Ball (2007)	Cohort (III)	HR to THA N = 20 (21 hips) Male: 55% Age: 50.2 years (23–72 years) Primary THA N = 58 (64 hips) Male: 65% Age: 50.8 years (27–64 years)	HR to THA 3.8 years (1–9.4 years) Primary THA 4.8 years (2–8.8 years)	HR to THA OA, n = 12 (57%) DDH, n = 5 (24%) ON, n = 2 (10%) Other, n = 2 (10%) Primary THA OA, n = 33 (52%) DDH, n = 11 (17%) ON, n = 10 (16%) Other, n = 10 (16%)	Indication for conversion from HR to THA: • femoral neck fracture (n = 5 hips) • femoral component loosening (n = 16 hips) Indication for primary THA: • denial from insurance carrier for HR • bone quality of femoral head compromised due to extensive ON or cystic degeneration
Grammatopoulos (2009)	Cohort (III)	HR to THA N = 53 hips Male: 36% Age: 53.7 years (20–71 years) Primary THA N = 103 Male: 38% Age: NR	3 years (0.8–7.2 years)	HR to THA • Primary OA, n = 40 (75.5%) • DDH, slipped upper femoral epiphysis, and AVN; n = 13 (24.5%)	Indications for MoM HR revision to THA • inflammatory pseudotumor (n = 16) • femoral neck fracture (n = 21) • other to include loosening, infection, AVN/collapse, and recurrent disclocations (n = 16) Primary THA group matched for gender, age, pre-op diagnosis, and length of follow-up • pseudotumor (n = 32) • fracture (n = 41) • other (n = 30)

AVN: Avascular necrosis; BHR: Birmingham hip resurfacing system; DDH: Developmental dysplasia of the hip; HR: Hip resurfacing; MoM: Metal-on-metal; OA: Osteoarthritis; ON: Osteonecrosis; THA: Total hip arthroplasty.

Table 7. Hip Resurfacing Revision, Results

Author (year)	Surgery time	Functional and clinical outcomes	Activity score	Further revision	Complications
Ball (2007)	HR to THA 178 minutes (140–255) Primary THA 169 minutes (110–265) *P* = .0263	• UCLA hip score • Harris hip score • SF-12 *physical* HR: 48.6 THA: 47.1 *mental* HR: 54.2 THA: 50.3 • Blood loss HR: 509 mL (100–1200 mL) THA: 578 mL (250–1600 mL) *P* = .314 • Length of hospital stay HR: 4.0 days (3–6 days) THR: 4.2 days (3–8 days) *P* = .479 • Radiographic evaluation: no difference in stem or acetabular fixation scores, limb length discrepancy, and femoral offset and the horizontal position of the center of rotation of the hip	• UCLA *pain* HR: 9.3 THA: 9.6 *walking* HR: 9.4 THA: 9.2 *function* HR: 9.3 THA: 8.8 *activity* HR: 6.8 THA: 6.4 • Harris hip score HR: 92.2 THA: 90.3 *P* = NS for all comparisons	HR, n = 0 THA, n = 1 two-stage revision for deep infection	HR to THA, n = 3 • femoral nerve palsy that completely resolved (n = 1) • intraoperative, nondisplaced, proximal femoral fracture (n = 1) • perioperative myocardial infarction (n = 1) Primary THA, n = 6 • femoral nerve palsy that completely resolved (n = 3) • periprosthetic femoral shaft fractures (n = 2) • deep infection requiring a two-stage revision (n = 1)

Author (year)	Surgery time	Functional and clinical outcomes	Activity score	Further revision	Complications
Grammatopoulos (2009)	HR • pseudotumors: 161.6 minutes (± 24.5) • other: 129.4 minutes (± 36.7) • fracture: 99.6 minutes (± 30.4 *P* < .002 THA • pseudotumors: 113.1 minutes (± 51.7) • other: 104.4 minutes (± 39.2) • fracture: 95.9 minutes (± 31.8) *HR versus controls* • pseudotumor: significantly longer (P < .001) • fracture and other groups: no difference	• OHS • UCLA score • complications	• OHS HR pseudotumor: 20.9 (± 9.3) fracture: 40.2 ± 9.2) other: 37.8 (± 9.4) *P* < .001 for pseudotumor vs. fracture and other groups THA pseudotumor: 39.1 (± 9.2) fracture: 42.7 (± 7.5) other: 39.7 (± 10.1) Difference between OHS was significantly different for the pseudotumor group only when comparing primary THA to HR revision group (39.1 vs 20.9, *P* < .001) • UCLA score HR pseudotumor: 3.8 (± 1.9) fracture: 7.0 (± 2.0) other: 6.7 (± 2.1) *P* < .001 for pseudotumor vs. fracture and other groups	HR • fracture, n = 3 (14%) • pseudotumor, n = 5 (38%) • other, n = 2 (13%) THA, n = 0	HR • blood transfusion: fracture, n = 7 (33%) pseudotumor, n = 12 (75%) other, n = 7 (44%) • dislocation: fracture, n = 0 pseudotumor, n = 3 (19%) other, n = 0 • nerve palsy: fracture, n = 0 pseudotumor, n = 3 (19%) other, n = 0 • loosening: fracture, n = 0 pseudotumor, n = 2 (13%) other, n = 0 • infection: fracture, n = 3 (14%) pseudotumor, n = 0 other, n = 1 (6%) • perioperative fracture: fracture, n = 0 pseudotumor, n = 0 other, n = 1 (6%) • major complications: pseudotumor, n = 8 (50%) fracture, n = 3 (14%) other, n = 2 (13%) *P* = .02 THA (controls) • blood transfusion: fracture, n = 4 (10%)

Author (year)	Surgery time	Functional and clinical outcomes	Activity score	Further revision	Complications
			THA = NA		pseudotumor, n = 2 (6%) other, n = 3 (10%) • dislocation: fracture, n = 4 (10%) pseudotumor, n = 2 (6%) other, n = 2 (7%) • nerve palsy: fracture, n = 0 pseudotumor, n = 0 other, n = 0 • loosening: fracture, n = 0 pseudotumor, n = 0 other, n = 0 • infection: fracture, n = 0 pseudotumor, n = 0 other, n = 0 • perioperative fracture: fracture, n = 0 pseudotumor, n = 0 other, n = 0 Difference between major complication rate was significantly different for the pseudotumor group only when comparing primary THA to HR revision group (6.2% vs 50%, *P* < .01)

HR: Hip resurfacing; NA: Not available; NR: not reported; NS: not significant; OHS: Oxford Hip Score; THA: Total hip arthroplasty; UCLA: University of California Los Angeles Hip Scoring System.