Dutch guideline on total hip prosthesis

Table 3. Scientific evidence

What are the indications and contraindications for total hip replacement?

Reference	Level of evidence	Study type	Number of patients	Patient characteristics	Inclusion criteria	Intervention	Control	Follow-up	Outcome measures	Results	Remarks
Santaguida 2008	**A2**	SR	64 studies (total) 555 – 96.675 patients (THR)	-23 studies → knee replacement -38 studies →THR -3 studies→ botn Years of publication: 1989 - 2002; 60% published between 1997 and 2001. Studies based on: registries (*n*=19), administrative (e.g. Medicare) or state discharge databases (*n*=4) or large urban hospitals (*n*=4). 6 of 64 studies were prospective (including 1 multicentre randomized trial); other studies were retrospective.	-studies with sample sizes of 500 or more. -of the 441 non-English studies 73% were French (26.1%), German (22.5%), Scandinavian (14.1%) or Italian (10.0%). **At least 1 of the following outcome measures:** function and health, pain, revision, postoperative complications, mortality. **Prognostic factors:** age, sex, race, height, weight (or BMI), SES, work status, high physical demands. Maximum of 30% lost for mean follow-up time of 10 yr	-	-	Range of 6 weeks to 20 years postoperative (THR)	Revision Mortality	Revision (all causes) was reported in 28 studies. Of these, 14 reported hip data stratified by age, sex and obesity → **age and sex** were the most consistently evaluated prognostic factors. In particular, younger men had a higher risk of revision. Of 16 studies in which mortality was evaluated →5 extractable data. Mortality intervals reported for THR were 30 days, 60 days, 90 days and 1 year. Older age at time of surgery was associated with increased postoperative mortality. Male sex was also associated with higher mortality rates in all but 1 study.	Raters were not blinded to citation identifiers (e.g., author, institution, year of publication). It is not clear how many RCTs were included in the systematic review. No meta-analysis.

Reference	Level of evidence	Study type	Number of patients	Patient characteristics	Inclusion criteria	Intervention	Control	Follow-up	Outcome measures	Results	Remarks
					Inclusions • Humans with knee or hip joint arthroplasty • 90% of study participants with osteoarthritis diagnosis OR • The% of osteoarthritis patients is less than 90% but there was a minimum of 500 patients and the subsequent analyses were stratified with respect to this diagnosis				Function Pain Satisfaction	Of 17 studies that reported function → 7 extractable data. Older patients and women had poorer function and less improvement relative to baseline function. Pain was seldom reported separately. *Visuri et al.:* women experienced less postoperative pain than men. *Stickles et al:* satisfaction did not differ for obese patients after THR. *Espehaug et al:* age and sex did not affect the satisfaction level of patients undergoing primary hip arthroplasty. However, women and older patients undergoing revision were reported to be less satisfied	
Lubbeke 2007	**A2**	hospital-based prospective cohort study	2186 (2.495 hips) 589 THR in 508 obese patients. Obese men: 26.7% Obese women: 20.5%	<u>Women (n=1217)</u> *BMI< 30* N= 1095 (57,5%) *BMI ≥ 30* N= 287 (48,7%) <u>Men (n= 969)</u> *BMI< 30* N= 811 (42,5%) *BMI ≥ 30 (n=52)* N= 302 (51,3%) <u>Age at operation:</u> <u>Mean ± SD years</u> *BMI< 30* 69,0 ± 12,5 *BMI ≥ 30* 67,2 ± 9,9	Primary THR between March 26, 1996 and July 31, 2005	Incidence of main complication (infection, dislocation, revision) in obese individuals. Also function and patient satisfaction 5 years postoperative, stratified for sex.	Incidence of main complication (infection, dislocation, revision) in non-obese individuals.	Follow-up period through October 31, 2005 5 years postoperatively (n=817)	Main complication (infection, dislocation, revision) Function (Harris Hip Score and Western Ontario and McMaster Universities Osteoarthritis Index)	<u>Obese vs non-obese</u> - Infection: adjusted incidence rate ratio → **4,4 95% CI 1,8-10,8.** Women: - incidence rate ratio for infection comparing obese with non-obese women → 16.1 (95% CI 3.4 - 75.7). Men: - incidence rate ratio for infection	Obese patients were younger with slightly lower preoperative functional status (differences were greater in women) and higher ASA scores. A2 rating because of sufficient number of patients, adequate control of confounding and no selective follow-up.

Reference	Level of evidence	Study type	Number of patients	Patient characteristics	Inclusion criteria	Intervention	Control	Follow-up	Outcome measures	Results	Remarks
										comparing obese with non-obese men → 1,0; 95% CI 0,2-5.3. -Dislocation: adjusted incidence rate ratio → **2,4 95% CI 1,4-4,2** Outcomes of function and satisfaction were moderately lower in obese women than in non-obese women, partly because of higher complication rates. Men: less difference in function and no difference in satisfaction between obese and nonobese.	
Sadr Azodi 2008	**B**	Observational (data from Swedish registration and Swedish Construction Workers' cohort)	2.106 patients	<u>BMI categories</u> 18,5- 24,9 n= 681 25–29,9 n= 1132 ≥ 30 n= 282	Men with primary THR between 1997 and 2004.	Overweight, obesity and tobacco use.	No overweight, obesity and tobacco use.	Max. 8 years	The relation between BMI and tobacco use and implant dislocation in THR.	<u>Implant dislocation:</u> 53 patients (2,5%) developed dislocation during a mean of 2 (0–3) years of follow-up. Overweight and obesity were associated with higher risk: HR = 2,5 95% CI: 1.1–5.5 (overweight) and HR = **3,7 95% CI: 1.5–9,3 (obesity)** compared to normal weight. No significant association was found between tobacco use and	No blinding of outcome assessor Not clear whether groups were comparable.

Reference	Level of evidence	Study type	Number of patients	Patient characteristics	Inclusion criteria	Intervention	Control	Follow-up	Outcome measures	Results	Remarks
										risk of implant dislocation.	
Flugsrud 2007	**B**	Cohort	1535	Women n= 969 Men n= 566 Mean age at screening: 49 years Mean age at primary THR: 63 years Mean age at end of follow-up: 69 years	-Norwegian Arthroplasty Register -Cox regression analysis was used to estimate relative risks (RRs).	Risk factors overweight and high level of physical activity. Combined with age and sex → risk of revision	-	Follow-up was time between primary THR and event or censoring.	Relative risk (RR) (Event was defined as implant revision due to aseptic loosening of cup, stem or both.)	Men were at greater risk than women of loosening of the femoral stem **(RR 2.0, 95% CI 1.3–3.2).** Both men and women with upper-quartile body weight were at increased risk of revision due to loosening of the stem (RR 2.5 and 2.7, respectively). Men with a high level of physical activity during leisure time were at increased risk of revision due to loosening of the cup (RR 4.8, 95% CI 1.3–18). In the multivariate model with adjustment for activity, there was little association between age at primary THA and risk of revision due to loosening.	No blinding of outcome assessor and randomization.
Busato 2008	**B**	Cohort study	18.968 patients 20.553 hips	THR between 1965 and 2003 in 42 European and 1 Canadian hospital. Bilateral → 7,7% of de THR ♀ n=10,138 (53,5%) ♂ n=8,830 (46,5%) Mean age at THR: 64,8 (95%CI: 65,7-65,0) years Mean BMI at	<u>Exclusion</u> - radiographic signs of loosening of prosthetic components -revisions	Different groups based on BMI Underweight: BMI <18,5, Normal: BMI 18,5 - <25,0 Overweight: BMI 25,0 - <30,0 Obese I: BMI 30 - <35,0 Obese II: BMI 35,0 -	Different groups based on BMI	15 years (formal statistical tests at 3, 6, 9, 12 years after THR)	Pain Function	No significant difference between BMI groups for postoperative pain during entire follow-up. Significant difference in function between obese and normal weight (12 yrs follow-up; P< 0,05)	BMI significantly lower in women compared to men (women: 26,04 (95%CI: 25,94-26,14) kg/m^2; men 26,99 (95%CI: 26,91-27,08) kg/m^2) Results are adjusted for sex and diagnosis. Too little information to exclude selection bias (completely).

Reference	Level of evidence	Study type	Number of patients	Patient characteristics	Inclusion criteria	Intervention	Control	Follow-up	Outcome measures	Results	Remarks
				THR: 26,49 (95%CI: 26,42-26,55); median: 26,2 kg/m^2		<40,0 Extremely obese: BMI ≥ 40					No selective loss-to-follow-up.
Roder 2007	**B**	retrospective cohort study	12.925 patients 13.766 hips	International Documentation and Evaluation System European hip registry, between 1967en 2002 (65 hospitals in 8 european countries) ♀n= 6467 ♂n= 6458 ♀ THR: 68,6 (range, 24,3-94,8) years ♂ THR: 66,3 (range, 22,8-94,7) years	-primary total hip arthroplasty -one or more complete follow-up examinations -with three inclusion criteria: 1)age >20 years 2)diagnosis of osteoarthritis 3) ipsilateral involvement of the hip at the time of the primary total hip arthroplasty. Patients with unilateral hip disease who had medical comorbidities sufficient to compromise walking capacity were assigned to Charnley class C and therefore were excluded from the study.	-	-	Max. 10 years Mean number of follow-up visits per patient: 2,1 (range, 1-9) Mean duration of follow-up: 4,3 years (range: 29 days-10 years)	Pain was classified as none/mild, moderate, or severe/intolerable; walking capacity was classified as more than sixty minutes, thirtyone to sixty minutes, ten to thirty minutes, or less than ten minutes/not possible; range of hip flexion was classified as >90°, 71° to 90°, 30° to 70°, or <30°stiff. A modification of "mean age related ability" (MARA) curves was used to show the relationships between preoperative pain and function and postoperative functional outcome.	Long term, complete or nearly complete pain reduction was accomplished in >80% of patients (with complete follow-up) N=6,401 could walk >10 min. preoperatively → 57,1% walking capacity >60 min. after 2 years of follow-up. N=6,896 could walk <10 min. preoperatively → 38,9% walking capacity > 60 min. after 2 years follow-up Significant difference ($p < 0.01$). All groups showed improvement in walking capacity up to 3-4 years and showed slow but constant improvement thereafter. N=10.375 preoperative hip flexion range >70° → 74,7% flexion range >90° at 2 years follow-up. N=2793 preoperative hip flexion range <70°	Level of evidence B because it is a retrospective and not a prospective cohort study. This study investigated treatment outcome following total hip arthroplasties performed with different component designs and fixation modes and included patients from multiple centers and surgeons with different levels of experience. All of these factors could have influenced the study findings. Patients usually did not have a complete record of ten documented follow-up examinations and the analysis did not account for clustering of data by center of treatment. Thus, the study results may be positively biased by the withdrawal of patients who had an undesired outcome from follow-up routines at the center of the primary

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										→ 62,6% flexion range of >90° at 2 years follow-up (significant difference (p < 0.01). Postoperative improvement pattern and loss of hip flexion range was equal in all 4 groups.	intervention.

What is the preferred type of prosthesis?

Authors, year	Level of evidence	Study type	Patient characteristic study- versus Control group	Population (incl. sample size)	Inclusion criteria	Intervention	Control	Outcome (effect size, incl. follow-up)	Results	Remarks
Brodner 2003	A2	RCT		100	Unilateral hip arthrosis	Titanium alloclassic stem and cup with M-M bearing	Titanium Alloclassic stem and cup with C-PE bearing	Serum cobalt level for 5 years	M-M group increased serum cobalt levels, C-PE group below detection level	
Bierbaum 2002	B	Multi-center RCT		514		Omnifit HA stem and Ø 32 C-C bearing	Omnifit HA stem and Ø 28 M-PE bearing	4 years follow-up.	Clinical and radiologic Control no difference. No ceramic fracture.	Mediocre support of the follow-up research.

Capello 2008	A2	Multi-center RCT		475		Omnifit HA stem and C-C bearing	Omnifit HA stem and M-PE bearing	Min. 5 years follow-up and 10 years survival data	10 years survival for C-C group is 95,9% and for the M-PE group 91,3%, 0,5% ceramic fracture, equal Harris Hip Score	Authors received financial support of the prosthesis manufacturers
Garcia-Rey 2008	A2	RCT		90		Uncemented THA with conventional M-PE bearing	Uncemented THA with cross linked M-HXPE bearing	5 years follow-up,	Mean linear PE erosion a years is 38 µm for the M-PE group and 6 µm for the M-XLPE group	The authors have no conflict of interest
Geerdink 2009	A2	RCT		40	arthrosis	Uncemented THA with conventional M-PE bearing	Uncemented THA with cross linked M-HXPE bearing	Min. follow-up is 7 years	Mean linear PE erosion a year is 142 µm for the M-PE group and 88 µm for the M-XLPE group	
Kim 2005	A2	RCT		104	Age < 50 years and bilateral THA	Uncemented THA with M-HXPE bearing	Uncemented THA with C-HXPE bearing	Mean follow-up is 7 years	Mean linear PE erosion a years is 17 µm for the M-PE group and 8 µm for the C-PE group	
Kraay 2006	A2	RCT		60	Primary THA, age between 50 and 75 years	Cemented stem with metal head and uncemented cup with PE insert	Cemented stem with ceramic head and uncemented cup with PE insert	Mean follow-up is 4 years	Mean linear PE erosion a years is 60 µm for the M-PE group and 55 µm for the C-PE group	Authors doubt if measurements are precise enough
Lewis 2010	A2	RCT		56	Primary THA, age between 18 and 60 years	Uncemented stem with ceramic head and uncemented cup with PE insert	Uncemented stem with ceramic head and uncemented cup with ceramic insert	Mean follow-up is 8 years	Mean linear PE erosion a years is 20 µm for the C-C group and 110 µm for the C-PE group	

Mu 2009	A1	Systematic review of RCT's				7 articles with 8 studies comparing PE with XLPE		Follow-up varies between 2 and 5.5 years	All RCTs show statistically significantly reduced erosion for the XLPE group.	
McCalden 2009	A2	RCT		100	Primary THA, age between 40 and 79 years	Hybrid THA with PE insert	Hybrid THA with XLPE insert	Min. follow-up is 5 years	Mean linear PE erosion a years is 51 µm for the M-PE group and 3 µm for the M-XLPE group	Authors received financial support from the prosthesis manufacturers
Seyler 2006	B	Matched cohort-control	M/F 77%/23% Age 45 years	79 pt. C-C osteonecrosis 76 pt. C-C arthrosis 26 pt. M-CPE osteonecrosis 25 pt. M-CPE arthrosis	Primary THA for osteonecrosis or arthrosis	Uncemented ceramic on ceramic THA	Uncemented metal on conventional PE THA	7 years survival analysis	No difference in HHS or survival between osteonecrosis and arthrosis group and no difference between C-C and M-PE group	
Rajadhyaksha 2009	B	Matched cohort-control	M/F = 14/11 Mean age 60 resp. 62 years	54	Primary THA	27 uncemented THA's with XLPE insert	27 uncemented THA's with PE insert	Min. 5 years follow-up.	Mean linear PE erosion a year is 85 µm for the M-PE group and 22 µm for the M-XLPE group	
Triclot 2007	B	RCT	M/F = 50/52 Mean age 71 years	102	Primary THA	Hybrid THA with XLPE insert	Hybrid THA with CPE insert	Mean 4,9 years follow-up	Mean linear PE erosion a year is 106 µm for the M-PE group en25 µm for the M-XLPE group	

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Reference	Level of evidence	Study type	Number of patients	Patient characteristics	Inclusion criteria	Follow-up duration	Outcome measures	Results	Remarks
Eskelinen, 2006	B	Cohort study	8 cup-stem combinations were included	Data from the Finish Arthroplasty Register of 1980-2003 Cup- stem combinations: 1. ABG I/ABG I 2. ABG I/ABG II 3. Anatomic Mesh/Harris-Galante II 4. Biomet Bi-Metric/Mallory 5. Biomet Bi-Metric/Romanus 6. Biomet Bi-Metric/Universal 7. Biomet Bi-Metric/Vision 8. PCA Std/PCA Pegged	- Patients <55 years at the time of surgery - Patients with primary arthrosis as indication for surgery - Cup - stem combinations that were used in > 100 surgeries during the study period, including new types with a short follow-up (Mean < 5 years) <u>Excluded:</u> - Uncemented smooth-threaded cups that have well documented bad results. - Lord Madréporique stem was often used (n = 273, 96%) together with the Lord smooth-threaded cup → this was excluded from the study.	Survival of 5,10,13 years	Survival prosthesis The endpoint for survival was defined as revision when either one component or the whole implant was removed or exchanged. Both revision for any reason (including exchange of liner) and aseptic loosening served as endpoints. Aseptic loosening was selected as a separate endpoint, because "revision for any reason" also included non-implant-related re-operations.	*<u>Revision because of a-septic detachment:</u>* 1. ABG I/ABG I Number revisions/ total number of surgeries: 3/105 Mean follow-up: 8.2 yrs. At risk (5 yrs.): 99 % 5 yrs. Survival (95% CI): 100 At risk (10 yrs.): 27 % 10 yrs. Survival (95% CI): 60 (91-100) Risk ratio (95% CI): 0.6 (0.2- 1.9) *Not statistically significant* 2. ABG I/ABG II Number revisions/ total number of surgeries: 3/266 Mean follow-up: 4.3 yrs. At risk (5 yrs.): 122 % 5 yrs. Survival (95% CI): 99 (97-100) Risk ratio (95% CI): 0.9 (0.3- 3.2) *Not statistically significant* 3. Anat. Mesh /HG II Number revisions/ total number of surgeries: 14/127 Mean follow-up: 9.7 yrs. At risk (5 yrs.): 120 % 5 yrs. Survival (95% CI): 98 (95-100) At risk (10 yrs.): 75 % 10 yrs. Survival (95% CI): 93 (88-98) At risk (13 yrs.): 20 % 13 yrs. Survival (95% CI): 82 (73-92) Risk ratio (95% CI): 1.6 (0.8- 3.0) *Not statistically significant* 4. Bi-Metric/Mallory Number revisions/ total number of surgeries: 6/107 Mean follow-up: 7.5 yrs. At risk (5 yrs.): 95 % 5 yrs. Survival (95% CI): 96 (92-100) At risk (10 yrs.): 20	The risk ratio was adjusted for age and gender. *All types were compared to the Bi–Metric/Universal THR *<u>For 'any' revision:</u>* 1. ABG I/ABG I Number revisions/ total number of surgeries: 21/105 Mean follow-up: 8.2 yrs. At risk (5 yrs.): 99 % 5 yrs. Survival (95% CI): 99 (95-100) At risk (10 yrs.): 27 % 10 yrs. Survival (95% CI): 79 (70-88) Risk ratio (95% CI): 1.3 (0.8- 2.1) *Not statistically significant* 2. ABG I/ABG II Number revisions/ total number of surgeries: 3/266 Mean follow-up: 4.3 yrs. At risk (5 yrs.): 122 % 5 yrs. Survival (95% CI): 99 (97-100) Risk ratio (95% CI): 0.3 (0.1- 1.0) *Statistically significant (p=0.04)* 3. Anat. Mesh /HG II Number revisions/ total number of surgeries: 29/127 Mean follow-up: 9.7 yrs. At risk (5 yrs.): 120 % 5 yrs. Survival (95% CI): 97 (94-100) At risk (10 yrs.): 76 % 10 yrs. Survival (95% CI): 86 (80-93) At risk (13 yrs.): 20 % 13 yrs. Survival (95% CI): 63 (51-75) Risk ratio (95% CI): 1.0 (0.7- 1.6) *Not statistically significant* 4. Bi-Metric/Mallory Number revisions/ total number of surgeries: 21/107 Mean follow-up: 7.5 yrs. At risk (5 yrs.): 96 % 5 yrs. Survival (95% CI): 94 (90-99) At risk (10 yrs.): 21 % 10 yrs. Survival (95% CI): 62 (46-79) At risk (13 yrs.): 2 Risk ratio (95% CI): 1.5 (1.0- 2.5) *Not statistically significant* 5. Bi-Metric/Romanus

Reference	Level of evidence	Study type	Number of patients	Patient characteristics	Inclusion criteria	Follow-up duration	Outcome measures	Results	Remarks
								% 10 yrs. Survival (95% CI): 87 (74-100) Risk ratio (95% CI): 1.4 (0.6- 3.4) *Not statistically significant* 5. Bi-Metric/Romanus Number revisions/ total number of surgeries: 19/106 Mean follow-up: 9.4 yrs. At risk (5 yrs.): 99 % 5 yrs. Survival (95% CI): 95 (91-99) At risk (10 yrs.): 58 % 10 yrs. Survival (95% CI): 86 (78-93) At risk (13 yrs.): 15 Risk ratio (95% CI): 2.8 (1.6- 4.9) *Statistically significant (p<0.001)* 6. Bi-Metric/Universal Number revisions/ total number of surgeries: 36/858 Mean follow-up: 7.4 yrs. At risk (5 yrs.): 706 % 5 yrs. Survival (95% CI): 99 (98-99) At risk (10 yrs.): 216 % 10 yrs. Survival (95% CI): 93 (90-96) At risk (13 yrs.): 57 % 13 yrs. Survival (95% CI): 89 (85-94) Risk ratio (95% CI): ref.* 7. Bi-Metric/Vision Number revisions/ total number of surgeries: 0/385 Mean follow-up: 2.6 yrs. At risk (5 yrs.): 55 % 5 yrs. Survival (95% CI): 100 8. PCA Std/PCA Peg. Number revisions/ total number of surgeries: 37/107 Mean follow-up: 11.1 yrs. At risk (5 yrs.): 101 % 5 yrs. Survival (95% CI): 95 (91-99) At risk (10 yrs.): 78 % 10 yrs. Survival (95% CI): 72 (66-83) At risk (13 yrs.): 40	Number revisions/ total number of surgeries: 45/106 Mean follow-up: 9.4 yrs. At risk (5 yrs.): 101 % 5 yrs. Survival (95% CI): 90 (84-95) At risk (10 yrs.): 60 % 10 yrs. Survival (95% CI): 68 (58-77) At risk (13 yrs.): 15 Risk ratio (95% CI): 2.2 (1.5- 3.1) *Statistically significant (p<0.001)* 6. Bi-Metric/Universal Number revisions/ total number of surgeries: 112/858 Mean follow-up: 7.4 yrs. At risk (5 yrs.): 707 % 5 yrs. Survival (95% CI): 96 (95-98) At risk (10 yrs.): 220 % 10 yrs. Survival (95% CI): 79 (75-83) At risk (13 yrs.): 57 % 13 yrs. Survival (95% CI): 74 (69-79) Risk ratio (95% CI): ref.* 7. Bi-Metric/Vision Number revisions/ total number of surgeries: 2/385 Mean follow-up: 2.6 yrs. At risk (5 yrs.): 55% 5 yrs. Survival (95% CI): 100 (99-100) Risk ratio (95% CI): 0.3 (0.1- 1.1) *Not statistically significant* 8. PCA Std/PCA Peg. Number revisions/ total number of surgeries: 40/107 Mean follow-up: 11.1 yrs. At risk (5 yrs.): 101 % 5 yrs. Survival (95% CI): 95 (91-99) At risk (10 yrs.): 78 % 10 yrs. Survival (95% CI): 72 (64-81) At risk (13 yrs.): 40 % 13 yrs. Survival (95% CI): 60 (50-70) Risk ratio (95% CI): 1.4 (1.0- 2.1) *Not statistically significant*

Reference	Level of evidence	Study type	Number of patients	Patient characteristics	Inclusion criteria	Follow-up duration	Outcome measures	Results	Remarks
								% 13 yrs. Survival (95% CI): 63 (52-73) Risk ratio (95% CI): 4.0 (2.5- 6.5) *Statistically significant (p<0.001)*	
Swedish Hip Arthroplasty Register (Annual Report 2007)	A2	Register	170.413 completely uncemented and cemented hip replacement		Total hip prosthesis	1992-2007	Relative risk	Uncemented prosthesis implants 33% higher risk compared to cemented prosthesis: RR= 1.33 *95% CI: 1.23-1.41* After 1998 (modern implant design) n= 115.959 RR= 1.37 *95% CI: 1.13-1.67* Risk early revision (within 2 years) Almost double risk for uncemented prosthesis implants compared to cemented prosthesis RR= 1.86 *95% CI: 1.55-2.23* Including infections as a risk: RR= 2.35 *95% CI: 1.55-2.89* <u>Uncemented prosthesis</u> Dislocation, loosening, fracture, infection <u>Cemented prosthesis</u> Dislocation, infection, loosening, fracture	Results were only described for the total cemented and uncemented prosthesis; not for the separate components.
The Norwegian Arthroplasty Register (Annual Report 2008)	A2	Register	1987-2007 in total 110.985 primary surgeries and 18.496 revisions.		Total hip prosthesis implants	1987-2007	Survival Relative risk	<u>Cemented prosthesis</u> Years RR *P* 1987-1990 1 1991-1993 1.6 *<0.001* 1994-1996 1.1 *0.04* 1997-1999 0.8 *<0.001* 2000-2002 0.7 *<0.001* 2003-2007 0.9 *0.1* <u>Uncemented prosthesis</u> Years RR *P* 1987-1990 1 1991-1993 0.8 *0.002* 1994-1996 0.5 *<0.001* 1997-1999 0.3 *<0.001* 2000-2002 0.3 *<0.001* 2003-2007 0.9 *0.1*	RR adjusted for age and sex

Reference	Level of evidence	Study type	Number of patients	Patient characteristics	Inclusion criteria	Follow-up duration	Outcome measures	Results	Remarks
Australian Orthopedic Association (Annual Report 2008)	A2	Register	<u>Cemented prosthesis implants</u> Total: 15.864 Revisions: 380 <u>Uncemented prosthesis</u> Total: 66.736 Revisions: 1779				- Observed component years (OCY) - using the number of revisions per 100 observed component years - 95% CI - % revision primary hip replacement	<u>Cemented prosthesis implants</u> OCY: 57.336 Revision per 100 OCY: 0.7 95% CI: 0.60-0.73 % revision after 7 yrs.: 3.8 95% CI: 3.3-4.3% <u>Uncemented prosthesis</u> OCY: 195750 Revision per 100 OCY: 0.9 95% CI: 0.87-0.95 % revision after 7 yrs.: 4.4 95% CI: 4.1-4.8%	The risk of revision depends on patient age.
National Joint Registry UK (5th Annual Report 2007)	A2	Register	<u>Cemented primary prosthesis implants</u> Total : 26.685 (43%) Of which patient data: 21.810 <u>Uncemented primary prosthesis</u> Total : 20.690 (33%) Of which patient data: 16.406	<u>Cemented primary prosthesis implants</u> ♀: Tot. 14.337 (66%) <45 yrs. 100 45-54 yrs. 357 55-64 yrs. 1859 65-74 yrs. 5282 75-84 yrs. 5496 >85 yrs. 1243 ♂: Tot. 7.473 (34%) <45 yrs. 83 45-54 yrs. 244 55-64 yrs. 1171 65-74 yrs. 3103 75-84 yrs. 2445 >85 yrs. 427 <u>Uncemented primary prosthesis</u> ♀: Tot. 9.398 (57%) <45 yrs. 373 45-54 yrs. 872		2003-2007	- Revision Rate - 95% CI - Hazard ratio - 95%CI For each age category, sex and for cemented and uncemented prostheses	<u><65 years</u> n: 35.288 RR: 1.8% 95% CI: 1.6-2.0% HR: 1.0 95% CI: - <u>65-74 years</u> n: 36.881 RR: 1.0% 95% CI: 0.9-1.1% HR: 0.8 95% CI: 0.6-0.9 <u>75+ years</u> n: 30.009 Revision: 0.9% 95% CI: 0.7-1.0% RR: 0.8 95% CI: 0.6-0.9 <u>♂</u> n: 41.220 RR: 1.4% 95% CI: 1.3-1.6% HR: 1.0 95% CI: - <u>♀</u> n: 60.926 RR: 1.1% 95% CI: 1.0-1.2% HR: 0.9	There was a decrease in uncemented prosthesis implants of 53% to 43% from 2004 to 2007, respectively. There was an increase in cemented prosthesis implants of 21% in 2004 to 33% in 2007.

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				55-64 yrs. 2952 65-74 yrs. 3341 75-84 yrs. 1593 >85 yrs. 267 ♂: Tot. 7.008 (43%) <45 yrs. 411 45-54 yrs. 763 55-64 yrs. 2239 65-74 yrs. 2469 75-84 yrs. 1021 >85 yrs. 105				95% CI: 0.8-1.0 <u>Cemented prosthesis</u> n: 54.769 RR: 0.7% 95% CI: 0.6-0.8% HR: 1.0 95% CI: - <u>Uncemented prosthesis</u> n: 28.590 revision: 1.8% 95% CI: 1.6-2.1% HR: 2.4 95% CI: 2.1-2.9	
Morshed 2007	B	SR	91501 cemented prosthesis implants and 20593 uncemented total hip prosthesis implants	20 controlled studies that compared cemented with uncemented total hip prosthesis implants	1. All THR's except those placed for a fracture 2. controlled comparison of cemented vs. uncemented fixation 3. outcome revision for all reasons. 4.only randomized trials.	Not specifically described, only on a per study basis.	Survival of the prosthesis	1. no statistically significant overall difference in survival between the cemented and the uncemented prosthesis 2. if all ages were studied, then the un- cemented prosthesis implant had a better survival. 3. Cemented Stainless steel or cobalt chrome stems and uncemented titanium stems had good results 4. For comparisons of cups using a threaded or macro-ingrowth implant with those using a micro ingrowth or on-growth uncemented design, the former favored cemented fixation whereas the latter did not, and the difference between subgroups were significant. 5. As publication year progressed, results of the uncemented prosthesis implants improved.	
Fitzpatrick 1998	A1	Health technology assessment SR (no meta-analysis)	11 RCTs were found that compared outcomes of prostheses; Mean n= 186 only 1 RCT with sign. difference	Electronic search Medline and Embase (1980-1995) 11 journals with the highest yield of relevant articles	RCT, observational cohort research, observational research with at least 5 years of follow-up	Follow-up mean 3.9 years;	revision percentage	The most favorable revision percentages were found in the Exeter, Lubinus and Charnley prosthesis Average results: Muller, McKee-Farrar and Stanmore prosthesis. Worst results: Ring, Harris-Galante, PCA and Charnley-Muller prosthesis	

Reference	Level of evidence	Study type	Number of patients	Patient characteristics	Inclusion criteria	Follow-up duration	Outcome measures	Results	Remarks
Mäkelä 2008	A2	Register	50968	Group 1 without cement: straight, proximal circumferent porous coated stem and a modular, porous coated pressfit cup Group 2 without cement: anatomically proximal porous coated and/or hydroxyapatite coated stem with a modular porous coated and/or hydroxyapatite coated pressfit cup Hybrid group : Cemented stem and pressfit cup Cemented group	1. THR, 2. > 55 years at the time of surgery 3. primary coxarthrosis 4. >l 50 implants of prosthesis already placed.	0-25 years	Revision for all reasons	With respect to aseptic loosening 1. Uncemented stem prosthesis implants better than the cemented stems for patients >74 years. For patients >74 years no difference 2. Uncemented cup had a lower revision percentage than the cemented cups for patients <74 years. For patients >74 years the uncemented hydroxyapatite coated press fit cup performed better than cemented cups. 3. The cemented prosthesis implants had a higher revision percentage after 10 years for patients <74 years. >74 years no differences were observed. With respect to revision of the prosthesis implants for all reasons: no difference between cemented and uncemented Liner change because of polyethylene erosion occurred so often for uncemented prosthesis implants for that between group differences disappeared.	

11 *What is the value of resurfacing hip arthroplasty?*

Authors, year	Level of evidence	Study type	Population (incl. sample size)	Inclusion criteria	Intervention (incl. duration, dosage)	Control (incl. duration, dosage)	Outcome (effect size, incl. follow-up)	Results	Remarks
Marker 2009	B	Systematic Review		9 studies RHA versus THA (4 studies RCT and 5 studies cohort)				In general no differences in clinical outcome score.	5 studies positive RHA for activity score and chance of dislocation
Lavigne 2010	A2	RCT	48	Hip arthrosis unilateral, age < 65 yrs,	Resurfacing Hip prosthesis (Durom; Zimmer)	Big head circumference THR (CLS stem and Durom head cup; Zimmer)	Walking speed, balance, gait analysis, SF36, WOMAC, UCLA, Merle d'Aubigné	Follow-up 0,3,6 and 12 months. Comparable results for both prostheses.	Numbers are low but satisfy the power analysis.
Mont 2009	B	Matched Cohort-control	108	Primary & sec. coxarthrosis. Exclusion: pregnancy, HIV, metal allergy, neurological deficit on the affected leg.	Resurfacing THR (Conserve Plus, Wright Medical)	Regular THR (Osteonics Trident cup and Accolade stem; Stryker)	Primary: HHS, Likert-scale, satisfaction, activity score, complications and X-rays.	Comparable results on effect sizes subject to higher activity scores resurfacing per and postoperative.	Short follow-up (mean 40 months). Power analysis adequate.
Pollard 2006	B	Matched Cohort-control	108	Hip arthrosis unilateral, age < 65 yrs,	Resurfacing THR (BHR; S&N)	Regular hybrid THR	Oxford, UCLA, EuroQol and complications / revisions.	Oxford the same, UCLA and EuroQol higher resurfacing. Revision 6 vs. 8 %.	Follow-up 5-7 years.
Fowble 2009	B	Consecutive Cohort-control	94	Cox arthrosis for self-referred for resurfacing vs. regular THR	Resurfacing THR (Conserve Plus, Wright Medical)	Regular THR (Summit and Pinnacle; DePuy)	HHS, SF-12, UCLA, duration of operation, dislocation	Preoperatively statistically significant difference in parameters. HHS the same post-OK versus resurfacing higher SF-12 and UNCLA. Dislocation both one.	Follow-up 2-4 yrs. Non-matched control series (demographics different).
Prosser 2010	B	Australian Joint Replacement Registry	12.093	Resurfacing for coxarthrosis September 1999 – December 2008	Resurfacing THR	Regular THR in similar period	Revision operation	Statistically significant more revisions with hip circumference < 50 mm. After 8 yrs revisions RHP > THR (5.3 vs. 4.0 %). Pat < 55 yrs and hip head circumference >50 mm revision after 7 yrs RHP = 3.0 %. Revision percentages differ per design.	

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13 *What is the preferred surgical approach for total hip replacement?*

Reference	Level of evidence	Study type	Number of patients	Patient characteristics	Inclusion criteria	Intervention	Control	Follow-up duration	Outcome measures	Results	Remarks
Jolles and Bogoch 2009	**B**	Systematic review of 4 prospective cohort studies	241 patients and prosthesis	Primary total hip prosthesis	RCT	Total hip prosthesis through posterolateral or direct lateral approach	No	?	Dislocation Trendelenburg gait Nerve damage Pain	No differences in dislocation were observed between posterolateral and the direct lateral approach. The same for Trendelenburg gait Direct lateral approach results in more nerve damage (not n.ischiadicus) Final rotation movement is greater for the posterolateral approach	Few studies satisfying criteria, therefore no conclusion could be made.
Kwon 2006	**B**	Systematic review of 1 RCT and cohort studies	4115 prosthesis	Primary total hip prosthesis	Studies that described approach and soft tissue repair	Total hip prosthesis via the posterolateral with (PL+) and without soft tissue repair (PL-)	Studies that described dislocation for other approaches	Minimum 6 months	Dislocation	PL+: 1648 THR – 8 dislocation (0,49%) PL-: 2467 TPH– 110 dislocation (4,49%) (RR 8,21;95%CI 4,05-16,67) Anterolateral: 2147 THR – 15 dislocation (0,70%) Lateral: 2309 THR– 10 dislocation (0,43%)	Type of prosthesis? Experience? Position prosthesis?
Masonis 2002	**B**	Systematic review of cohort studies	13233 prosthesis implants with respect to dislocation 2455 prosthesis implants with respect to limping	Primary total hip prosthesis	Studies that described dislocation and limping	Dislocation and limping	None	?	Dislocation Limping	Trans troch: 2988 – 38 lux. (1,27%) PL+: 2262 – 46 lux (2,03%) PL- :3719 – 141 (3,95%) Anterolateral: 826 – 18 lux (2,18%) Direct lateral: 3438 – 19 lux (0,55%) Anterolateral – lateral approach limping: 4-20% Posterolateral approach limping: 0 – 16 %	Little literature about limping and dislocation. The available literature did not allow for meta-analysis

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19 *What is the value of minimal invasive procedures?*

Reference	Level of evidence	Study type	number of patients	Patient characteristics	Inclusion criteria	Intervention	Control	Duration of follow-up	Outcome measures	Results	Remarks
Verteuil 2008	A1	Systematic review	12 RCTs 22 observational studies 8 case series 1 registration (Norway)	RCT: majority < 200 patients (20-219) <u>Single mini-incision THR (9 RCTs):</u> SI: n= 492 Mean age : 65,7 yrs. MI: n= 487 Mean age: 64,8 yrs. <u>Two mini-incision THR (3 RCTs):</u> Two: n= 63,3 Mean age: 65,7 yrs. MI: n= 63,3 Mean age: 64,8 yrs.	Long term follow-up (revision data) from registry (Norway). Article in English, Chinese or Japanese. THR with respect to arthritis. <u>Excluded:</u> Article focused on THR for reasons such as, osteoporosis, fractures or tumors. Revision surgery, resurfacing or computer modeling Surgery.	<u>9 RCTs</u> Single mini-incision THR <u>2 RCT</u> Two mini-incision THR <u>1 RCT</u> Two mini-incision THR	Standard THR Single mini-incision THR Standard THR	<u>5 RCTs</u> less than a year. minimum 1 year (case series or cohort study with two or more surgeons) at least 3 years (case series with 1 surgeon)	(only RCTs) MI=mini-incision vs. S=standard Revision (n; MI: 197; S:198) Postoperative dislocation (n; MI: 347; S: 352) Implant position (cup) (n; MI: 235; S: 239) Implant position (stem) (n; MI: 323; S: 331) Infection (n; MI: 407; S: 412) Deep venous thrombosis (n; MI: 317; S: 322) Operation duration (n; MI: 427; S: 432) Blood loss (n; MI: 347; S: 352) Hospital stay (n; MI: 297; S: 302) Harris hip score (≤ 3 months)(n; MI: 167; S: 168)	Peto OR (95% CI) 7,96 (0,16 – 402) (*p*= 0,30) compared to standard 1,72 (0,43 – 6,92) (*p*= 0,45) compared to standard 0,93 (0,50 – 1,74) (*p*= 0,83) compared to MI 0,70 (0,35 – 1,40) (*p*= 0,45) compared to MI 7,48 (0,78 – 72,16)(*p*= 0,08) compared to standard 0,39 (0,12 – 1,30) (*p*= 0,12) compared to MI WMD -3,70 (-5,67-1,74) (*p*= 0,0002) compared to MI WMD -56,59 (-71,63- -41,55) (*p*< 0,00001) compared to MI WMD -0,50 (-0,83--0,18) (*p*= 0,002) compared to MI WMD -1,25 (-3,75-1,24) (*p*= 0,33) compared to MI	Included cost effect analysis: Mean QUALY with 1 years: 0,677 standard THR 0,695 mini-incision THR Mean QUALY with 40 years: 8,463 standard THR 8,480 mini-incision THR (only for outcomes revision, postoperative dislocation, deep venous thrombosis and pulmonary embolism) Too little standardization in measurement of outcome measures Reviewers were not blinded for author, institute or publication details.

Reference	Level of evidence	Study type	number of patients	Patient characteristics	Inclusion criteria	Intervention	Control	Duration of follow-up	Outcome measures	Results	Remarks
									Harris hip score (> 3 months)(n; MI: 217; S: 219)	WMD 0,35 (-0,13-0,83) (*p*= 0,152) compared to. standard	
Wall 2008	B	Review	69 studies of which 9 RCTs	Not described	Studies in English language published between 1998 and 2008	minimal invasive surgery (no 2-insicion approach)	Standard approach (posterior and lateral)	< 2 years	(only RCT) *Ogonda et al., 2005* Bloodloss *Bennett et al., 2006/ Lawlor et al., 2005, Dorr et al., 2007* *Kim et al. 2006* *Chimento et al. 2005* *Pour et al. 2007* *Duka et al. 2007*	Statistically significant difference (52 ml difference). MIS group had shorter hospital stay, faster mobility and less pain. MIS group had statistically significant shorter time of surgery and fewer total blood replacement. MIS group had statistically significantly less blood loss (Mean difference 43 ml) and that fewer patients limped after 6 weeks. The treatment of patients had a statistically significant greater effect on the outcomes than cut length. MIS group had statistically significant shorter operation time and blood loss.	They searched only in Pubmed. 3 of the 9 RCTs were from the same research group . (*Ogonda et al., 2005; Bennett et al., 2006; Lawlor et al., 2005*) No pooled results Quality of the included studies was determined using the Cochrane Reporting Quality Score → 12 criteria, score of 0-2 (Total 24 points) Range score review 12- 22 points.

Reference	Level of evidence	Study type	number of patients	Patient characteristics	Inclusion criteria	Intervention	Control	Duration of follow-up	Outcome measures	Results	Remarks
									Hart et al., 2005	The early Harris Hip score was better in the standard group. No statistically significant difference.	
Goldstein 2008	B	Comparative study	538 total hip prosthesis. 221 x THR via MIS 317 x via standard 512 patients with a min follow-up of 1 years were given a questionnaire to evaluate the cosmic results of the surgery. 287 patients returned the questionnaire; 123 hips via MIS for 109 patients and 186 hips via the standard procedure in 171 patients.	<u>MIS group (n hips= 123)</u> Incision ≤ 5 inches Mean follow-up: 21 months (12-36) ♀/♂: 62/61 <u>Standard group (n hips = 186)</u> > 5 inches Mean follow-up: 25 months (12-36) ♀/♂: 111/75	A primary total hip prosthesis between March 2001 and March 2003.	Questionnaire after >1 years to evaluate the cosmic results of the surgery.	n.a.	> 1 years.	-Opinion about the cosmetic appearance of the scar. - uneven scar edges -Is the skin next to the scar wrinkled or bumpy? - is the space between the edges of the scar too big? - do the edges of the scar curl or sink? -is the scar swollen or thick?	95% of both groups reported that the scar looked good. In the MIS group the percentage of patients that reported uneven scar edges and a wrinkled/bumpy skin around the scar was higher. Standard group : 12 patients MIS: 5 patients space between the edges too big. Difference NS (*p*-0.451) MIS group sig. higher number of incidents of sinking or curling of the edges of the scar compared to the standard group (*p*= 0,001) MIS: 2 patients Standard: 1 patient reported a swollen scar. <u>Standard group :</u> 72% of de patients scored the optimum (of 6) for cosmic outcomes > 1 yrs. follow-up postoperative. <u>MIS:</u> 64% of de patients scored the optimum	This is a subjective measurement. Selection procedure was not clearly described.

Reference	Level of evidence	Study type	number of patients	Patient characteristics	Inclusion criteria	Intervention	Control	Duration of follow-up	Outcome measures	Results	Remarks
										(of 6) for cosmetic outcomes > 1 yr. follow-up postoperatively. No complications were reported.	
Mahmood 2007	C	Review	36 articles of: 3 RCTs *(were also included in Verteuil et al., 2008)* 6 observational studies (prospective) 8 cohort studies 9 retrospective studies 10 case series 6098 patients; 6626 THR 5285 patients with I Of which 1341 THR SMI	<u>Intervention</u> Mean 62,2 yrs. (48-73,4) Mean BMI: 26,7 (25 studies) <u>Control</u> Mean 63,3 yrs. (49-69) Mean BMI: 28,2 (25 studies)	Only published papers in the English language in peer-reviewed journals.	minimal invasive incision procedure (MI)	Single incision procedure (SI)	65,1 weeks (range: 4-260 weeks)	Blood loss Average operation time Average Hospital stay <u>Complications</u> Infection Dislocation Thrombosis Early revision Intra-operative fracture Nerve damage	NS average difference in blood loss reported in 18 of the 36 studies. MI: 80,4 min. (range 37,5-148 min.) SI: 86,5 min. (range 54-166 min.) NS MI: 3,69 days (range 1-6 days) SI: 4,98 days (range 3-6 days) (*p= 0,024)* NS NS NS NS NS NS	Methodologically scored using the Coleman score. Scored by two researchers. Scored using 10 criteria on a scale of 0-100 (with 100 representing very good quality) Mean score: 48,2 (range 27-82) 5 criteria were weakly present. Type of study, description of rehabilitation protocol, outcome criteria, outcome estimates, process of subject selection. <u>Limitation studies:</u> Only studies published in the English language were included. Comparison of outcomes was simplistic (reported averages were compared although there was a lot of heterogeneity in study design) This reviews does not describe which studies were included. The search strategy was not clearly described.

Reference	Level of evidence	Study type	number of patients	Patient characteristics	Inclusion criteria	Intervention	Control	Duration of follow-up	Outcome measures	Results	Remarks
Chen 2009	B	Prospective, randomized	83 in group 1 and 83 in group 2	Group 1: minimal invasive two incision technique transgluteal Group 2: traditional transgluteal approach	Patients with coxarthrosis; similar prosthesis for both groups	Minimal invasive 2 incision approach	Traditional transgluteal approach	2 years	Operation duration, blood loss, technical problems, cup inclination, anteversion angle, stem alignment, canal filling ratio, Harris Hip Score, WOMAC, pain relieve.	Group 1: longer duration of operations, more blood loss, more complications Group 1: Temporarily lesion N.cut.fem.lat 27 (32,5%) proximal femur fracture 6 (7.2%) area wound infection 1 (1,2%) group 2: proximal femur fracture 4 (4,8%) area wound infection 1 (1,2%) dislocation 1 (1,2%) less NSAIDs used in group 1 and for a shorter period	
Nuelle 2007	B	Prospective	50 patients in each group	Group 1: 11 hip prosthesis, 14 knee prosthesis Group 2: 8 hip prosthesis, 17 knee prosthesis All approaches were normal traditional	Hip- and knee prosthesis.	Group 2 this program is normally offered to patients given a minimal invasive treatment (mini protocol)	Group 1 normal program of anesthesia, postoperative pain relieve and physiotherapy	Not described	ADL tests, duration of hospital stay	Group 2 (mini protocol) quicker recovery	
Mow *et al.*, 2005	B	Prospective	Group 1: 20 patients Group 2: 14	Group 1: mini-posterior Group 2: standard posterior approach	Hip prosthesis	All scars were photographed, length of scar was immeasurable on the photo. Two researchers judged the photos independently using similar criteria. Patient opinion was also assessed.	2 researchers	17 months	Scar: color, contour, deformation, Fitzpatrick classification, general appearance	Scars after the standard posterior approach were prettier than after a mini-posterior approach	N= Small Were the groups comparable?
Mardones	C	Corpse	10 corpses	Each corpse	Ad random	Measurement of	no	no	Measurement of	Both approaches	No comparative

Reference	Level of evidence	Study type	number of patients	Patient characteristics	Inclusion criteria	Intervention	Control	Duration of follow-up	Outcome measures	Results	Remarks
et al., 2005		study		obtained a prosthesis one side placed using the 2-incision technique and a prosthesis on the other side placed using the mini-posterior approach		muscle tissue damage.			length and breadth of the muscle damage	damaged the muscles and this damage was more pronounced at the 2 incision technique.	study; case series N= small

21 *What prophylactic measures against infection should be used in primary total hip replacement?*

Reference	Level of evidence	Study type	number of patients	Inclusion criteria	Patient characteristics	Intervention	Control	Follow-up	Outcome measures	Results	Remarks
Albuhairan 2008	A1	meta-analysis or 26 RCTs	11.343 (26 RCTs)	- Patients with primary or revision THR - antibiotics preop administered - Reporting outcome measure wound infection - study type RCT	Not reported	1) antibiotics (AB) 2) systemic AB 3) teicoplanin 4) first generation cephalosporin 5) all generation cephalosporin	1) no AB 2) with antibiotic-impregnated cement 3) first and second generation cephalosporin 4) second generation cephalosporin 5) penicillin derivate	From 10 days to 10 years	Wound infection defined as: visible purulent exudate at the surgical site	<u>Stat. sign.:</u> AB vs. no AB: N=3065 (7 RCTs) RR 0,19 (95%BI 0,12-0,31) <u>NS:</u> Syst. AB vs. with AB-impregnated cement: N=2388 (3 RCTs) RR 0,88 (95%BI 0,59-1,31) Teicoplanin vs. cephalosporin: N=2625 (5 RCTs) RR 1,22 (95%BI 0,64-2,34) first gen vs. second gen cephalosporin: N=2879 (8 RCTs) RR 1,08 (95%BI 0,63-1,84) Cephalosporin vs. penicillin derivate: N=386 (3 RCTs) RR 1,17 (95%BI 0,31-4,41)	Adequate randomisation(+/-/?): + (5 RCTs), ? (21 RCTs) Allocation concealment (+/-/?): + (4 RCTs), ? (22 RCTs) Blinding outcome assessor: triple (1 RCT), double (7 RCTs), single (6 RCTs), ? (12 RCTs) Intervention- and control group control group comparable (+/-/?): + (17 RCTs), ? (9 RCTs) Sufficient follow-up (≥80%) (+/-/?): + (12 RCTs), ? (11 RCTs), - (3 RCTs) Intention-to-treat analysis (+/-/?): + (4 RCTs), ? (10 RCTs), - (12 RCTs) Financing: No financial support from commercial party.

Reference	Level of evidence	Study type	number of patients	Inclusion criteria	Patient characteristics	Intervention	Control	Follow-up	Outcome measures	Results	Remarks
Gillespie, 2010	A1	meta-analysis of 23 RCTs	N=8447 (23 RCTs)	- Patients who undergo internal fixation or revision arthroplasty for closed fracture of proximal femur or other long bone. - antibiotics preop administered - Reporting outcome measure wound infection - study type RCT	Not reported	1) 1 preop doses and ≥2 postop doses parenteral antibiotics (AB) 2) 1 preop doses parenteral AB 3) 1 doses parenteral AB 4) 1 doses parenteral AB with long half-time 5) earlier multiple doses AB administered in ≤24 h 6) oral administration of AB	1) placebo or no treatment 2) placebo or no treatment 3) earlier multiple doses similar AB 4) earlier multiple doses AB with shorter half-time 5) earlier multiple doses AB administered in >24 h 6) parenteral administered AB	Not reported	Wound infection defined as: - deep wound infection (DWI) : occurrence < 1 year postop, implant in right position, infection affects tissue underneath fascia infection - Superficial wound infection (SWI): occurrence < 30 days postop, affects subcutaneous skin tissue or muscles superior of fascia. Other infections (urine tract (UWI), airway (AWI))	<u>Stat. sign.:</u> 1): N=1915 (10 RCTs) DWI: RR 0,35 (95%BI 0,19-0,62) SWI: RR 0,38 (95%BI 0,22-0,66) UWI: RR 0,63 (95%BI 0,53-0,76) AWI: RR 0,46 (95%BI 0,33-0,65) 2): N=3500 (7 RCTs) DWI: RR 0,40 (95%BI 0,24-0,67) SWI: RR 0,69 (95%BI 0,50-0,95) <u>NS.:</u> Comparison3-6	Adequate randomisation(+/-/?): + (5 RCTs), ? (15 RCTs), - (3 RCTs) Allocation concealment (+/-/?): + (7 RCTs), ? (13RCTs), - (3 RCTs) Blinding outcome assessor (+/-/?):+ (8 RCTs), ? (9 RCTs), - (6 RCTs) Intervention- and control group control group comparable (+/-/?): Not reported Sufficient follow-up (≥80%) (+/-/?): + (4 RCTs), ? (12 RCTs), - (7 RCTs) Intention-to-treat analysis (+/-/?): Not reported Financing: No conflict of interest
Engesaeter 2001	B	Retrospective (register) study: effectiveness AB prophylaxis on revision percentage	N=22.170 THR	- Patients with implants and cement and available long term results in registry. - primary implants in patients met idiopathic hip osteoarthritis - 1 of 4 cemented cup/stem implants combinations:: Charnley/Charnley Exeter/Exeter Titan/Titan	71% F Mean age: 72 (17-97)	Cemented implants	n.a.	0-14 years postop	revision percentage	696/22.170 revisions (3.1%), of which 440/696 (2.0%) because of aseptic loosening and 102/696 (0.5%) deep infection. Chance of revision syst+cement vs. syst alone: RR 1.4 (95%BI 1,1-1,7). AB prophylaxis regime with syst+cement: 4x daily at day of operation sign. better result than ≤3xdaags	Selective loss to follow-up (+/-/?): ? Sufficient follow-up (+/-/?): + Financing: No conflict of interest

Reference	Level of evidence	Study type	number of patients	Inclusion criteria	Patient characteristics	Intervention	Control	Follow-up	Outcome measures	Results	Remarks
				Spectron/ International total Hip (ITH) - implant with high-viscosity cement Palacos with or without gentamycin or Simplex with or without colistin/erythromycin - AB prophylaxis with cephalosporin (first gen. cephalotin or second gen. cefuroxime) or penicillin (cloxacillin or dicloxacillin, both semi synthetic penicillinase-resistent)						
Parvizi 2008	B	meta-analysis of 6 comparative studies (meta-analysis of studies, mostly level B)	N=24.661 hip replacements (6 studies) N=21.445 analysed	- Patients who undergo primary or revision THR - Reporting outcome measure deep wound infection and overall survival - study type comparative study with AB-impregnated cement vs. cement without AB Exclusion: - 'Boneloc' cement, Simplex cement	Not reported	with AB-impregnated cement	cement without AB	Not reported	- deep wound infection (DWI) - overall survival (OS)	<u>Stat. sign.:</u> N=15.137 primary THR (6 studies) DWI: RR 0,51 (95%BI 0,34-0,75) N=55.600 revision THR (5 studies) DWI: RR 0,72 (95%BI 0,63-0,83) Survival: Prim. THR: 98% Rev. THR: 88%	Meta-analysis reports no information about the included studies (except for being comparative). The authors state to have done a quality assessment. Financing: unknown
Lidwell, 1982	B	Multicenter RCT (19 centres in England, Scotland and Sweden)	N= 8136 surgeries N=8055 analysed (6781 hip 1274	- Patients who undergo THR or knee replacement	Not reported	OR with ultraclean air (UCA)(<10KVE/m^3) ventilation system; yes/no use whole-body exhaust-ventilated suits NB: hospitals used different UCA	OK with conventional ventilation system (modern, positive air pressure) NB: large variation in median KVE/m^3	Mean. duration follow-up: 2-2,5 yr	Deep infection, defined as bacterial joint infection with associated with clinically apparent tissue damage.	Infection percentage I: 23 / 3922 = 0,57% C: 63 / 4133 = 1,5% I vs. C: RR 0,38 (95%BI 0,24-0,62)	Adequate randomisation(+/-/?): ? no uniform randomisation method Allocation concealment (+/-/?): ? (unplanned alternations in randomisation list, in

Reference	Level of evidence	Study type	number of patients	Inclusion criteria	Patient characteristics	Intervention	Control	Follow-up	Outcome measures	Results	Remarks
		Study period:1974-1979	knee)			systems => different levels of contamination					one hospital ¾ of all surgeries was in control environment) Blinding outcome assessor (+/-/?): - Intervention- and control group control group comparable (+/-/?): ? Sufficient follow-up (≥80%) (+/-/?): + (1%, no reasons reported) Intention-to-treat analysis (+/-/?): - Substantial variation in use of AB prophylaxis. Financing: unknown
Persson 1999	B	Cost-effectiveness study	Whole register ?	Patients from the Swedish arthroplasty register who received antibiotics.	Swedish arthroplasty register	Price and risk of aseptic loosening	n.a.	n.a.	Relation between risk of aseptic loosening and costs	Plain Palacos results in best price/quality ratio Sulfix, Simplex and CMW have a higher risk of aseptic loosening at higher cost than plain Palacos Palacos gentamycine gives a lower risk of aseptic loosening, but at considerable higher cost. Keeping in mind the reduction of the risk of deep infection is a combination of systemic antibiotics with gentamycine cement and 'surgical enclosure' the most cost-effective method.	
Meehan, 2009	**D**	current concepts review, no primary study of meta-									

Reference	Level of evidence	Study type	number of patients	Inclusion criteria	Patient characteristics	Intervention	Control	Follow-up	Outcome measures	Results	Remarks
		analysis									
Kasteren 2007	C	Retrospective cohort study	1922	Surgical prophylaxis and Surveillance. (CHIPS) project 2000–2002 11 v.d.13 Dutch hospitals involved in CHIPS project provided data on primary THR postoperative wound infection according to US Centres for Disease control and Prevention-criteria.	Female: 69% Mean age (±SD) 68,8±10,8 years ASA score: >2 → 12% Mean stay preop: (±SD) 1,2±2,1 days Mean. duration procedure: (±SD) 78,.6±35, 3 min, Mean hospital stay postop: (±SD) 8,8±5,6 days	n.a.	n.a.	n.a.	Risk factors for postoperative wound infection after THR	Antibiotics prophylaxis *OR(95% CI)* Prophylaxis duration **Single doses** = Reference Multiple postoperative doses ≤ 24 hour 2,0 (0,6–7,0) NS Multiple postop doses >24 hours 1,4 (0,2–9,2) NS Administration of prophylaxis 160 min before incision 1,3 (0,4–4,4) NS 31–60 min before incision 0,9 (0,4–2,1) NS 1–30 min before incision → Reference During or after incision 2,8 (0,9–8,6) NS Administering of AB-impregnated cement 0,8 (0,3–1,9) NS Patient- and procedure related variables Age, year 1,4 (1,0–2,1) NS Female gender. 1,7 (0,7–3,9) NS ASA score 1→ Reference 2→ 1,5 (0,6–3,8) NS 3+→ 2,8 (0,8–9,2) NS Operation duration in the 175th percentile 2,5 (1,1–5,8) P= 0,04	All patients received antimicrobial prophylaxis. The used antibiotics were classified according to the Dutch group for antibiotics-policy clinical guideline. (cefazolin [*n*=947], flucloxacillin [*n*=48], and erythromycin [*n*=8] or clindamycin [*n*=1] in case of allergy) or with broad spectrum (cefamandol [*n*=39], cefuroxim [*n*=873], amoxicillin plus netilmicin [*n*=1], and clindamycin plus gentamycin [*n*=1]).
Bowers 1973	C	Animalstudy medication stage I-III	80	healthy canines ≥ 18kg, negative blood analysis	healthy canines ≥ 18kg, negative blood analysis	Antistaphylococcus treatment	?	?	(1) permeability of antibiotics and persistence in the bone (2) effect of cephaloridin administration in standard	Cephaloridin easily penetrated hematomas in the bone and persisted bacteriological concentrations. Preop cephaloridin resulted in sterile wounds that did not infect. Cephaloridin administered ≥6 hour after: infection stable.	

Reference	Level of evidence	Study type	number of patients	Inclusion criteria	Patient characteristics	Intervention	Control	Follow-up	Outcome measures	Results	Remarks
									wound infection		
Classen 1992	A2	Prospective cohort study	2847	Patients planned for surgery May 1985-November 1986 Exclusion: -Surgery within >48h after hospital admission -Patients who received no antibiotics -treatment with antibiotics > 28 before or after surgery -Patients who had an existing infection -surgery for which antibiotics are not recommended- Patients who had more than 1 surgery during the same hospital stay.	Mean age. 53 years (range, 11-97) Female: n= 1758 Male: n= 1089 Mean hospital stay: 7,6 days 55 patients died during hospital admission 1359 clean operations 1488 clean-contaminated operations	Early administration n= 369 (2-24 hours before incision) Preoperatively n= 1708 (2 hours before incision) Perioperatively n= 282 (during 3hours after incision) Postoperative n= 488 (between 3 and 24 hours after incision)	n.a.	?	Surgical wound infection	Early administration % infections: 3,8 RR: 6,7 95% CI: 2,9-14,7 OR: 4,3 95% CI: 1,8-10,4 Preoperatively % infections: 0,59 RR: 1 Perioperatively % infections: 1,4 RR: 2,4 95% CI: 0,9-7,9 OR: 2,1 95% CI: 0,6-7,4 Postoperatively % infections: 3,3 RR: 5,8 95% CI: 2,6-12,3 OR: 5,8 95% CI: 2,4-13,8 A stepwise logistic regression shows that preoperative administration of antibiotics results in the lowest risk of postoperative wound infection.	
Stefansdottir 2009	C	Retrospective cohort study	114	?	Group 1 N= 114 university clinic in Lund 2008 Group 2 N= 291 patients from Swedish knee arthorplasty register	n.a.	n.a.	-	Time of administrating antibiotics before surgery	Group 1 n=51 received first doses antibiotics 15-45 min before surgery. N=22 surgery had started or antibiotics were administered at the start of surgery Group 2 N= 113 received first doses antibiotics 15-45 min before surgery.	Care provider was blinded
Streinberg, 2008	A2	Prospective cohort	4472	July –November 2003 (baseline)	N=3405; cephalosporin alone	Group 1 N=1844 Vancomycin/Fluoro	Group 4 N=188 Port-incision	-	Time of administration	113 infections in 109 patients	

Reference	Level of evidence	Study type	number of patients	Inclusion criteria	Patient characteristics	Intervention	Control	Follow-up	Outcome measures	Results	Remarks
		study		February-July 2005 (measurement) Surgeries hart patients (n=1949), hip and knee implants (n=1735) and hysterectomy (n=788).	or antibiotics designed by SCIP (surgical care improvement project) added within 60 minutes before incision, N= 575; Cephalosporin plus vancomycin, N= 218; vancomycin alone, N= 240; Fluoroquinolones with or without agents, N= 34; antibiotics (not documented)	quinolones added within60 minutes or cephalosporin added within 30 minutes before incision <u>Group 2 N= 1796</u> Vancomycin/Fluoro quinolones 61-120 minutes or cephalosporin 31-60 minutes before incision <u>Group 3 N= 644</u> other pre-incision supplement			of prophylaxis to prevent postoperative wound infection	<u>Group 1</u> Infection risk: 2,1 % RR (95% CI): Reference OR (95% CI): Reference <u>Group 2</u> Infection risk: 2,4 % RR (95% CI): 1,16 (0,75-1,79) OR (95% CI): 1,48 (0,92-2,38) <u>Group 3</u> Infection risk: 2,8 % RR (95% CI): 1,36 (0,78-2,36) OR (95% CI): 1,30 (0,70-2,41) <u>Group 4</u> Infection risk: 5,3 % RR (95% CI): 2,58 (1,31-5,10) OR (95% CI): 2,20 (1,03-4,66)	
Soriano 2006	B	Prospecti ve cohort study	<u>Period A</u> n= 256 <u>Period B</u> n= 256	-Patients who underwent surgery for 'femoral neck fracture' <u>Period A</u> January - May 2002 <u>Period B</u> June 2002 - May 2003	<u>Period A</u> Mean age(years): 80,1 ± 10,1 Female/male 4,8/1 <u>Period B</u> Mean age (years): 81,6 ± 9 Female/male 5/1	<u>Period A</u> 2 doses 1,5 g cefuroxime, 1 during de anaesthesia introduction and the other 2 hours postop.	<u>Period B</u> cefuroxime plus 600 mg teicoplanin during de anaesthesia introduction	12 months	Incidence of postoperative wound infection	<u>Period A</u> total % infections 5,07% (n=13 of 256) N= 7 → MRSA <u>Period B</u> total % infection2,36% (n=12 of 507). N= 1 → MRSA	No other preventive measures were taken during the surgery and operation rooms were similar. The study design did not include randomisation or blinding. Two cohorts are being compared.
Josefsson 1993	A2	Randomis ed prospecti ve controlled analysis control	Hip→ 1688, Patient s → 1599	March 1976 - May 1978 487 patients died during study period. → <u>SA:</u> 239 (29%) <u>GBC:</u> 248 (29%) Lost to follow-up:	Female: 816 Mean age at surgery: 70 years (range 25-98 years) Man: 783 Mean age surgery: 68 years (range 25-84 years)	SA (systemic antibiotics) n= 835 Cloxacillin 1g 4x daily for 7-14 days, N= 359 hips Cloxacillin 1g 4x daily for 8-14 days,	GBC (gentamycin bone cement) N= 835	10 years N= 115 hips <u>SA</u> N= 550 <u>GBC</u> N= 565	Deep wound infections	**<u>1 and 2 year study</u>** 16 deep wound infections <u>SA/GBA</u> 13 (1,6%)/ 9 (0,4%) *P*< 0,05 **<u>5 years study</u>** 23 deep wound infections <u>SA/GBA</u>	Randomised, not blinded

Reference	Level of evidence	Study type	number of patients	Inclusion criteria	Patient characteristics	Intervention	Control	Follow-up	Outcome measures	Results	Remarks
				Total: 86 hips SA: 46 GBC:40		N= 192 hips Cephalexin 1g 4x daily for 9-11 days, N= 209 hips Phenoxymethyl penicillin 0,65g 4x daily for 10 days, N= 75 hips				16 (1,9%) / 7 (0,8%) *P*< 0,05 **10 years study** 22 deep wound infections SA/GBA 13 (1,6%) / 9 (1,1%) NS	
Espehaug 1997	B	cohort	10.905 primary THR	Sept. 1987-1995; reported in Norwegian hip-register -only patients who had surgery for primary hip-osteoarthritis -no earlier surgery -cement used in both components-only THR with Charnley), Titan or Spectron/ITH Cement → high-viscosity Palacos or Simplex -only common types of systemic antibiotics: cephalothin (n=6168), cefuroxim (n = 1969), dicloxacillin (n = 1468) and cloxacillin (n = 785) -Antibiotics containing cement: gentamycin in combination with Palacos (0,5 g per 40,0 g polymethylmethacrylate; n = 5898) and erythromycin/colistin	1) combined n= 5804 male: 31% <65 years: 15% 65-74 years: 49% 2) systemic n= 4586 male: 30% <65 years: 17% 65-74 years: 52% 3) bone cement n= 239 male: 31% <65 years: 15% 65-74 years: 49% 4) no antibiotics n= 276 male: 30% <65 years: 17% 65-74 years: 53%	1) patients receive both systemic as local antibiotics prophylaxis in the bone cement 2) patients who received systemic antibiotics prophylaxis alone 3) patients who received antibiotics prophylaxis in the bone cement alone 4) no antibiotics prophylaxis	n.a.	7 years	Survival Revision likelihood	Survival is shown in a figure, percentages are difficult to extract. The combined systemic + cement antibiotics result in best survival, followed by systemic alone. Infection as end stage (5 yr. failure prob. %; 95% CI)/ number of revisions 1) 0,2 (0,1-0,4)/ 8 2) 0,8 (0,5-1,1)/ 25 3) 0,9 (0,0-2,0)/ 3 4) 1,2 (0,0-2,5)/ 3 Aseptic loosening as end stage (5 yr. failure prob. %; 95% CI)/ number of revisions 1) 1,0 (0,7-1,4)/ 44 2) 1,9 (1,3-2,4)/ 54 3) 2,1 (0,0-4,1)/ 7 4) 1,7 (0,0-3,4)/ 4 Any end stage (5 yr. failure prob. %; 95% CI)/ number of revisions 1) 1,6 (1,2-2,0)/ 70 2) 3,1 (2,4-3,8)/ 94 3) 2,9 (0,5-5,2)/ 10 4) 2,9 (0,7-4,9)/ 7	

Reference	Level of evidence	Study type	number of patients	Inclusion criteria	Patient characteristics	Intervention	Control	Follow-up	Outcome measures	Results	Remarks
				with Simplex cement (0,5 g erythromycin en 0,24 g colistin per 40,0 g polymethyl-methacrylate; n = 145) -infection as primary reason for revision							

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23 *What is the preferred method to prevent postoperative thromboembolic complications?*

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Reference	Level of evidence	Study type	Number of patients	Patient characteristics	Intervention	Control	Follow-up duration	Outcome measures	Results	Remarks
Eriksson 2008	**A2**	**RCT**	**3153**	total hip arthroplasty	Rivaroxaban	Enoxaparine	36 days	Asymptomatic DVT, non-fatal pulmonary embolism and death	1,1% vs 3,7% ARR: 2.6%; 95% BI 1.5 - 3.7	Rivaroxaban is more effective and is equally safe with a long treatment duration
Eriksson 2007	**A2**	**RCT**	3494	total hip arthroplasty	Dabigatran etexilate 220mg and 150mg	Enoxaparine	33 days		6.0% (220mg) 8,6% (150mg) 6,7 (enoxaparine)	All treatment strategies are equally effective with similar safety.

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26 *What is the value physiotherapy?*

Reference	Level of evidence	Study type	Number of patients In/exclusion	Patient characteristics	Intervention/ Control	Outcome measures	Results	Remarks
Preoperative physiotherapy								
Gocen, *2004*	B	RCT	Study group N= 29 Control group N= 30	**Study group** ♀: 13 ♂: 16 mean age: 46,93 ± SD 11, 48 years BMI: 24,94 ± SD 3,7 kg/m^2 **Control group** ♀: 8 ♂: 22 mean age: 55,5 ± SD 14,44 years BMI: 27,69 ± SD 3,7 kg/m^2 Significant difference between both groups for age (*p*= 0,01)	**Study group** Eight weeks preoperative strength and mobility training for hip muscles and information on how to live with an implant. **Control group** no training- or information program Both groups received similar postoperative guidance	- Harris Hip Score - VAS-pain score (visual Analogue scale) - hip abduction range Variables were measured at baseline (=8w preop, only intervention Group), at dismissal from the hospital, 3 months and 2 years postoperative.	**Harris Hip Score** **Study group** 8 weeks preoperative: 42,7 ± 16,9 preceding surgery: 51,48 ± 18,32 at hospital dismissal: 64,46 ± 6,92 3 months postoperative: 85,30 ± 11,78 2 years postoperative: 97,14 ± 4,32 **Control group** 8 weeks preoperative: - preceding surgery: 45,30 ± 12,98 at hospital dismissal: 59,36 ± 6,82 3 months postoperative: 78,70 ± 9,41 2 years postoperative: 95,66 ± 6,08 Day (sd) resume activity: **Study group** Walking: 2,07±0,20 Climbing stairs: 6,17±1,69 Getting out of bed: 2,93±0,59 Going to toilet: 4,24±0,51 Rise from chair: 4,24±0,74 **Control group** Walking: 2,20±0,41 Climbing stairs: 7,37±1,02 Getting out of bed: 3,33±0,71 Going to toilet: 5,07±1,28 Rise from chair: 5,60±1,45 Statistically significant difference: climbing stairs, getting out of bed, going to toilet, rise from chair:	Patients randomly assigned with Excel random numbers. even numbers → control group Odd numbers → study group . The assessing physiotherapist was blinded. Blinding of patients and treating therapist are not mentioned. Patients In de study group was 1 'drop out. All other patients were analysed in the group they were randomized to. Significant difference between both groups concerning age. (*p*= 0,01) The study groups were rather small, it is not certain the results can be generalized. **clinical message:** Routine preoperatively physiotherapy and education programs are not useful for patients who undergo total hip replacement surgery.

Reference	Level of evidence	Study type	Number of patients In/exclusion	Patient characteristics	Intervention/ Control	Outcome measures	Results	Remarks
							(respectively: 0,01; 0,02; 0,02; 0,001)	
Rooks 2006	B	RCT	49 patients **Intervention group** N= 25 **Control group** N= 24	**Intervention group** ♀: 63% ♂: 37% mean age: 65 ± SD 11 years BMI: 28,4 ± SD 5,3 kg/m^2 **Control group** ♀: 52% ♂: 48% mean age: 59 ± SD 7 years BMI: 30,3 ± SD 9,1 kg/m^2	**Intervention group** - 3x weekly water and floor exercise - period: 6 weeks preop - surgery **Control group** Written information on home adjustments (increase accessibility and decrease fall accidents) and preparing for surgery by 3 telephone conversations, 2x written information via mail. Period: 6 weeks-preop – surgery.	Primary outcome measure - WOMAC function Secondary Outcome measures - WOMAC pain score - SF-36 - Lower-extremity strength - Balance - Mobility Evaluated at 4 points in time: - pre-intervention - post-intervention (directly preoperative) - 8 weeks postoperative - 26 weeks postoperative	Mean ± SD ***Baseline*** **Intervention group** WOMAC function 29,1 ± 12,9 **Control group** WOMAC function 29,8 ± 11,2 ***Preoperative**** **Intervention group** WOMAC function 26,9 ± 11,9 **Control group** WOMAC function 33,7 ± 101,9 ***8 weeks postoperative*** **Intervention group** WOMAC function 12,8 ± 9,0 **Control group** WOMAC function 12,9 ± 8,0 ***26 weeks post operative*** **Intervention group** WOMAC function 5,4 ± 5,8 **Control group** WOMAC function 5,3 ± 5,4 *statistically significant difference between the groups (p< 0,05)	Loss to follow-up > 20%. Randomisation and blinding procedures. Procedures are not described, it is stated that it is a randomised blinded controlled study.

Reference	Level of evidence	Study type	Number of patients In/exclusion	Patient characteristics	Intervention/ Control	Outcome measures	Results	Remarks
Ferrara 2008	B	RCT	23 patients **Exclusion criteria:** Cognitive degeneration assessed with mini-mental State Examination ≤ 23, de presence of other joint implants, hip dysplasia, inflammatory arthritis , Parkinson and neuropathy.	End stage arthritis, patients were on a waiting list for total hip replacement **Intervention group** ♀: 7 ♂: 4 mean age: 63,82 ± SD 9,01 years **Control group** ♀: 7 ♂: 5 mean age: 63,08 ± SD 6,89 years	**Intervention group** - 1 month preop group- (40 minutes) and individual (20 minutes) exercises - 60 minutes daily - 5 days per week - Also exercises for muscle strength and flexibility - Received information on how to deal and exercise with a hip implant. - 4 weeks postop recovery program with exercise in hospital **Control group** Only 4w postop recovery program in hospital	- Barthel Index - Short Form-36 (SF-36) - WOMAC - Harris Hip Score (HHS) - Muscle strength - Flexibility - VAS-pain score Measurements were taken in all patients : - 1 months preop (T0) - 1 day preop (T1) - 15 days postop (T2) - 4 weeks postop (T3) - 3 months postop (T4)	The study group and de control group showed statistically significant results for VAS (*p*= 0,04), ROM external rotation (*p*= 0,03), SF-36 physical composite score (*p*= 0,048) and hip abductor (*p*= 0,004) at T1 On all other time points there were no significant differences for all outcome measures except for VAS and ROM external rotation at T4. Mean ± SD **Study group** T4 VAS* 0,30 ± 0,48 ROM External rotation* 33,50 ± 4,11 **Control group** T4 VAS* 1,27 ± 1,00 ROM External rotation* 33,64 ± 4,52 *p= < 0,05	The patients were randomised by using a randomising-table. The assessors of effect were blinded. The physiotherapist who guided the exercise program was not blinded. Patient blinding is unknown. Small study population, it is not certain results can be generalized.
Post operative physiotherapy								
Suetta, 2004	B	RCT	168 patients on the waiting list, 86 matched the inclusion criteria, 36 consented to participate in the study 30 patients completed follow-up. SR - 3 patients SRW -1 patient NES - 2 patients (see column intervention/Control for meaning) **Inclusion** Patients on the waiting list for a primary unilateral total hip replacement. Age: 60 years or older, ASA score I or II	**SR (n=12)** Mean age (years): 68 ± SD 62-78 ♀/♂: 7/5 Mean weight (kg): 81,3 ± SD 5,8 Mean height (cm): 169,8 SD 2,1 BMI (kg/m^2): 28,2 ± SD 1,7 **SRW (n=13)** Mean age (years): 69 ± SD 60-86 ♀/♂: 6/7 Mean weight (kg): 77,8 ± SD 4,5 Mean height (cm):	**Intervention group** 3 groups: - Standard rehabilitation at home (SR) - Standard rehabilitation plus resistance-training (SRW) - Standard rehabilitation plus Neuromuscular Electrical Stimulation (NES) De SRW group and the NES group followed extra training or ES with the affected leg, in this way the non-affected leg could be the within-subject control. **Control group** n.a.	Hospital stay Muscle function, Muscle mass, Muscle strength	**Hospital stay** SRW : 10 ± 2,4 days, range 8-14) SR: 16 ± 7,2 days, range 9-35 SRW and SR differed significantly (*p*< 0,05) NES: 12 ± 2,8 days, range 8-16 **Muscle function (after 12 w)** ***all values compared to baseline*** SR No improvement SRW Improved: walking speed 30% (*p*< 0,001) Climbing stairs 28% (*p*<	Randomisations with the aid of a computer program, patients were stratified according to age and gender. Treating caregiver is blinded, blinding of patients and assessors is unknown. Comparable groups at baseline, small study population. → generalisability is questionable ITT analysis (though there were dropouts)

Reference	Level of evidence	Study type	Number of patients In/exclusion	Patient characteristics	Intervention/ Control	Outcome measures	Results	Remarks
			Excluded:: patients with cardiopulmonary, neurological or cognitive problems.	168,0 SD 2,0 BMI (kg/m^2): 27,4 ± SD 1,4 **NES (n=11)** Mean age (years): 69 ± SD 60-75 ♀/♂: 6/5 Mean weight (kg): 79,0 ± SD 4,2 Mean height (cm): 167,7 SD 2,8 BMI (kg/m^2): 27,9 ± SD 0,9			0,005) Sit-to stand test 30% (p< 0,001) NES Improved: walking speed 19% (p< 0,05) Climbing stairs 21% (p< 0,001) Sit-to stand test 21% (p< 0,001) **Muscle mass** SR Decline: 13% after 5 weeks (p<0,05) 9% after 12 weeks (p<0,05) SRW Stable after 5 weeks Improved 12% (p< 0,05) after 12 weeks NES Decline 4% in 5 weeks (p< 0,05) Improvement of 7% in 12 weeks (p< 0,05) **Muscle strength** SR no change SRW Improved 22-28% (p<0,05 compared to baseline) after 12 weeks NES no change	
Trudelle, 2004	B	RCT	**Study group** **N= 14** Control group **N= 14** **Inclusion** 4 to 12 months post operative total	**Study group** mean age (years): 59,4 ± SD 10,8 Mean weight (kg): 83,0 ± SD 17,2 Mean height (cm): 169,1 ± SD 7,6 Control group mean age (years): 59,6 ± SD 12,1 Mean weight (kg):	**Intervention group** strength- and stability exercises **Control group** isometric strength and active mobility training	– 12 Item Hip – Questionnaire – fear of fall – hip flexors, – hip extensors – hip abductors – knee-extensors – stability (stand on 1 leg)	**% change in muscle strength and stability after 8 weeks** **Study group** Stability 36,8* Hip flexors 24,4* Hip extensors 47,8* Hip abductors 41,2* knee-extensor 23,4* **Control group** Stability 0,9	The study design is single blind randomised study. Patients were randomized with a random number table. Patients were blinded, therapist was also blinded. Blinding of the assessor is not described. The number of patients included in the study is small.

Reference	Level of evidence	Study type	Number of patients In/exclusion	Patient characteristics	Intervention/ Control	Outcome measures	Results	Remarks
			hip replacement	80,4 ± SD 18,9 Mean height (cm): 170,5 ± SD 10,2			Hip flexors 7,2 Hip extensors 3,6 Hip abductors 3,3 knee-extensors 1,0 * p≤0,05 (difference between pre- and post exercise)	
Maire, 2006	C	RCT (Pilot study)	**14 patients** **Inclusion** Volunteers 65 years or older with primary hip osteoarthritis as main diagnose.	**Study** N= 14 mean age (years): 75,1 ± SD 4,8 Mean weight (kg): 73,8 ± SD 13,5 Mean height (cm): 158,2 ± SD 7,9 BMI (kg/m^2): 29,3 ± SD 4,7 **Intervention group** N= 7 ♀/♂: 1/6 Control group N= 7 ♀/♂: 1/6	**Intervention group** Besides the normal rehabilitation program, an interval training program of the arms (3 sessions a week) **Control group** Normal rehabilitation program alone.	Primary outcome measures – walking distance in 6 minutes, measured after 2 and after 12 months postoperative – WOMAC total and Physical Function (before surgery and after 2 and 12 months)	walking distance after two months **Intervention group :** mean 396 meters **Control group :** mean 268 meters $p < 0,05$) This difference was declined after one year, but still significant (mean value: 494 vs 406 m, $p < 0,05$). Both groups improved on all WOMAC-aspects after 2 months and after one year in comparison with the preoperative outcomes ($p < 0,05$). However, the intervention group had lower WOMAC-scores than the control group ($p < 0,05$).	Small study population, compromises generalisability. No procedures for randomisation and blinding of outcome assessor are described.
Galea, 2008	B	RCT	23 patients **Inclusion** Uncomplicated unilateral THR; primary diagnosis: hip OA - being able to walk 45m independently -independently Sit-to-stand transfer -able to adequately understand written and oral instructions.	*I= intervention* *C=Control* *Mean ± SD* **Gender (♂/♀)** I:3/8 C:4/8 NA **Age (years)** I: 68,6±9,7 C:66,6±7,9 *p=0,*55 **Weight (kg)** I: 76,3±14,4 C:81,6±20,3 *p=0,*47 **Height (m)** I: 1,6±0,1 C:1,6±0,1 *p=0,*83 **BMI (kg/m2)** I: 28,1±4,5 C: 29,6±5,2 *p=0,*49 **Affected side**	**Intervention group** 'supervised training group (in hospital or rehabilitation centre) (n= 12) Twice weekly; 45 min. Received extra instructions about exercise progression from a physiotherapist in 2 sessions. 7 exercises: (Figure-or-eight path walk, Sit to stand, Active single-leg stance, Climbing steps, Hip abduction, Heel raise, Side stepping.) **Control group** At home training	TUG test Climbing stairs 6MWT physical function Quality of Life	Intervention group practiced 4,7x compared to 5,8 x for the control group. NS after 8 weeks→ physical function, climbing stairs, 6MWT test and quality of life (F = 0,438, p= 0,9) TUG test → sig. difference between both group en after 8 weeks (p= 0,042)	No real control group (Placebo) Randomised, unknown how. No information on blinding of outcome assessor. Small study population

Reference	Level of evidence	Study type	Number of patients In/exclusion	Patient characteristics	Intervention/ Control	Outcome measures	Results	Remarks
				(left/right) I: 5/6 C: 6/6 NA	(n= 11) Written guidance, similar exercises as intervention group.			
Unlu 2007	B	RCT	**26 patients** **<u>Inclusion</u>** 12 -24 months postoperatively **<u>Exclusion:</u>** Neurological, cognitive or metabolic diseases, early postoperative complications, revisions or other joint problems which may cause difficulties in moving the patient.	**<u>Group 1</u>** (n= 9) Mean age (years): 45,44 ± SD 8,7 ♀/♂: 7/2 Mean weight (kg): 77,55 ± SD 4,74 Mean height (cm): 162,11 ± SD 6,75 Mean age implant (months): 17 ± SD 6,16 Implant side (L/R): 5/4 **<u>Group 2</u>** (n= 8) Mean age (years): 57,75 ± SD 7,45 ♀/♂: 6/2 Mean weight (kg): 73,25 ± SD 9,11 Mean height (cm): 158,75 ± SD 7,70 Mean age implant (months): 19 ± SD 8,05 Implant side (L/R): 4/4 **<u>Group 3</u>** (n= 9) Mean age (years): 52,55 ± SD 10,32 ♀/♂: 5/4 Mean weight (kg): 72,44 ± SD 12,61 Mean height (cm): 162,78 ± SD 9,17 Mean age implant (months): 16,55 ± SD 8,51 Implant side (L/R): 4/5 Significant difference forage *p*=0,033	**<u>Group 1</u>** Exercise program at home → mobility and muscle strength exercises Twice daily, 6 weeks consecutively. Experienced physiotherapist explains exercises in practice lesson. 1 weekly contact with physiotherapist. **<u>Group 2</u>** Similar exercise programmes group 1, but executed under the supervision of a physiotherapist in the hospital. **<u>Group 3</u>** Walking	**<u>Primary outcome:</u>** strength Other outcome measures: Walking speed (meters per minute), cadence (number of steps per minute)	*All p-values compared to baseline* after 6 weeks **<u>Group 1</u>** (mean ± SD) **Strength (ft. lb)** Begin: 30 ± 12 End: 38 ± 11 *p-values*: 0,018 **Walking speed (m/min)** Begin: 67,8 ± 23 End: 74,35 ±24 *p-values*: 0,021 **Cadence (steps / minute)** Begin: 97,7 ± 18 End: 111 ± 17 *p-values*: 0,011 **<u>Group 2</u>** (mean ± SD) **Strength (ft. lb)** Begin: 18 ± 10 End: 30 ± 9,8 *p-values*: 0,012 **Walking speed (m/min)** Begin: 48,53 ± 4 End: 56,7 ± 5 *p-values*: 0,012 **Cadence (steps/ minute)** Begin: 90,75 ± 6 End: 104 ± 7 *p-values*: 0,012 **<u>Group 3</u>** (mean ± SD) **strength (ft. lb)** Begin: 18 ± 10 End: 19 ± 8 *p-values*: 0,200 **Walking speed (m/min)** Begin: 58,01 ± 12 End: 59,8 ± 14 *p-values*: 0,110 **Cadence (steps/ minute)** Begin: 87 ± 16 End: 88,22 ± 16	80 patients were recruited of which 22 were excluded. Of the remaining 58 patients, 32 could not be randomised (12 unable to be reached by phone), 20 dropped out because of financial issues. The remaining 26 patients were randomised (32,5 % of total) Low number for generalisability. Other limitations: short rehabilitation period (6 weeks) Strengths of the study: Randomisation Blinding of outcome assessor, patients and therapist. (Closed envelopes with a symbol corresponding with a treatment group, using a list of numbers which were randomly generated. ITT analysis There was a significant difference for mean age between Group 3 and the other groups.

Reference	Level of evidence	Study type	Number of patients In/exclusion	Patient characteristics	Intervention/ Control	Outcome measures	Results	Remarks
							p-values: 0,119 There were not significant differences between group 1 and 2. Walking speed and cadence were significantly different in group 3 compared to group 1 and 2.	
Jan, 2004	B	RCT	53 patients randomised **Intervention group** n=29 lost to follow-up n=3 analyze n=26 **Control group** n=29 lost to follow-up n=2 analyze n=27 **Inclusion** Undergoing a primary total hip replacement 1,5 years or more before start of the study, executed by the same surgeon who used the anterolateral technique, no revision afterwards and able to walk without support.	**Intervention group (low compliance)** (n=13) Mean age (years): 59,3 ± SD 10,3 ♀/♂: 8/5 Mean weight (kg): 142,4 ± SD 22,7 Mean height (cm): 158,5 ± SD 4,6 Months after THR: 72,2 ± 51,6 Affected side (L/R): 7/5 **Intervention group (high compliance)**(n=13) Mean age (years): 58,8 ± SD 12,9 ♀/♂: 9/4 Mean weight (kg): 137,7 ± SD 22,2 Mean height (cm): 159,5 ± SD 7,6 Months after THR: 54,2 ± 46,5 Affected side (L/R): 7/6 **Control group** Mean age (years): 57,0 ± SD 18,8 ♀/♂: 10/17 Mean weight (kg): 141,8 ± SD 21,4 Mean height (cm): 163,0 ± SD 9,7 Months after THR: 76,0 ± 52,0 Affected side (L/R): 14/13	**Intervention group** -At home exercise program; hip flexibility exercises, strength exercises, 30 minutes walking training on average/low speed. **Control group** -No intervention	- Muscle strength (measured with dynamometer) - Walking speed on 3 different terrains (video) - functioning (Harris Hip Score)	The intervention group (high compliance) improved on all outcome measures significantly (p= 0,05) better than the control group and the low compliance group after 12 weeks.	Patients were randomly assigned to the intervention group or control group. Blinding of the outcome assessor is not mentioned. 50% of the intervention group showed low compliance. Difference between the intervention group (high and low compliance) and the control group was significant for height (p= 0,05)

Reference	Level of evidence	Study type	Number of patients In/exclusion	Patient characteristics	Intervention/ Control	Outcome measures	Results	Remarks
				Difference between the groups is significant for height (p= 0,05)				

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29 *How does one prevent haematogenous infection of prostheses?*

Reference	Level of evidence	Study type	Number of patients In/exclusion	Patient characteristics	Intervention/ Control	Outcome measures	Results	Remarks
Ainscow 1984	C	Case series	1000 patients 1966-1980	284 male 716 female 1112 total joint prostheses Mean age was 70 years (range 49-85 years) Primary or secondary osteoarthritis (n=866) Rheumatoid or the like (n=134)	No instructions for antibiotics in tooth surgeries or other surgeries or in case of infections (antibiotics only administered on basis of clinical indication) *Follow-up* mean 6 years (range; 3-15 years)	Deep infections Hematogenic infection	22 joints developed deep infection: 11 within 3 months, 8 after 3 months (non-hematogenic) 3 were caused by hematogenic infection Overall incidence was 0,27% in 6 years. Annual incidence was 0,04% Of the 134 rheumatoid arthritis patients, 2 developed hematogenic infection (1,5%; p < 0,05) 450 patients had no risk 224 patients had tooth surgery or other surgery → none of these patients developed a hematogenic infection 288 patients developed a urine tract, lung- or other infection → some had tooth surgery, none of them developed a hematogenic infection. Of the 40 patients whose skin was ulcerated and infected, 3 pt developed a hematogenic infection. (7,5%; p< 0,01)	

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Krijnen 2001	B	Cost- effectiveness study	4907 patients Joint disease Amsterdam Data from prospective study on bacterial arthritis were combined with data from literature to examine risks and advantages. Effectiveness and cost-effectiveness of antibiotics was assessed in different groups/patients. Groups based on (*a*) type of infection (skin-, lung- or urine tract infection) and invasive medical procedure and (*b*) the patient sensitivity for bacterial arthritis, which was present in the form of rheumatoid arthritis, larger joint prostheses, comorbidity, and older age.	14 of the 37 were hematogenic	Administering antibiotics (n= 37)/ no antibiotics (n=4870)	Cost-effectiveness of antibiotics prophylaxis for hematogenic bacterial arthritis	59% had no characteristics for sensitivity for bacterial arthritis, and 31% had 1. <u>Skin infection</u> Effectiveness of antibiotics was maximal 35 quality Adjusted life days (QALDs) and cost-effectiveness max. $52 000 per quality adjusted life year (QALY). <u>Other infections</u> Effectiveness of antibiotics was lower and de cost-effectiveness was higher. Antibiotics prophylaxis for invasive medical use seems acceptable for patients with high sensitivity: 1 QALD at costs of $1300/QALY The results affected sensitivity when the effect of the prophylaxis or the cost of the prophylaxis changed.	Knee and hip prosthesis patients, no separate data
Kaandorp, 1998	?	Is a thesis						
Uckay2008	**D**	Is no original study or meta-analysis with data collection and analysis, but current concepts review.						
Deacon, 1996	**D**	Is no original study or meta-analysis with data collection and analysis, but current concepts review.						