The hip

- Arthritis of the hip may appear at any time during the course of chronic inflammatory joint disease.
- Using modern methods, favorable results can be expected from cemented hip prostheses.
- Often, rheumatic patients are young at the time of surgery, hence creating a risk that the prosthesis will wear out and loosen.
- Wear-related problems in a prosthesis may be decreased by using articular heads that are smaller and of higher quality.
- Infection-related problems can be controlled by good surgical technique, antibiotic prophylaxis, and treatment of potential foci of infection, such as foot and leg ulcers.
- Protrusion should be managed by bone transplantation to regenerate bone and normalize joint mechanics, with a goal of decreasing problems related to loosening.
- Metal reinforced cups intended for cement-free anchorage may cause greater wear on plastic, and, in the absence of long-term findings, cannot be recommended for general use.
- No evidence supports the use of uncemented femur components.

Arthritis of the hip may manifest itself at any time during the course of chronic inflammatory joint diseases. Apart from pain, synovitis and exudate with elevated pressure in the hip joint eventually lead to flexion contracture, which along with outward rotation and adduction cause functional shortening of the limb, valgus pressure in the knee joint, and malpositioning of the foot. Early in the course, patients may appear normal in radiographic examination, but may experience severe pain from synovitis both at motion and at rest. Radiographic changes are observed in patients having a longer duration of disease, but as long as the head of the femur is reasonably spherical, symptoms in some cases may be negligible.

No direct association has been found between radiographic findings and clinical symptoms. Arthritis of the hip may have a rather explosive course involving bone infarction in the head of the femur. The association between osteonecrosis and steroid medication or trauma has not been fully investigated.

Bone loss in the acetabulum often result in protrusion, where the head of the femur moves deeper into the pelvis, a condition which in itself does not cause symptoms and may therefore progress quite far before loss of mobility eventually brings the patient to examination. Protrusion is observed in up to 40% of patients with RA [21]. Progression is usually slow, but may be explosive in some cases [3]. Shortening of a limb can be accentuated by protrusion. Patients with known protrusion should receive regular radiographic check ups to assure that bone loss does not become so extensive that later prosthetic implantation becomes difficult or even impossible.

Magnitude of the problem

The rate of arthritis in the hip after the onset of chronic inflammatory joint disease is difficult to report, since ultrasound screening shows that asymptomatic synovitis of the hip is as common as hip symptoms with and without synovitis [4]. Problems in the hip joint are said to occur in 20% to 40% of all patients with rheumatoid arthritis [5,12,18]. Radiographic changes are easier to identify, depending on the selection of patients.

In a Swedish study, 5 of 89 patients with early rheumatoid arthritis developed hip problems that were severe enough to require arthroplasty within 4 years after the onset of disease, and one in ten patients had undergone prosthetic hip surgery within 5 years, with a higher risk in patients with highly active disease (Table 1) [4].

Table 1. Occurrence of radiological hip osteoarthritis after onset of rheumatoid arthritis

Author	n	Follow-up	Age	Hip arthritis (%)	Moderate (%)	Severe (%)	Protrusion (%)	Risk factors factors
Hastings & Parker (1975)	694	3	41–77	36			5	Steroids
Lehtimäki et al. (1986)	103	8		20	10	3	1[a]	Elevated SR/CRP
Eberhardt et al. (1995)	113	>5			13[b]			High disease activity

[a] progression 2 mm per year.
[b] requiring prosthesis

Hip arthroplasty is the most common procedure in rheumatic surgery. In Finland, the need in those with rheumatoid arthritis is estimated to be 100 per million inhabitants [15]. In Norway, approximately 1400 hip arthroplasties per million inhabitants were performed annually by the late 1980s, whereof 60 involved rheumatoid arthritis [8]. In Sweden, 1300 hip arthroplasties per million inhabitants are performed annually, whereof approximately 5% involve rheumatic patients [19].

Indications and surgical methods

Nonsurgical treatment such as antiinflammatory treatment, use of a cane, and physical therapy can postpone and, in some cases, eliminate the need for surgery.

Indications for surgery include severe pain in moving and resting, but poor mobility and/or advanced protrusion represent indications for surgery in only exceptional cases.

The hip joint represents the greatest body of experience with endoprosthetic surgery, and the outcome of this surgery is so reliable that other surgical alternatives have been pushed into the background. Osteotomy, resection arthroplasty, and arthrodesis no longer have a place in the arsenal of surgical treatment. Radical synovectomy is technically difficult to perform and associated with a risk for complications.

In the absence of long-term followup studies of uncemented prostheses, prosthetic anchorage using bone cement is considered to be the "gold standard". Osteopenia and subchondral cyst formation reduce the chances for successful prosthetic anchorage, especially on the acetabular side. Since the long-term loosening rate of cemented cups is not insignificant, a recent trend has developed toward using uncemented cups [26].

Surgery in patients having a pronounced protrusion involves transplantation of their own bone, and/or donor bone, in the bottom of the acetabulum. The bone heals predictably and safely [10, 14].

Mechanic (aseptic) loosening of a prosthetic device is the most common reason for revision. The problem is often solved through conventional surgical methods, ie, replacement and recementing of loose prosthetic components. However, some cases may require both bone transplantation (using donor bone and bone from the patient's iliac crest) and specific implants aimed at strengthening the hip bone weakened by disease and prosthetic loosening. New methods (bone packing) are being developed to improve prosthetic anchorage associated with revision [6].

Prosthetic infection is rare (<1%) but, when it occurs, it can usually be treated by exchanging the prosthesis in one or two stages, using local and systemic antibiotic treatment in the interim.

Problems that remain to be solved involve anchoring the cup and minimizing the wear on plastic (plastic wear can generate plastic particles which, via osteolysis, may cause the prosthesis to loosen).

Rehabilitation

Mobilization following total hip replacement is usually uncomplicated for patients and medical staff alike. Mobilization may, however, be more difficult in patients with poorly functioning upper extremities who subsequently have difficulty using assistive walking devices. Patients with active arthritis in multiple joints may find it difficult to avoid placing weight on bones after extensive reconstruction surgery that involves bone transplantation.

Table 2. Clinical results of hip arthroplasty

Author	n	Follow-up	Age	Prosthesis	Method	Before arthroplasty	After arthroplasty	Good (%)	Satisfied (%)
Ranawat et al. 1980	35	4		Unspec.	MAP[a] Total MAP ΣROM[b]	2	8 +100°	66	
Poss et al. 1984	138	7		Unspec.					96
Ranawat & Zahn 1986	27	4		Unspec.				96	
Johnson et al. 1987	27	7		Hip + knee not walking	Walks at 1 years Walks at 3–13 yrs	0	33/52%[c] 33/52%[c]		
Unger et al. 1987	83	12	40	Unspec.	MAP[a]			82	81
Torisu et al. 1989	24	3	53	Bipolar	Japan OA[d]	43 (22–59)	73 (65–92)	88	
Kilgus et al. 1990	53	6	43	Various cemented	UCLA[e]pain UCLA walking UCLA function Σ ROM[b]	4.5 4.5 4.0 67°	8.5 5.9 5.9 176°		
Vázquez et al. 1990	114	8	62	Bipolar	MAP[a]			85	
Kinzinger et al. 1991	27	5	47	Unspec., cemented	MAP[a]pain MAP walking MAP ROM		5,7 4,1 5,4		
Severt et al. 1991	75	7	50	Various, cemented	UCLA[e]pain UCLA walking UCLA function UCLA activity	3,4 4,0 3,6 2,7	9,0 7,0 5,9 3,9		
Cage et al. 1992	29	11	18	Charnley, cemented	Harris score[f] Wheelchair ROM flexion	17 94% 52 (10–90)	68 (26–97) 13% 86 (20–130)		
Cracchiolo et al. 1992	45	4	41	Various, uncemented	UCLA[e] pain UCLA walking UCLA function UCLA activity	3.1 4.0 3.5 3.0	9.0 7.3 6.0 4.9		
Kirk et al. 1993	17 25	5 3		Cemented uncemented	Harris score[f] Harris score		84 86		
Lachiewics 1994	35	5	41	Harris-Galante uncemented	Harris score[f] HSS score[g]	34 16	91 34	86	

[a] MAP: Score according to Merle d'Aubigné & Postel
[b] ROM: Range of motion, sum of mobility in three planes
[c] with/without crutches
[d] Pain, mobility, gait, function
[e] Pain, function, and gait satisfactory
[f] Harris hip score: excellent, good
[g] HSS score Hospital for Special Surgery hip score. excellent, good

Results of surgical treatment

Hip arthroplasty is among the most successful procedures in orthopedics, having beneficial effects on pain, mobility, and function, even in long-term followup. These results are based mainly on experiences from procedures performed in patients with arthrosis. Several studies have confirmed that hip arthroplasty also has beneficial effects on symptoms resulting from rheumatic hip degeneration (Table 2). The effect on pain is almost better than in surgery for arthrosis, while recovery of extremity functions is inhibited by progression of the disease in multiple joints. In long-

Table 3. Occurrence of deep infection after hip arthroplasty

Author	n	Followup (year)	Age	Prosthesis	Infection (%)
Poss et al. 1984	138	7		Various	2.6
Unger et al. 1987	83	12	40	Various	4
Torisu et al. 1989	24	3	53	Bipolar	0
Kilgus et al. 1990[a]	53	6	43	Various cemented	5
Vázquez et al. 1990	114	8	62	Bateman bipolar	0
Kinzinger et al. 1991	27	5	47	Unspec cemented	0
Severt et al. 1991	75	7	50	Various cemented	5
Cracchiolo et al. 1992	45	4	41	Various uncemented	0
Wilson& Scott 1993	16	4	46	Bipolar	0
Lachiewics 1994	35	5	41	Harris-Galante	0
Partio et al. 1994	84	8–12		Lubinus	0

[a] Bechterew patients only.

term followup, the outcome is poorer due to the influence from other joints affected by the disease. Scoring systems to evaluate outcomes usually include a function or activity section which assesses the overall function of the lower extremities, and is hence a rough instrument for evaluating the hip. Scoring systems are based on ordinal scales, where a 1-point improvement can have different meanings, depending on which two steps on the scale the estimate falls between. Hence, these points cannot be used to calculate differences before and after surgery or to calculate mean scores. Rephrasing the scores in terms like "excellent" or "good" does not make the procedure more correct. Only mobility and strength can be measured, and pain can, with difficulty, be estimated.

In a study of older Americans, hip arthroplasty in rheumatoid arthritis was found to have a perioperative mortality, ie, within 30 days, of 0.65% (compared to arthrosis 0.73%). Furthermore, mortality during the 3 years following the procedure in the patient group older than 65 years does not differ from that in patients with arthrosis who underwent the same procedure [32]. Survival, when matched for age and gender, was even better than that in the nonoperated population.

Complications from hip arthroplasty can be divided into early, general, local, and late complications. An early complication involves problems in wound healing, which appears to be more common in rheumatoid arthritis than in, eg, arthrosis. Severt et al reported wound healing problems in 19% of 75 cemented hip prostheses [26]. Luxation of the prosthetic joint usually occurs early, before the articular capsule has healed, or later when the plastic cup has worn and lost its hemispheric shape. In studies that have addressed luxation, the reported rates were 2% to 3% [17,21,30].

Deep infection is a serious complication of hip arthroplasty (Table 3) and may strike early after, eg, peroperative contamination of the joint, or later in secondary surgery, or by spreading through the circulatory system. Poss et al estimated the infection risk from total hip arthroplasty in rheumatic patients to be 1.8 times greater than that in arthrosis surgery [21].

The most common serious complications of hip arthroplasty are loosening of the components from the bone bed and wear on the plastic cup. Two mechanisms are given as reasons for loosening. Radiostereometric analysis (RSA) has been used to show, with high precision, that some implanted components are not completely fixated, and microscopic movement, micromotion, can be observed between the implant and the implant-cement or bone-cement interfaces. This motion may cause resorption of the adjacent bone, and radiography reveals a visible zone which widens until a shift in the position of the prosthesis can be detected even by ordinary radiology methods, indicating a loosening of the prosthesis. Prosthetic loosening is painful and reoperation may be required to exchange loose components. Other mechanisms are also given as causes of zone changes, eg, injury to the bone close to the prosthesis in surgical preparation, toxic effects of monomers leaking from bone cement, and heat damage from the exothermic cement hardening

Table 4. Occurrence of prosthetic loosening and revision after hip arthroplasty

Author	n	Follow-up (years)	Age	Prosthesis	Femur component		Cup	
					Loose (%)	Revised (%)	Loose (%)	Revised (%)
Ranawat et al. 1980	35	4		Unspecified	8		3	
Poss et al. 1984	138	7		Various	31[a]	2	14[a]	0
Ranawat & Zahn 1986	27	4		Various, protrusion			0	
Unger et al. 1987	83	12	40	Various	2	6	13	7
White 1988	15	≈7	≈38	Various			15[b]	
Torisu et al. 1989[c]	24	3	53	Bipolar	25[d]		18[a]	
Kilgus et al. 1990	53	6	43	Various,cemented	5			
Sarmiento et al. 1990	34	8	<50	Charnley+STH	3[e]	?	0 (21/21)[f]	
	74	6	>50	Charnley+STH	5[e]	?	4 (2/16)[f]	
Vázquez et al. 1990	114	8	62	Bipolar	4		4 (+2 with plastic defect)[a]	
Kinzinger et al. 1991[c]	27	5	47	Various,cemented	0		11	
Severt et al. 1991	75	7	50	Various,cemented	4	1	9 (70[e])	5
Cage et al. 1992	29	11	18	Charnley, cemented	27	0	23	0
Cracchiolo et al. 1992	45	4	41	Various, uncemented[g]	4	0	2	0
Wilson&Scott 1993[c]	16	4	46	Bipolar	6	0	30[a]	
Lachiewics 1994	35	5	41	Harris-Galante	10[h]	0	0[h]	0
Raut et al. 1994	47	7	55	Charnley revision	13[i]	0[i]	36[i]	4[i]

[a] Migration, ie, change of position
[b] 40 % of the cup and femoral shaft loose based on radiology findings
[c] With bone transplantation for protrusio acetabuli
[d] All migrating in the uncemented group, ie, 6/7
[e] Full zone around the component
[f] (Number with wear/Number with full zone)
[g] 8% perioperative femur fractures, healed
[h] Another 10% in femur and 3% in acetabulum showed osteolysis, ie, cystic destruction of bone
[i] Indicates revision results

process. Since the process leading up to loosening takes several years, studies of total hip arthroplasty have attempted to identify indicators to predict loosening, to be able to earlier evaluate a method or design modification. Hence, hip arthroplasty studies can be based on RSA findings, ie, microscopic motion, size, and extension of zones, positional change of the prosthesis, so called migration, loosening, which is considered to be present if zones or migration of a certain magnitude (varies with different studies) exists, and the rate of reoperation for loosening.

Ranawat et al noted that if the prosthetic center of movement was more than 10 mm from the healthy joint's normal center, as a result of protrusion, this led to a full zone around the cup at followup in 94%, while cases with less than 5 mm deviation did not have a full zone [22]. This has led to placing bone from the removed femoral head and/or donor bone in the bottom of the acetabulum and then attaching a cup by the usual technique to this bone transplant. The finding was confirmed by Poss et al, who found cup migration only in cases with protrusio [21]. Transplanted bone seems to heal in, and strengthen, the floor of the acetabulum within 1 year [14,23]. Concern that the implanted bone would later become packed, and hence lead to cup loosening, has led to attempts involving a so called bipolar prosthesis in protrusion. This has a large metal articular head, in the center of which there is a plastic cup articulating toward a conventional femur prosthesis. Some change in position can be accepted using this approach, since the head is not attached. Table 4, only shows the occurrence of migration, which is a sign that the bone is being reshaped.

Comparisons among different series are difficult due to variations in patient dropout rates, patient age and gender distributions, and evaluation methods. The so called survival method has been used in an attempt to draw more standardized comparisons despite patient dropout. The risk for

Table 5. Occurrence of prosthetic loosening or revision based on survival statistics (according to Kaplan-Meier)

Author	n	Age	Prosthesis	Event	Risk (%) / time (years)				
					5	7	10	12	20
Severt et al. 1991	75	50	Div cem.	Lossen. radiographic		7		23	
Joshi et al. 1993[a]	74	<40	Charnley	Revision					4
				Cup revision					1
				Femur revision					4
Partio et al. 1994[b]	84		Lubinus	Revision	3		9		
Önsten et al. 1994[c]	201	64	Charnley	Revision			7		
				Cup loosen. radiographic			21		
			Surgery <1981	Cup loosen. radiographic		13			
				Fem. loosen. radiographic		20			
			Surgery >1981	Cup loosen. radiographic		4			
				Fem. loosen. radiographic		4			
Malchau et al. 1993[d]	1905	74–65	Women	Revision		3	6		
	1434	64–55	Women	Revision		5	11		
	1118	<55	Women	Revision		7	18		
	558	74–65	Men	Revision		7			
	503	64–55	Men	Revision		10			
	669	<55	Men	Revision		8	10		

[a] Risk factor: men (weight and age no significance), (compare to revision OA in the same study: 49% / 20 years)
[b] Risk factor: age only
[c] Risk factor: younger men and older cementing methods (before 1981)
[d] Various prostheses analyzed using modified Kaplan-Meier

a distinct event is then calculated by comparing it to the number of remaining patients in the study at the actual time of the event. Accumulated risk can then be estimated and presented on a survival curve (according to Kaplan-Meier). A suitable event would be revision of a prosthesis, but radiological loosening has also been analyzed. The curve can then be presented as risk for revision over time (Table 5). In statistical comparisons among risks, adjustments can be made for differences in age or gender distribution.

Radiological loosening is difficult to evaluate in cement-free prostheses, since these may shift, ie, migrate somewhat, before they heal into place. Lachiewics does not report failure in any cases, nor any cases needing revision, in his series despite a migration up to 10 mm in some femoral components [17].

Wear on the plastic component eventually leads to its becoming dysfunctional by a breakdown in the plastic or changes in its geometry sufficient enough to cause the joint to become unstable and dislocate. The microscopic plastic particles which break away because of wear are thought to contribute further toward loosening of the prosthesis as they penetrate into the thin zone between the prosthesis or cement and the bone bed. Here they promote an inflammatory process, causing more rapid bone resorption or cyst-like defects in the bone bed, accelerating the loosening process. In a 10 to 20 year followup of Charnley cups, Kobayashi et al found that patients with a complete zone around the cup were younger and showed three times greater wear of the cup [16]. They found increased wear in younger men in whom there was a thin layer of cement. Increased wear of the cup in younger persons was also reported by Sarmiento et al [25].

In conclusion, good results can be expected when using modern methods of cemented hip arthroplasty. However, the problems associated with wear and prosthetic loosening remain. Potentially, the wear problem can be reduced by using articular heads that are smaller and of higher quality. Protrusion should be managed by bone transplantation to recreate bone and normalize joint mechanics to reduce problems related to loosening. Metal reinforced cups intended for cement-free anchorage may increase plastic wear, and the absence of long-term results means they cannot yet be recommended for general use. No evidence supports the use of uncemented femoral compo-

Table 6. Occurrence of micromotion (migration) according to RSA

Author	n	Follow-up	Age	Prosthesis	Group	Migration	
Snorrason et al (1993)[a]	15	2	55	Lubinus cup		0.5 mm	73% migrrates
Önsten et al (1993)[b]	23	2	65	Charnley cup	All		96% migrrates
						Proximal 0.6 mm	Medial 0.2 mm
					Protrusio (n 5)	Proximal 1.4 mm	Medial 0.4 mm
					No protr. (n 18)	Proximal 0.4 mm	Medial 0.2 mm
Önsten et al (1995)[c]	32	2	66	Charnley cup		Proximal 0.5 mm	Medial 0,.2 mm
Önsten et al (1995)[d]	25	2	66	Charnley femur		0.94 mm	

[a] Flat cup, poor bone quality, and small cement surface are risk factors for migration.
[b] Protrusio and low weight are risk factors for migration. Bone transplantation was used in protrusion.
[c] Ogee cup. No correlation between bone quality and migration.
[d] Men migrate more. No correlation between bone quality, weight, or age, and migration.

nents. The problem of infection can be controlled only via good surgical techniques, antibiotic prophylaxis, and treatment of potential foci of infection, eg, foot and leg ulcers.

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