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Developmental Dysplasia of the Hip — Good Results of Later Total Hip Arthroplasty

7135 Primary Total Hip Arthroplasties after Developmental Dysplasia of the Hip Compared With 59 774 Total Hip Arthroplasties in Idiopathic Coxarthrosis Followed for 0 to 15 Years in the Norwegian Arthroplasty Register

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Abstract: The purpose of the present article was to compare the results of primary total hip arthroplasty (THA) done because of developmental dysplasia of the hip (DDH) with the results of THA done because of idiopathic coxarthrosis (osteoarthritis) using data from the nationwide Norwegian Arthroplasty Register (NAR). In the period from 1987 to 2003, 84 871 primary THAs were reported to the NAR. Of these, 6347 (7.5%) were performed because of sequelae after DDH, 788 (0.9%) because of sequelae after DDH with complete dislocation of the femoral head, and 59 774 (71.0%) because of idiopathic coxarthrosis. The results of THAs after DDH were the same as those of THAs after idiopathic coxarthrosis after adjustments for younger age and for the use of more uncemented prostheses in patients with DDH.
Key words: dysplasia, DDH, THA, arthroplasty, hip, register.

Developmental dysplasia of the hip (DDH) is the most common underlying condition leading to secondary coxarthrosis [1-4]. In the past, the results of total hip arthroplasties (THAs) in patients with hip dysplasia were often reported to be poor [5-7]. This has partly been explained by technical difficulties in performing joint arthroplasties in patients with DDH due to morphological deformities in the proximal end of the femur and in the acetabulum [8,9], but THAs in DDH are also often combined with negative prognostic factors such as young age and inferior uncemented prostheses [10].

The Norwegian Arthroplasty Register (NAR) is a nationwide registry for all total hips performed in the country, with a capture rate of more than 97% [11,12]. The purpose of the present study from NAR was to compare the results of THAs performed because of DDH with the results of THAs performed because of idiopathic coxarthrosis (osteoarthritis [OA]), having made adjustments for confounding variables such as age, gender, and prostheses.

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Patients and Methods

The NAR was established in September 1987 and is a prospective ongoing observational study. Each THA performed in Norway is reported individually to the register by the surgeon by filling in a standard form [13]. Information on the form includes the identity of the patient, the date of operation, indication for surgery, type of prosthesis, type of cement, duration of operation, type of operating room ("greenhouse," laminar air ventilation, ordinary ventilation), and type of systemic antibiotic prophylaxis. From the start of the register in September 1987 to the end of December 2003, 84 172 primary THAs were reported. In the present article, primary THAs performed because of sequelae after DDH, sequelae after DDH with complete dislocation of the femoral head, and idiopathic coxarthrosis (primary OA of the hip) were included. Failure (revision) of the implant was defined as surgical removal or exchange of the whole or part of the implant. Using the unique identification number assigned to each inhabitant of Norway, the information on the primary THA was linked to an eventual later revision.

Separate analyses were performed on cemented THAs (both cup and stem cemented) and on uncemented THAs (both cup and stem uncemented). Furthermore, discrete studies were done on the most common cemented prostheses (Charnley stem stainless steel/Charnley polyethylene cup, DePuy, Leeds, UK) and on the 2 most common uncemented prostheses (Corail hydroxyapatite coated titan stem in combination with Atoll or with Tropic polyethylene cup with hydroxyapatite coated metallic backing, DePuy).

In separate analyses, only THAs where systemic antibiotic (penicillin [cloxacillin or dicloxacillin] or cephalosporin [cephalotin or cefuroxime]) had been given or where high-viscosity cement of the brands Palacos with gentamicin (Shering-Plough International Inc, Kenilworth, NJ) or Simplex with colistin/erythromycin (Howmedica International, London, UK) were used were selected. These selections were made because we previously have shown that these combinations have given the best results in cemented THAs [14].

Statistical Analyses

Survival analyses were performed with the Kaplan-Meier method and Cox regression. Patients who died or emigrated during follow-up were identified from files provided by Statistics Norway (Oslo, Norway), and the follow-up times for prostheses in these patients were censored at the date of death or emigration. A Cox multiple regression model was used to study relative risks (RRs) of revision (failure rate ratios) for the THAs from the 3 different hip diseases, with adjustments for the possible influences of sex, age (<51, 51-60, 61-70, 71-80, >80 years), type of systemic antibiotic prophylaxis (penicillin [cloxacillin or dicloxacillin] or cephalosporin [cephalotin or cefuroxime]) and duration of systemic prophylaxis, operating theater, and the duration of the operation (<51, 51-70, 71-90, 91-110, 111-130, 131-150, >150 minutes). Estimates from Cox analyses with the 3 diagnosis groups as strata factors were used to construct adjusted survival curves. For revisions, the surgeon had recorded 1 or more reasons for failure, but in combination with infection, infection was considered as the primary cause of revision. Aseptic loosening was otherwise counted as the principal cause of revision when given in combination with other causes.

The statistical package SPSS 14.0 (SPSS, Chicago, Ill) was used for the analyses.

Results

A total of 84 871 primary THAs were reported to the NAR for the period from 1987 to 2003. Of these, 6347 (7.5%) were performed because of sequelae after DDH, 788 (0.9%) because of DDH with dislocation, and 59 774 (71.0%) because of primary OA (Table 1).

Compared with OA without adjustments, the overall risk of revision for THAs after DDH was 1.5 times higher (95% CI, 1.4-1.6; $P < .001$), and that for THAs after DDH with dislocation was 2.0 times higher (95% CI, 1.7-2.3; $P = .001$) (Fig. 1).

The THAs in the 3 groups of hip diseases were, however, not comparable, because the patients with DDH were younger, and the duration of the operation was longer than for the patients with primary OA

Table 1. Data on All Patients With THAs Due to DDH, DDH with Dislocation, or Primary OA

Hip Disease	No. THAs	Both Components Cemented	Both Components Uncemented	Mean Age (y)	Females (%)	Mean Operative Time, min (SD)
DDH	6347	51%	38%	59.0	75.9	100.6 (35)
DDH with dislocation	788	33%	57%	52.9	84.8	145.7 (57)
Primary coxarthrosis	59 774	85%	9%	71.0	69.1	96.3 (28)
Total	66 909	80%	12%	69.4	70.0	97.3 (30)

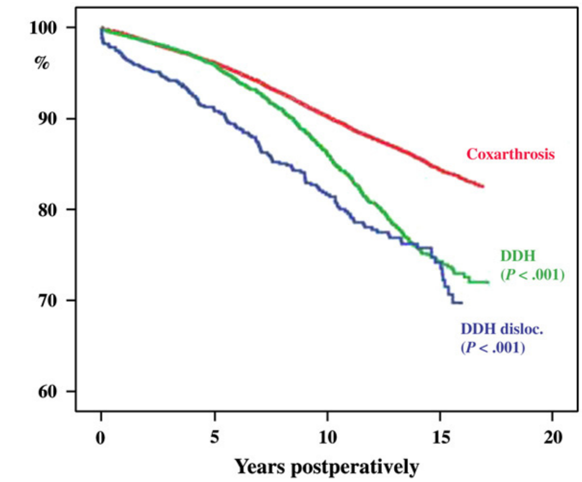

Fig. 1. Survival curves without any adjustments in the Cox model with all reasons for revisions as end points in the analyses for DDH, DDH with dislocation, and idiopathic coxarthrosis.

(Table 1). In addition, the types of prostheses implanted in the 3 groups of diagnoses were different. Cemented prostheses, both in the femur and the acetabulum, were used in 85% of patients with primary coxarthrosis, in 51% of those with DDH, and in 33% of those with DDH with dislocation. Uncemented THAs, both in the femur and the acetabulum, were preferred in only 9% for those with coxarthrosis but in 38% for those with DDH and in 57% for those with DDH with dislocation.

In 2941 hips, hybrid prostheses were used (4.4% of the operations), some of these with cemented stem (3.4% of all operations, n = 2 275) and others with cemented cup (1.0% of all operations, n = 666).

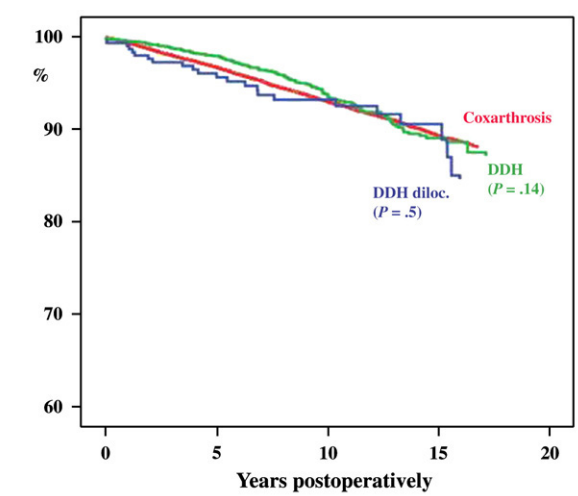

Fig. 2. Survival curves for cemented THAs with adjustments in the Cox model for age, sex, type of systemic antibiotic, operating theater, and duration of the operation, with all reasons for revisions as end points in the analyses for DDH, DDH with dislocation, and idiopathic coxarthrosis.

Table 2. Results for Primary Charnley Prostheses with Antibiotic in the Cement Performed Because of DDH, DDH With Dislocation, or Primary Coxarthrosis

End Point in Analyses	THAs	Revisions	14-y Revision	RR*	95% CI	P
All reasons for revision	15 545	521				
DDH	841	41	14.9%	1.1	0.8-1.5	.7
DDH with dislocation	86	7	10.9%	1.6	0.7-3.7	.2
Idiopathic coxarthrosis	14 618	473	9.4%	1	–	–
Aseptic loosening	15 545	327				
DDH	841	33	12.9%	1.2	0.8-1.8	.3
DDH with dislocation	86	4	6.1%	1.2	0.4-3.3	.8
Idiopathic coxarthrosis	14 618	290	7.0%	1	–	–
Infection	15 545	74				
DDH	841	0	0.5%	–	–	–
DDH with dislocation	86	2	2.7%	4.3	0.8-22.7	.09
Idiopathic coxarthrosis	14 618	72	0.9%	1	–	–
Dislocation	15 545	89				
DDH	841	5	0.6%	1.1	0.4-2.8	.9
DDH with dislocation	86	1	2.5%	3.2	0.4-25.1	.3
Idiopathic coxarthrosis	14 618	83	1.0%	1	–	–

Number of THAs, number of THA revisions, Kaplan-Meier 14-year revision percentages, Cox RR of revision (with THAs due to coxarthrosis as reference value), 95% CI for RR, and *P* value estimated with all reasons for revision, aseptic loosening, infection, and dislocation of the prosthesis as end points in the analyses.
*Adjusted in the Cox model for sex, age, systemic antibiotic prophylaxis, type of operating theater, and operation duration.

Because of low numbers of hybrid implants in each of the 3 diagnostic groups and because the hybrid implants with cemented cup were mainly used the last few years, no further analyses could be performed.

Cemented THAs

Separate analyses were therefore performed on THAs where both components were cemented (n = 54 249) and with full adjustments in a Cox model for age, sex, type of systemic antibiotic, duration of the operation, and type of operating theater. With adjustments, no differences in risk for revision, with all reasons for revisions as end points in the analyses, could be detected between OA (n = 50 721) and DDH without dislocation (n = 3260; RR = 0.9; 95% CI, 0.8-1.0; *P* = .14) or between OA and DDH with dislocation (n = 263; RR = 1.2; 95% CI, 0.8-1.8; *P* = .5) (Fig. 2).

To obtain an even more homogenous group of cemented THAs, we selected only patients with the

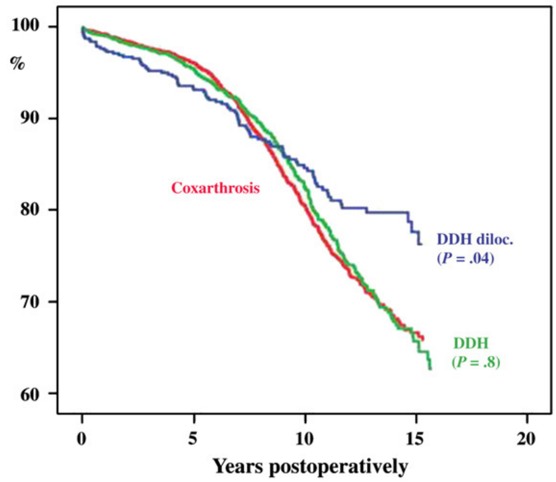

Fig. 3. Survival curves for uncemented THAs with adjustments in the Cox model for age, sex, type of systemic antibiotic, operating theater, and duration of the operation, with all reasons for revisions as end points in the analyses for DDH, DDH with dislocation, and idiopathic coxarthrosis.

most common cemented prosthesis in Norway, the Charnley prostheses used in combination with high-viscosity cement and with antibiotic prophylaxis both systemically and in the cement (n = 15 545). Again, no increased risk for revisions could be detected for DDH without (n = 841) or DDH with (n = 86) dislocation compared with OA (n = 14 618), irrespective of whether the end point in analyses was all revisions, aseptic loosening, infection, or dislocation (Table 2).

In this Charnley subgroup of implants, we also performed separate analyses for revision because of aseptic loosening for the acetabular and for the femoral component of the prosthesis. For DDH, 18 implants had to be revised because of aseptic loosening of the acetabular component; for DDH with dislocation, 2; and for idiopathic coxarthrosis, 110, with no differences among the groups (P = .20). For the femoral component, the corresponding numbers were higher, with 22 implants for DDH, 4 implants for DDH with dislocation, and 253 implants for coxarthrosis (P = .70).

Uncemented THAs

The uncemented prostheses (n = 8099) were then selected, and the risks for revision for the 3 groups of hip diseases were analyzed. With all reasons for revisions as end points and with full adjustments, no increased risk for revisions between DDH without dislocation (n = 2425) and OA (n = 5229) were found (RR = 1.0; 95% CI, 0.8-1.1; P = .8). Developmental dysplasia of the hip with dislocation (n = 445) had, in fact, less risk for revision than OA (RR = 0.8; 95% CI, 0.6-1.0; P = .04) (Fig. 3).

Then, the 2 most common uncemented prostheses in Norway, Corail stems with either Atoll or with Tropic cups (n = 2 702), were selected. Again, no differences among the 3 diagnosis groups could be detected with all revisions, with aseptic loosening, with infection, or with dislocation as an end point in the analyses (Table 3).

Also in this subgroup of Corail stem and Atoll/Tropic cup, separate analyses were performed to disclose which component failed in aseptic loosening. For prostheses in DDH, aseptic loosening of the acetabular component was found for 70 implants; for DDH with dislocation, 22 implants; and for coxarthrosis, 100 implants, with no differences among the 3 groups (P = .83). Very few femoral components had to be revised, however, because of aseptic loosening: 5 implants in DDH, 4 implants in

Table 3. Results for Primary Uncemented Corail Stem with Atoll or Tropic Cup Performed Because of DDH, DDH With Dislocation, or Primary Coxarthrosis

End Point in Analyses	THAs	Revisions	14-y Revision	RR*	95% CI	*P*
All reasons for revision	2702	384				
DDH	807	129	40.2%	0.9	0.7-1.2	.6
DDH with dislocation	203	42	26.2%	0.8	0.5-1.2	.3
Primary coxarthrosis	1692	213	33.0%	1	–	–
Aseptic loosening	2702	202				
DDH	807	73	23.9%	1.1	0.8-1.5	.5
DDH with dislocation	203	25	16.5%	1.0	0.6-1.8	.9
Primary coxarthrosis	1692	104	18.5%	1	–	–
Infection	2702	13				
DDH	807	4	0.5%	1.1	0.3-3.9	.9
DDH with dislocation	203	1	0.6%	0.4	0.0-5.9	.5
Primary coxarthrosis	1692	8	0.9%	1	–	–
Dislocation	2 702	34				
DDH	807	9	1.9%	0.7	0.3-1.7	.4
DDH with dislocation	203	4	2.1%	0.9	0.2-3.8	.9
Primary coxarthrosis	1692	21	1.5%	1	1	–

Number of THAs, number of THA revisions, Kaplan-Meier 14-year revision percentages, Cox RR of revision (with THAs due to coxarthrosis as reference value), 95% CI for RR, and P value estimated with all reasons for revision, aseptic loosening, infection, and dislocation of the prosthesis as end points in the analyses.

*Adjusted in the Cox model for sex, age, systemic antibiotic prophylaxis, type of prosthesis, type of operating theater, and operation duration.

DDH with dislocation, and 10 implants in coxarthrosis (P = .66).

Cemented vs Uncemented THAs

The cemented THAs as one group (including the 3 groups of hip diseases, n = 54 244) were then compared with the uncemented THAs as one group (including the 3 groups of hip diseases, n = 8099). With all reasons for revisions as end points in the analyses, the risk for revision for the uncemented THAs was 1.3 times higher (95% CI, 1.3-1.4) than for the cemented implants after adjustments in the Cox model for sex, age, systemic antibiotic prophylaxis, type of operating theater, and operating time (P < .001).

Discussion

The present study shows that the results of primary THAs in DDH with or without dislocation are the same as those of THAs in idiopathic coxarthrosis, provided that adjustments are made for differences in age and for type of prostheses.

The diagnoses of DDH, DDH with dislocation, and coxarthrosis in the present article are based on the decision of the operating surgeon, who filled in the form to the register immediately after the surgery. The Danish Hip Arthroplasty Registry has a similar registration system with a nearly identical registration form and completeness of registration to the Norwegian register. In the Danish register, the diagnoses made by the surgeons in patients undergoing primary THA were evaluated with x-ray examinations by independent observers, and the diagnoses were confirmed in 84% of the patients [15].

Performing THA in DDH can be technically challenging because of dysplastic femora and high location of the head. These deformities may necessitate special surgical procedures such as shortening of the femur and acetabular reconstruction [8,16]. Furthermore, the pathology in the anatomy may also stress the design of the prosthesis. Accordingly, inferior results of THAs after DDH could be expected, but as shown by others [17] and in the present study, given that the correct prostheses are used, the results of implanting hip prostheses after hip dysplasia are good and comparable with that of coxarthrosis.

When comparing the results of THAs in patients with different hip diseases, attention has to be paid to other factors that are associated with increased risk for revisions. In Norway, 85% of all primary THAs are cemented, but there is a tendency toward more use of uncemented prostheses in younger patients. The most common uncemented prostheses in Norway have been Corail stems with either Atoll or Tropic hydroxyapatite titanium metal-backed cups with UHMWPE liner (DePuy, Chaumaont, France) [18]. These cups have worse results than cemented Charnley all-polyethylene cups [18] and about the same as the other uncemented cups in Norway [19]. The results for the Charnley THAs are about the average for the cemented prostheses in the NAR [18,19]. Patients with pediatric hip diseases were younger, and they have often received first-generation or second-generation uncemented prostheses that have been shown to give inferior results [10]. In accordance with this, an apparently better survival of THAs in the patients with OA was found in the present study compared with the patients with DDH, but after adjustments for age and after stratification in cemented or in uncemented implants, the differences among the hip diagnoses disappeared.

In a previous article [10], we have shown that results of THAs with Charnley prostheses with antibiotic-containing high viscosity cement and with systemic antibiotic prophylaxis are good for patients with OA. When the analyses in the present article were restricted to such THAs, no statistical differences could be detected among the 3 groups of diagnoses. Our present results confirm previous findings that age and implants seem to be more important than the diagnosis leading to the diseased hip [10,13].

The results of THAs among the 3 different hip diseases were equal when the analyses were performed separately for cemented and uncemented implants. The risk of revision of the uncemented prostheses as a group was, however, 1.3 times higher than for the group of cemented prostheses even after full adjustments. The main reason for revisions of the uncemented THAs was an increased revision risk among uncemented metal-backed cups with UHMWPE liners [18].

In conclusion, the present study shows that the results for primary cemented and primary cementless THAs after DDH, with or without dislocation, are just as good as after idiopathic coxarthrosis. Adjustments for differences in age and prosthesis choice must be made when the results of hip arthroplasty are studied in different diagnostic groups. The implant seems to be more important for the result of the arthroplasty than the disease causing the hip damage.

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