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ORIGINAL ARTICLE

Is it feasible to merge data from national shoulder registries? A new collaboration within the Nordic Arthroplasty Register Association

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Background: The Nordic Arthroplasty Register Association was initiated in 2007, and several papers about hip and knee arthroplasty have been published. Inspired by this, we aimed to examine the feasibility of merging data from the Nordic national shoulder arthroplasty registries by defining a common minimal data set.

Methods: A group of surgeons met in 2014 to discuss the feasibility of merging data from the national shoulder registries in Denmark, Norway, and Sweden. Differences in organization, definitions, variables, and outcome measures were discussed. A common minimal data set was defined as a set of variables containing only data that all registries could deliver and where consensus according to definition of the variables could be made.

Results: We agreed on a data set containing patient-related data (age, gender, and diagnosis), operative data (date, arthroplasty type and brand), and data in case of revision (date, reason for revision, and new arthroplasty brand). From 2004 to 2013, there were 19,857 primary arthroplasties reported. The most common indications were osteoarthritis (35%) and acute fracture (34%). The number of arthroplasties and especially the number of arthroplasties for osteoarthritis have increased in the study period. The most common arthroplasty type was total shoulder arthroplasty (34%) for osteoarthritis and stemmed hemiarthroplasty (90%) for acute fractures.

Conclusion: We were able to merge data from the Nordic national registries into 1 common data set; however, the set of details was reduced. We found considerable differences between the 3 countries regarding incidence of shoulder arthroplasty, age, diagnoses, and choice of arthroplasty type and brand.

Level of evidence: Epidemiology Study; Large Database Analysis

Keywords: Registry; shoulder; arthroplasty; collaboration; epidemiology; incidence

Ethical Committee approval: not required.

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New arthroplasty types can be released onto the market without any evidence of clinical efficacy and safety. The main advantage of arthroplasty registries is postmarketing surveillance as demonstrated by national hip and knee arthroplasty registries in Norway and Sweden.[3,6,7,15] From an international perspective, however, the number of inhabitants in the Nordic countries is small, with <10 million people in each country (Denmark, Finland, Norway, and Sweden). Recognizing this limitation, the Nordic Arthroplasty Register Association was initiated in 2007, and several papers about hip and knee arthroplasty have been published since then.[8,9,14,19,24]

National shoulder arthroplasty registries were established in Finland,[18] Norway,[5] Sweden,[21] and Denmark[22] between 1980 and 2004. So far, a few publications regarding revision rates have been published by the registries. However, because of the relatively small number of cases, statistically significant differences between arthroplasty types could not be detected.[4,23] To report revision rates and especially to examine differences between arthroplasty types, collaboration between the national shoulder arthroplasty registries is needed. There is today no international standard available for terminology and definition of diagnosis, arthroplasty type, or reasons for revision. This may limit the possibility not only of merging data but also of comparing results.

The aim was to examine the feasibility of merging data from the Nordic national shoulder registries by defining a common minimal data set, to report demographic data, and with the reverse shoulder arthroplasty as an example, to demonstrate the advantage of merging data.

Materials and methods

A group of orthopedic surgeons with a special interest in shoulder surgery met in March 2014 to discuss the feasibility of merging data from the Nordic national shoulder arthroplasty registries. Differences in organization, definitions, variables, and outcome measures were discussed. A common minimal data set was defined as a set of variables containing only data that all participating registries could deliver and where consensus regarding definition of the variables and related values could be made. Because the Danish register was established with the Swedish register as a model, the data sets in Denmark and Sweden were compatible. The Norwegian data set, however, is based on a common joint replacement form and is somewhat different from the Danish and the Swedish registries and not as rich in details. So, to establish the common data set, some variables and related values were transformed to fit the common data set.

In all the Nordic countries and consequently in the national registries, each patient is identified by a unique civil registration number given at birth. Transformation of national data, including deletion of the civil registration number and the day of birth, was performed within the national registries. Instead, a serial number and a code for nationality were given to each patient. Anonymous data were then merged into one common data set without the possibility of identifying patients at an individual level. Thus, data were treated with full confidentiality according to the standards of the data protection agencies in the individual countries.

The Finnish register was unable to deliver data for the present study because of incomplete format and inadequate maintenance of the registry. The national registries in Denmark, Norway, and Sweden were able to deliver data on primary shoulder arthroplasty from 2004 to 2013. Revision procedures, defined as removal or exchange of any component or the addition of a glenoid component, were linked to the primary operation using the civil registration number.

Two annual meetings with a minimum of 2 participants from each registry were planned. Authorship is first and foremost based on the recommendation developed by the International Committee of Medical Journal Editors. We anticipate that at least 1 participant from each country will qualify by acquisition of data. An additional participant from each country will often qualify by contribution to the conception of study and by interpretation of data, leaving each country with 2 authorships.

Descriptive statistics were used to report demographic data for the individual registries and for the common data set. Differences in demographic data between countries were compared using χ^2 test for categorical variables and analysis of variance for continuous variables. The Kaplan-Meier method was used to illustrate the unadjusted cumulative revision rate. A Cox regression model was used to calculate hazard ratios as a measure of the relative risk of revision. The statistical analyses were performed using SPSS version 19.0 (IBM Corp, Armonk, NY, USA). The level of statistical significance was set at $P < .05$, and all P values were 2 tailed.

Results

We agreed on a data set containing patient-related data (age, gender, and diagnosis), operative data (date, arthroplasty type and brand), and data in case of revision (date, reason for revision, and new arthroplasty brand) (Table I). The variables gender, age, date of surgery, side, and arthroplasty brand were easily defined. Other variables, especially diagnosis, arthroplasty type, and reason for revision, were inconsistently defined and not fully compatible. In these cases, we redefined and transformed data from the individual registries (Tables II to IV). For instance, the variable "fracture sequelae" exists only in the Norwegian register; but by defining "fracture sequelae" as fractures reported as nonunion, malunion, with previous osteosynthesis, or together with osteoarthritis or humeral head necrosis, we were able to extract data from the registries in Denmark and Sweden. If more than 1 diagnosis or reason for revision had been reported to the individual registries, we used a hierarchy of diagnosis and a hierarchy of reason for revision, respectively, so that only 1 diagnosis

Table I The minimal data set divided into primary procedures and data in case of revision

Primary procedures
Country
Serial number
Gender
Age
Date of surgery
Side operated on
Primary diagnosis: acute fracture; fracture sequelae; inflammatory arthritis; rotator cuff arthropathy; osteoarthritis; others; missing
Arthroplasty brand
Arthroplasty type: stemmed hemiarthroplasty; total shoulder arthroplasty; resurfacing hemiarthroplasty; resurfacing total shoulder arthroplasty; reverse shoulder arthroplasty; stemless hemiarthroplasty; stemless total shoulder arthroplasty; others; missing
Revisions
Reason for revision: infection; periprosthetic fracture; luxation and instability; loosening; rotator cuff problem; others; missing
New arthroplasty brand
Date of revision
Number of revisions
Status: alive; death; immigrated
Date of status

Table II Definitions and hierarchy of the variable "diagnosis"

Hierarchy	Definitions
Acute fractures	All fractures that are not categorized as fracture sequelae
Fracture sequelae	Nonunion; malunion; previous osteosynthesis; fractures reported together with osteoarthritis or humeral head necrosis
Inflammatory arthritis	Rheumatoid arthritis; ankylosing spondylitis; juvenile arthritis; psoriasis arthritis
Rotator cuff problem	Reported as "others" in the Norwegian registry
Osteoarthritis	Primary osteoarthritis and secondary osteoarthritis; if not reported together with fracture
Others	Humeral head necrosis if not reported together with fracture; infection; tumors; and pain with no other reason reported

Table III Definitions and hierarchy of the variable "reason for revision"

Hierarchy	Definitions
Infection	An infection that requires revision of the arthroplasty
Periprosthetic fracture	A fracture that requires revision of the arthroplasty
Luxation and instability	Instability is reported as "others" in the Danish and the Swedish registries
Loosening	Loosening of any arthroplasty component
Rotator cuff problem	Rotator cuff problem is reported as "others" in the Norwegian registry
Others	Glenoid wear; biomechanical problems including dislocation; overstuffing; and pain with no other reason reported

and only 1 reason for revision were registered in the common data set (Tables II and III). Any disagreements on what to include in the common data set and how to define hierarchies were solved by a consensus decision. The Western Ontario Osteoarthritis of the Shoulder Index[13] was used as patient-reported outcome in Denmark and Sweden but with different follow-up (1 year and 5 years, respectively). The Norwegian register did not systematically collect patient-reported outcomes. Thus, we were unable to include patient-reported outcome in the minimal data set.

For the present study, 19,857 primary shoulder arthroplasties were included. There were 69% women, and the mean age was 70 years. The majority of patients were treated between the ages of 60 and 80 years (Fig. 1). There were 6856 patients with osteoarthritis (35%), 6757 with acute fracture (34%), 1663 with rotator cuff arthropathy (8%), 1563 (8%) with fracture sequelae, 1463 (7%) with inflammatory arthritis, 528 (3%) with others, and 1025 (5%) with a missing diagnosis. The most common arthroplasty types were total shoulder arthroplasty (34%) for osteoarthritis, stemmed hemiarthroplasty (90%) for acute fractures, and reverse shoulder arthroplasty (79%) for rotator cuff arthropathy (Table V).

The incidences of shoulder arthroplasty for osteoarthritis and rotator cuff arthropathy increased during the study period.

Table IV Definitions of arthroplasty types

Humeral hemi arthroplasty	Anatomical total arthroplasty	Reversed total arthroplasty
Resurfacing: Reamed but head not resected	Resurfacing: Including a glenoid component	
Stemmed*: Head is resected	Stemmed*: Including a glenoid component	Stemmed*: Head and socket are reversed.
Stemless†: Head resected, no stem into diaphysis	Stemless†: Including a glenoid component	Stemless†: Head and socket are reversed.

* Stemmed arthroplasty, stem is extended in to the humeral diaphysis.
† Stemless arthroplasty is restricted to the humeral methaphysis.

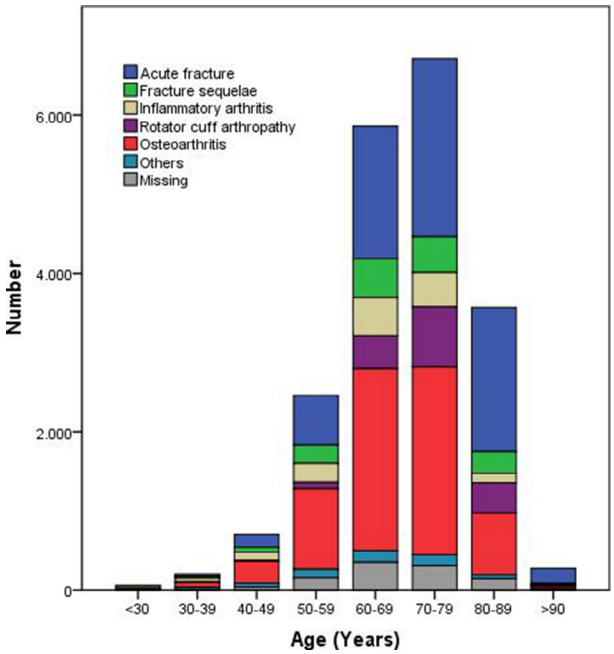

Figure 1 The number of shoulder arthroplasties according to age and primary diagnosis.

The indication of acute fracture initially increased but remained stable from 2008. The indications of inflammatory arthritis and fracture sequelae have remained stable throughout the study period (Fig. 2). The use of total shoulder arthroplasty and reverse shoulder arthroplasty has increased, whereas resurfacing hemiarthroplasty decreased. Stemmed hemiarthroplasty remained stable throughout the study period (Fig. 3).

There were 7469, 3635, and 8753 shoulder arthroplasties included from Denmark, Norway, and Sweden, respectively. The average incidence in the studied period was different, with 13.3/100,000 per year in Denmark, 7.1/100,000 in Norway, and 9.1/100,000 in Sweden ($P < .001$). The proportion of women was 66% in Sweden, 69% in Denmark, and 72% in Norway ($P < .001$). Mean age was 69 years in Denmark and Sweden and 70 years in Norway ($P < .001$). There were different distributions of diagnoses ($P < .001$). In particular, the proportion of shoulder arthroplasty for acute fracture was high in Denmark (Table VI). There were different preferences of arthroplasty type for the most common diagnoses (Table V). In particular, resurfacing hemiarthroplasty was frequently used for osteoarthritis in Denmark, whereas total shoulder arthroplasty was more frequently used in Sweden ($P < .001$). Reverse shoulder arthroplasty was more frequently used for acute fractures in Norway than in Denmark ($P < .001$).

A reverse shoulder arthroplasty was mainly used for rotator cuff arthropathy, and the Delta Xtend (DePuy, Raynham, MA, USA) and the Delta III (DePuy) were the most frequently used arthroplasty brands (Fig. 4). The Delta III was mainly used in the beginning of the study period (Fig. 5). Seventy (14.4%) Delta III arthroplasties and 120 (4.3%) Delta Xtend arthroplasties required revision. The difference between the unadjusted cumulative revision rates was statistically significant (Fig. 6). A Cox regression model showed a statistically significant difference between these 2 reverse arthroplasty brands when age, gender, primary diagnosis, and year of surgery were included in the model. Thus, the risk of revision after Delta III was 2.2 (95% confidence interval [CI], 1.4-3.6; $P < .01$ with the Delta Xtend as a reference). When the same analysis was performed using data from the individual registries, the risk of revision in Denmark, Norway, and Sweden was 1.8 (95% CI, 0.9-3.4; $P = .09$), 1.2 (95% CI, 0.4-4.3; $P = .73$), and 2.32 (95% CI, 1.0-5.3; $P = .05$), respectively.

Discussion

In this paper, we have described the process of and the challenges in merging data from individual national registries into a common database. The main findings were an increased number of shoulder arthroplasties and differences between the countries regarding incidence, age, diagnosis, and choice of arthroplasty type and brand. The Delta III was associated with a high risk of revision compared with the Delta Xtend.

Data from the individual registries were successfully merged into a common data set, but the data set was not as rich in details as the individual registries, and there were certain challenges. The Norwegian data set is based on a common joint form, and it is not possible to directly report rotator cuff arthropathy as the primary diagnosis. Instead, the surgeons report

Table V The distribution of arthroplasty types and arthroplasty brands for the most common diagnoses

	Combined No. (%)	Denmark No. (%)	Norway No. (%)	Sweden No. (%)	*P* value*
Acute fracture					
Stemmed hemiarthroplasty	6109 (90.4)	3196 (94.2)	834 (81.4)	2079 (88.9)	<.001
Bigliani-Flatow	1738 (28.4)	1202 (37.6)	8 (1.0)	528 (25.4)	
Global FX	1484 (24.3)	886 (27.7)	276 (33.1)	322 (15.5)	
Aequalis Fracture	564 (9.2)	240 (7.5)	27 (3.2)	297 (14.3)	
Reverse shoulder arthroplasty	565 (8.4)	144 (4.2)	179 (17.5)	242 (10.3)	<.001
Delta Xtend	463 (81.9)	113 (78.5)	140 (78.2)	210 (86.8)	
Delta Mark III	36 (14.8)	12 (8.3)	3 (1.7)	21 (8.7)	
Aequalis Reverse	30 (11.1)	14 (9.7)	16 (8.9)	0 (0.0)	
Osteoarthritis					
Total shoulder arthroplasty	2340 (34.1)	366 (16.2)	359 (27.1)	1615 (49.3)	<.001
Global Advantage	523 (22.4)	148 (40.4)	82 (22.8)	293 (18.1)	
Bigliani-Flatow	452 (19.3)	118 (32.2)	14 (3.9)	320 (19.8)	
Aequalis Standard	414 (17.7)	2 (0.5)	219 (61.0)	193 (12.0)	
Stemmed hemiarthroplasty	1578 (23.0)	425 (18.8)	268 (20.2)	885 (27.0)	<.001
Bigliani-Flatow	451 (28.6)	126 (29.6)	10 (3.7)	272 (30.7)	
Global Advantage	306 (19.4)	169 (39.8)	93 (39.8)	87 (9.8)	
Aequalis Standard	161 (10.2)	6 (1.4)	27 (10.4)	128 (14.5)	
Resurfacing arthroplasty, hemi	1923 (28.0)	1266 (56.1)	252 (19.0)	405 (12.4)	<.001
Copeland	1149 (59.8)	743 (58.7)	160 (63.5)	246 (60.7)	
Global CAP	670 (34.8)	488 (38.5)	64 (25.4)	118 (29.1)	
Reverse shoulder arthroplasty	592 (8.6)	142 (6.3)	299 (22.5)	151 (4.6)	<.001
Delta Xtend	367 (62.0)	113 (79.6)	131 (43.8)	123 (81.5)	
TESS Reverse	92 (15.5)	0 (0.0)	80 (26.8)	12 (7.9)	
Delta Mark III	61 (10.3)	22 (15.5)	31 (10.4)	8 (5.3)	
Rotator cuff arthropathy					
Stemmed hemiarthroplasty	180 (10.8)	95 (11.6)	7 (4.3)	78 (11.4)	<.001
Global Advantage	83 (46.1)	56 (58.9)	5 (71.4)	22 (28.2)	
Bigliani-Flatow	29 (16.1)	6 (6.3)	0 (0.0)	23 (29.5)	
Comprehensive	15 (8.3)	8 (8.4)	0 (0.0)	7 (9.0)	
Resurfacing hemiarthroplasty	136 (8.2)	113 (13.8)	5 (3.1)	18 (2.6)	<.001
Copeland	107 (78.7)	88 (77.9)	4 (80.0)	15 (83.3)	
Global CAP	20 (14.7)	19 (16.8)	1 (20.0)	0 (0.0)	
Reverse shoulder arthroplasty	1313 (79.0)	595 (72.7)	150 (92.0)	568 (83.3)	<.001
Delta Xtend	999 (76.1)	447 (75.1)	106 (70.7)	446 (78.5)	
Delta Mark III	186 (14.2)	103 (17.3)	16 (10.7)	67 (11.8)	
TESS Reverse	41 (3.1)	0 (0.0)	13 (8.7)	28 (4.9)	

* χ^2 test for differences between the 3 individual countries.

the indication to be "other" and then have the possibility of writing rotator cuff arthropathy. It is likely that some patients with rotator cuff arthropathy are reported as osteoarthritis. This could explain the low proportion of patients with rotator cuff arthropathy and the high proportion of reverse shoulder arthroplasty used in the treatment of osteoarthritis in Norway. We discussed the need of a medical chart review to improve the accuracy of data reporting, but the Norwegian registry does not have access to medical charts. Another challenge in the process of merging data was to define a hierarchy in cases in which more than 1 diagnosis or 1 reason for revision was reported. Experienced surgeons from each country agreed on the hierarchy, but it is possible that other surgeons would have chosen differently.

The distribution of diagnoses with an equal number of acute fractures (34%) and osteoarthritis (35%) is different from that reported by the New Zealand Joint Registry, in which 10% and 53% were diagnosed with an acute fracture and osteoarthritis, respectively.[17] Also, in the United States, only 13% were operated on because of fracture in 2011.[25] The choice of arthroplasty type was different from international trends too. We found that 34%, 28%, 23%, and 9% of the osteoarthritic patients were treated with total shoulder arthroplasty, resurfacing hemiarthroplasty, stemmed hemiarthroplasty, and reverse shoulder arthroplasty, respectively. In Australia, 67% were treated with anatomic total shoulder arthroplasty and only 6% with resurfacing hemiarthroplasty.[1] In the United States, approximately 70% of the osteoarthritic patients were

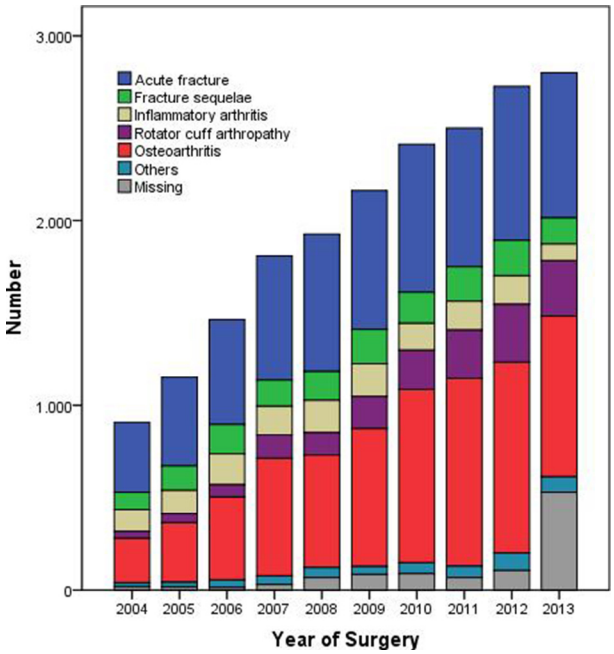

Figure 2 The number of shoulder arthroplasties during the studied period.

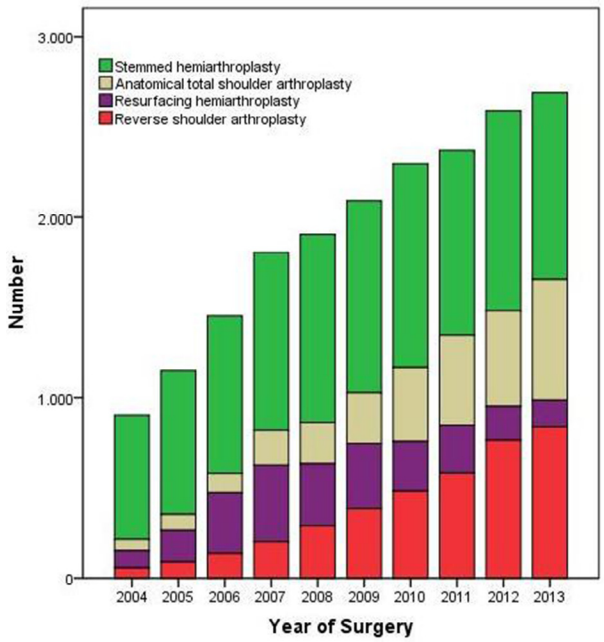

Figure 3 The number of shoulder arthroplasty types during the studied period.

treated with anatomic total shoulder arthroplasty or reverse shoulder arthroplasty in 2008.[12] The reason for the lower proportion of total shoulder arthroplasty in the Nordic countries is unknown, but it may be related to surgical tradition of not using a glenoid component because of an uncertainty regarding the risk of aseptic loosening of the glenoid component, and it may have been considered a more technically demanding procedure.

Differences in the distribution of arthroplasty brands and the high marketing proportion of certain arthroplasty suppliers are probably related to distribution networks. Some manufacturers may have their focus on knee and hip arthroplasty, arthroscopy, or osteosynthesis products rather than on shoulder arthroplasty. Finally, there may be different costs for the same arthroplasty brand in the countries.

The increased use of shoulder arthroplasty is similar to that reported in the annual reports from the national registries in Australia[1] and New Zealand[17] and from the United States.[11,12] Also, the stable incidence of shoulder replacement in the treatment of inflammatory arthritis is similar to a paper from the United States reporting data from 1991 to 2005.[16] The increased use of total shoulder replacement and reverse shoulder arthroplasty follows international trends. In the United States, the use of total shoulder arthroplasty increased from 10,658 replacements just before the reverse shoulder arthroplasty was approved by the U.S. Food and Drug Administration in 2003 to 26,773 replacements in 2008.[12] However, a dedicated *International Classification of Diseases, Ninth Revision, Clinical Modification* code for reverse shoulder arthroplasty was not available, and the authors were unable to distinguish between anatomic total shoulder arthroplasty and reverse shoulder arthroplasty.

We found different incidences of and indications for shoulder arthroplasty within the individual countries. The reason for this is unknown, but it has previously been suggested that the prevalence of osteoarthritis is different with the Nordic countries.[10] Regional differences in the prevalence of osteoporosis and subsequently need of fracture management may also exist.[20] The surgeons' preferences regarding management of especially acute fractures may be different. Thus, the difference in the rate of arthroplasty for acute fracture between the countries within the study may be related to a national difference in the use of locking plate osteosynthesis, nonsurgical treatment, or both. The reason for the different use of arthroplasty type between the countries is unknown. We believe that the differences mainly are related to surgical traditions, including considerations regarding aseptic loosening of the glenoid component. The different incidences of shoulder arthroplasty between the countries are, of course, influenced by the completeness of registration in the individual registries.

We found an increased risk of revision of the Delta III arthroplasty brand. The reason for this is unknown, but a likely explanation is that the Delta III was used in the beginning of the study period. The increased risk of revision may therefore reflect the early experiences with the reverse shoulder arthroplasty (learning curve). The Delta III is no longer routinely used. The increased risk of revision was statistically significant only in the merged data set and not in the individual countries. This demonstrates the strength of merging data to increase statistical power as opposed to analyzing data from the individual registries side by side.

The Finnish Arthroplasty Register is governed by the National Institute for Health and Welfare and is funded by the Finnish government. It was established in 1980 and is the

Table VI Reported diagnoses in Denmark, Norway, and Sweden

	Denmark			Norway			Sweden		
	No.	Incidence*	%	No.	Incidence*	%	No.	Incidence*	%
Acute fracture	3392	6.0	45	1025	2.0	28	2339	2.4	27
Fracture sequelae	463	0.8	6	573	1.1	16	527	0.5	6
Inflammatory arthritis	305	0.5	4	394	0.8	11	764	0.8	9
Rotator cuff arthropathy	818	1.5	11	163	0.3	5	682	0.7	8
Osteoarthritis	2256	4.0	30	1327	2.6	37	3275	3.4	37
Others	200	0.4	3	138	0.3	4	190	0.2	2
Missing	34	0.1	0	15	0.0	0	976	1.0	11
Total	7469	13.3	100	3635	7.1	100	8753	9.1	100

* Cases/year/100,000.

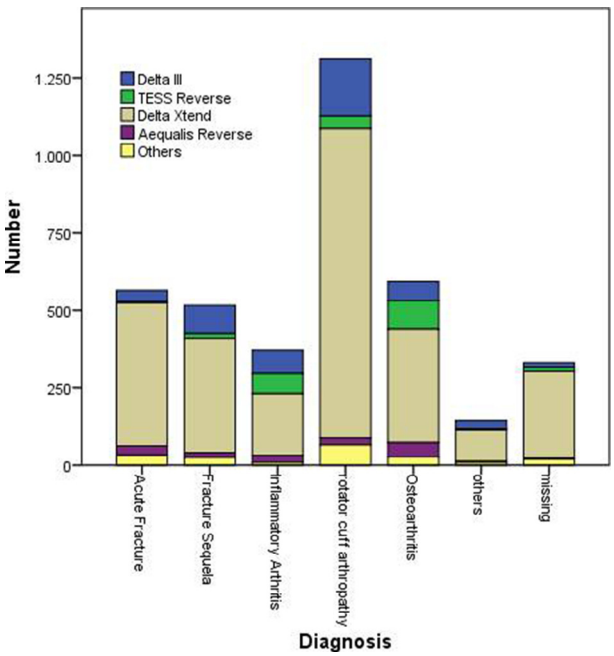

Figure 4 The number of reverse shoulder arthroplasties according to diagnosis and arthroplasty brand.

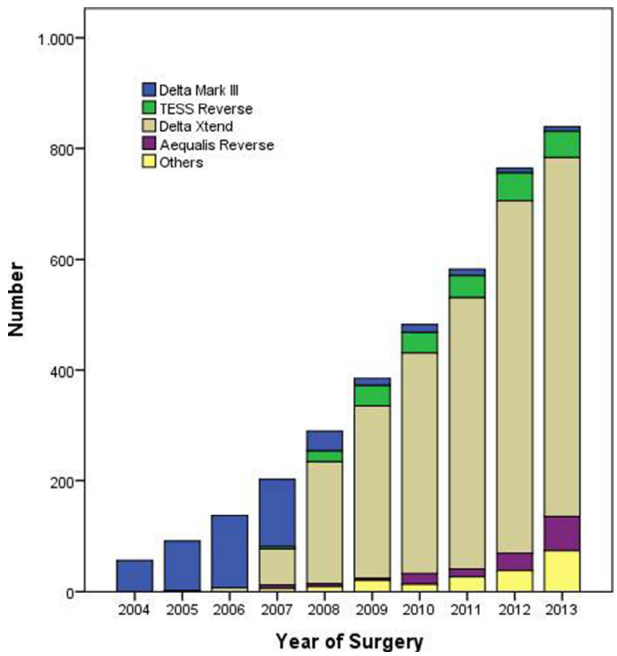

Figure 5 The number of reverse shoulder arthroplasties during the study period according to arthroplasty brand.

oldest existing national shoulder arthroplasty registry. The reporting was initially voluntary, but as there were concerns about the completeness of the data, the reporting was made mandatory in 1997. Data are still collected with paper forms that were originally designed for hip and knee arthroplasties. Because of a lack of specificity and insufficient coding, there are many limitations in the registry; for example, the distinction of the arthroplasty type (anatomic vs. reverse or hemi vs. total) is impossible, and the register includes elective procedures only. The register is currently under a revision process. A specific steering committee, including participants from all significant shoulder units, has been nominated and began their work in March 2015. The common goals include all-electronic data input and output, comparability with other Nordic registries concerning variables and related values, and inclusion of preoperative and postoperative Western Ontario Osteoarthritis of the Shoulder Index. The register was unable to deliver data for the present study but aims to participate in the collaboration in the near future.

There are 2 major advantages of this collaboration. First, because of the high number of cases, there is increased statistical strength to compare arthroplasty types and arthroplasty brands for different diagnoses concerning revision rates and reasons for revision. Second, by adapting identical variables and related values, we are able to directly compare results between the participating countries. The major limitations of the collaboration are the reduced number of variables compared with the national registries and the lack of a patient-reported outcome measure. There are also the common limitations to joint register data, including the risk of incorrect reporting and the degree of completeness. The Danish and the Norwegian registries have documented completeness above 90%, whereas the completeness in the Swedish registry is 80%.[2]

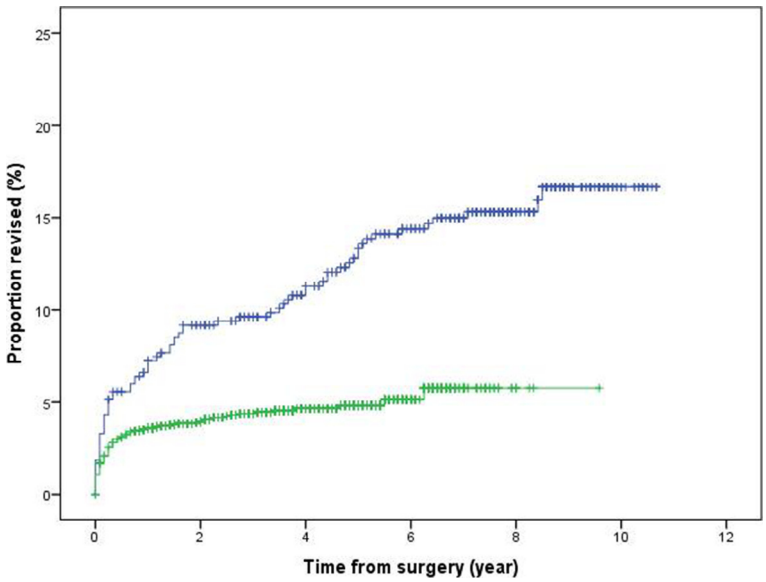

Figure 6 The cumulative revision rate after Delta Mark III (*blue*) or Delta Xtend (*green*) showing a highly statistically significant difference ($P < .01$).

As we are in the initial phase of the collaboration, we decided to include only data that all participating registries could deliver and where consensus according to definition of the variables and related values could be made. In the future, we aim not only to increase the set of details by adapting compatible variables in the individual registries but also to agree on common patient-reported outcome measures with compatible follow-up. Using the present common data set, we expect to report results of arthroplasty types and brands continuously. It also became apparent that different definitions and terminology exist and that this may decrease the external validity. The usefulness of registry data would be improved if common definitions and terminology are broadly accepted.

Conclusion

We were able to merge data from the Nordic national registries into 1 common data set; however, as a consequence of different and incompatible variables, the set of details was reduced. Future revisions of the national data sets should be done in collaboration within the Nordic Arthroplasty Register Association to improve data compatibility. We found considerable differences between the 3 countries regarding incidence of shoulder replacement, age, diagnoses, and choice of arthroplasty type and brand. The reason for this is unknown but may be related to different surgical traditions and distribution networks. Merging data from the Nordic national registries improved the statistical power of the implant survival analysis.

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