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Reduction in Orthopedic Surgery Among Patients With Chronic Inflammatory Joint Disease in Norway, 1994–2004

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Introduction

Chronic inflammatory joint diseases are associated with joint destruction and subsequent marked disability and the need for orthopedic surgery. Relieving pain, correcting deformities, and replacing destroyed joints to achieve a better function are major indications for surgical treatment. In a long-term followup study of 1,600 patients with rheumatoid arthritis (RA), 25% underwent total joint arthroplasty within 22 years after disease onset (1).

In general, the incidence of joint replacement procedures has increased during recent years (2). It has been suggested that a major reason for this trend is an increase in the prevalence of osteoarthritis (OA) due to an increased number of elderly persons in the population (2) and an increasing number of individuals who are overweight (3). Findings from some published studies suggest the opposite trend in the incidence of surgical procedures, including joint replacement procedures, due to RA (4–6).

The major goal of the present study was to assess the use of orthopedic surgery among patients with chronic inflammatory joint disease in Norway during the period 1994–2004. The incidence in the Norwegian population of total joint replacement procedures, synovectomies, and arthrodesis operations in patients with chronic inflammatory joint disease was investigated.

Patients and Methods

Nearly all patients receiving a primary arthroplasty of the shoulder, elbow, wrist, hand, hip, knee, ankle, or foot during the period from 1994 until 2004 were registered in the Norwegian Arthroplasty Register (NAR). The register was established in 1987 first as a hip prosthesis register, but from January 1994 it was extended to include all artificial joints (7). The NAR receives information directly from the orthopedic surgeon.

The Norwegian Patient Register (NPR) receives information from the hospitals' electronic administrative patient records. The present study was based on arthroplasties reported to the NAR and synovectomies and arthrodesis procedures registered in NPR among patients with inflammatory arthritis (IA) from 1994 to 2004. We investigated all such procedures in the Norwegian population of ~4.5 million inhabitants.

Data concerning the diagnosis were derived from the form completed by the operating surgeon for patients included in the NAR, and using International Classification of Diseases, Ninth Revision (ICD-9) and ICD-10 codes for patients in the NPR. A common group designated as having IA was defined as patients whose underlying disease had been identified as RA, psoriatic arthritis, reactive arthritis, or ankylosing spondylitis. In this group, RA was the most common diagnosis, present in 86% of patients. For the purpose of comparing the incidence of surgical procedures, patients with OA as well as IA were included.

The following procedures were considered in the present study: joint replacement surgery (or arthroplasty), arthrodesis, and synovectomy. For the purpose of this study, arthrosynovectomy and tenosynovectomy were included in a common group of operations called synovectomy.

To calculate incidences, the population of Norway for each of the included years was obtained from Statistics Norway (available at www.ssb.no/english/). Population information was obtained for both sexes and for different age categories: 0–49 years, 50–59 years, 60–69 years, 70–79 years, and ≥80 years. Annual incidence per 100,000 was calculated by dividing the number of cases per period by the number of persons at risk in the same period, multiplied by 100,000 for each age and sex category.

For joint replacement operations of the hands and feet, every joint was registered as a separate case. Patients having operations for more than 1 joint, i.e., 3 metacarpopha-

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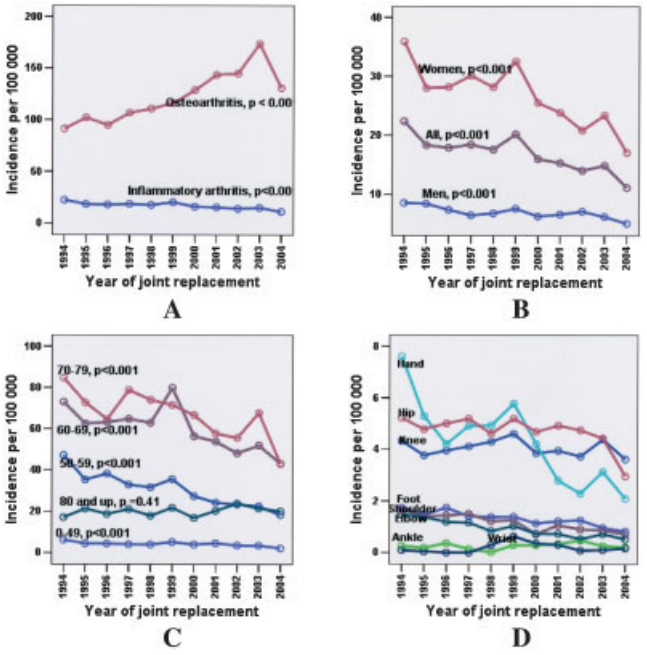

Figure 1. Incidence of joint replacement procedures. **A,** Patients with osteoarthritis versus inflammatory arthritis (IA; analysis adjusted for age and sex). **B,** Incidence according to sex in patients with IA (analysis adjusted for age). **C,** Incidence according to age category in patients with IA (analysis adjusted for sex). **D,** Incidence according to joint in patients with IA (analysis adjusted for age and sex).

langeal joints, were registered as having 3 separate operations. On average, 2.6 joints (in the hands and feet) were operated per patient. The location of a synovectomy or arthrodesis was given in the surgical procedure code and procedures of the ankle and foot were grouped together, as were procedures of the wrist and hand. In the NAR, joint replacements of the ankle and foot as well as the wrist and hand were registered separately.

Statistical analysis. Poisson regression analysis was used to analyze trends in the incidence of the different procedures in several subgroups of patients. The *P* values presented in Figures 1 and 2 were adjusted for sex and age. Separate analyses were performed for each sex (adjusted for age) and for different age categories (adjusted for sex). All *P* values were 2-tailed, and the significance level was set to 5%. All analyses were performed using SPSS software, version 13.0 (SPSS, Chicago, IL).

Results

There were 8,268 primary joint replacement procedures performed in patients with IA during the study period 1994–2004. Arthrodeses were performed in 3,554 patients and synovectomies were performed in 5,012 patients.

Age and sex at surgery. The distribution of age and sex was different for patients with IA compared with those with OA. For joint replacement procedures, patients with IA were significantly younger than patients with OA (mean age 63 and 71 years, respectively; $P < 0.001$). Similar results for synovectomies were found, whereas no major age differences were found for arthrodeses. Furthermore, the percentage of women in the IA group was higher than in the OA group for all 3 procedures.

Age at surgery in men and women and for each separate joint is shown in Table 1. Patients with IA were youngest when having synovectomies and oldest when having a joint replacement.

Distribution of procedures in the different joints. The number of operations for each joint during the entire study period among patients with IA is shown in Table 1. The knee and hip were the most frequent locations for joint replacements. The ankle/foot and the wrist/hand were the major locations for arthrodeses; synovectomies were frequently performed in all joints except the hip, and the most frequent locations were the knee and the wrist/hand.

Incidence of joint replacements. The total incidences of joint replacement operations for patients with IA and OA are shown in Figure 1A. An increase in the incidence of joint replacement surgery for OA was seen during the period, while the opposite was true for IA ($P < 0.001$ for both).

Incidence rates of joint replacements for men and women with IA are shown in Figure 1B. A decrease in the incidence from 1994 to 2004 was seen for both sexes ($P < 0.001$). As shown in Figure 1C, the incidence was highest in patients between 70 and 79 years of age, followed by patients from 60 to 69 years of age. There was a decrease in

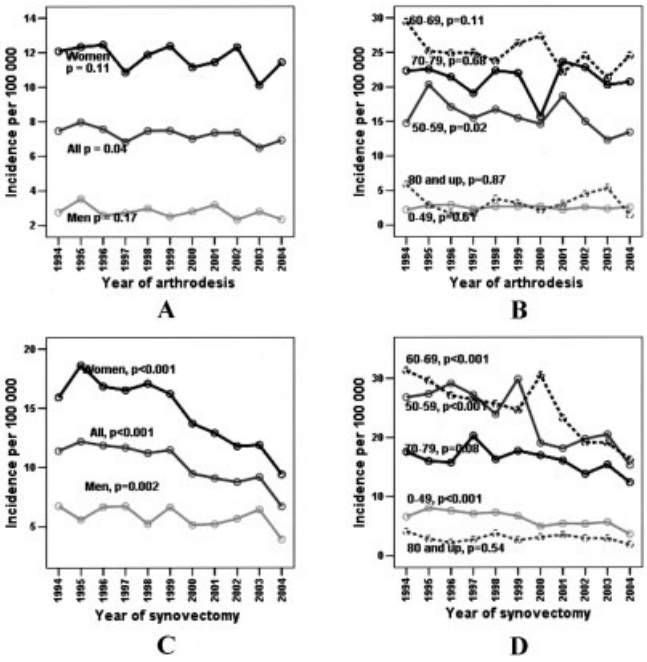

Figure 2. Incidence of arthrodesis and synovectomy in patients with inflammatory arthritis (IA). **A,** Incidence of arthrodesis according to sex in patients with IA (analysis adjusted for age). **B,** Incidence of arthrodesis according to age category in patients with IA (analysis adjusted for sex). **C,** Incidence of synovectomy according to sex in patients with IA (analysis adjusted for age). **D,** Incidence of synovectomy according to age category in patients with IA (analysis adjusted for sex).

Table 1. Age at surgery of different joints in patients with inflammatory arthritis

	Joint replacement		Arthrodesis		Synovectomy	
	No.	Age*	No.	Age*	No.	Age*
Hip	2301	62	4		20	42
Knee	1,986	66	21	55	1,493	47
Ankle/foot†	127/645	57/59	1,598	59	905	49
Shoulder	566	63	2		328	56
Elbow	457	61	0		435	53
Wrist/hand†	94/2,092	56/61	1,929	59	1,831	55
Total	8,268	62.5	3,554	59.1	5,012	51.4
Women/men	6,582/1,686	63/61	2,883/671	59/59	3,607/1,405	52/51

* Mean age at surgery.
† For the joint replacements, separate numbers for ankle and foot as well as hand and wrist were registered, whereas these were grouped together for arthrodeses and synovectomies.

the incidence of joint replacements for all groups except the oldest age group ($P = 0.41$).

Incidences of joint replacement procedures are shown for each separate joint among patients with IA in Figure 1D. A statistically significant decrease in incidence was present for arthroplasties of the foot, hip, shoulder, elbow, and hand ($P < 0.001$ for all). There was no significant change in the incidence of knee replacements ($P = 0.43$).

Incidence of arthrodesis and synovectomy. The incidences of arthrodeses among patients with IA from 1994 to 2004 in both sexes and in 5 age categories are shown in Figures 2A and 2B. A statistically significant decrease in incidence was seen for the entire group, but when divided into subgroups, no significant changes in incidence during the period were seen except in the age category 50–59 years, in which a decrease was seen ($P = 0.02$). Arthrodeses were almost exclusively performed in the ankle/foot and in the wrist/hand. When looking at arthrodeses performed at these locations separately, a statistically significant reduction in incidence was found for procedures of the wrist/hand ($P < 0.001$) whereas the opposite trend was seen for arthrodeses of the ankle/foot ($P < 0.001$).

Incidences of synovectomies during the 11-year period are illustrated in Figures 2C and 2D. The incidence decreased with time for men and women with IA and for the 3 youngest age categories ($P < 0.001$).

Discussion

In the present study, the major finding was a reduction in the use of orthopedic surgery among patients with IA during the time span 1994–2004. This trend was evident for the 2 procedures, arthroplasty and synovectomy, for which a decrease in incidence was found for both sexes and for most age groups. For arthrodeses a similar trend was found when considering all patients together, but for most subgroups there was no statistically significant trend. However, a decrease in arthrodeses of the hand/wrist was present.

An increase in joint replacement procedures for patients with OA was seen in the same period. Studies from several countries have demonstrated a similar increase in the use of total hip replacement during the last 10–15 years (5,8,9). Reasons for this increase may be an increase in the proportion of elderly persons in the population, changes in the clinical criteria for performing joint replacement procedures, and increased acceptance in patients and clinicians for operating on older patients and patients with severe comorbidity.

We found that the decrease in incidence of joint replacements and synovectomies in patients with IA did not include older patients. One reason for this might be the increased acceptance, in general, for operating on older patients. In addition, disease onset in many of the older patients occurred long before the improvement in the medical treatment of chronic inflammatory joint disease. Consequently, they have already developed joint destruction and the need for joint reconstructive surgery.

The treatment for chronic inflammatory joint disease has changed during the last 3 decades. During the late 1970s and early 1980s, methotrexate was introduced for treating RA. It assumed a dominant role during the 1980s and 1990s because both short-term trials and long-term observation studies proved the beneficial effect of this drug in the treatment of RA. This major change in the treatment of RA could represent an important factor in improving the prognosis and keeping patients from needing surgical treatment.

During the last 6 years, tumor necrosis factor α inhibitors have been introduced as potent medications for patients with RA and other inflammatory joint diseases. Both infliximab and etanercept have been shown to retard the radiographically assessed progression of joint damage. The impact of such treatment may also have influenced our results, because surgical treatment might have been postponed as a result of the treatment.

In the present study, we found a significant decrease in the incidence of joint replacement procedures for most joints, but not for the knee. The incidence of knee arthroplasty in Norway has for many years been much lower than that of other comparable countries (10). Thus there has been an accumulation of patients needing knee replacement, leading to a significant increase in knee replacements during recent years (10). It is likely that this has also affected patients with chronic inflammatory joint disease.

In a recent Swedish study, Weiss et al found a decrease in the rate of hospital admissions due to RA-related surgical procedures of the lower limbs from 1987 to 2001 (4). Similar findings were reported by a research group in Denmark describing a decrease in the incidence rate of total hip arthroplasties due to RA (5). Da Silva et al investigated the use of orthopedic surgery in patients with RA diagnosed from 1955 until 1995 (6). In that study, patients diagnosed with RA after 1985 were less prone to need surgery than those diagnosed before this period (6). As far as we can see, a reduction in the need for orthopedic surgery among patients with RA is consistent for all published articles on the subject. Therefore, our results showing a general trend towards less use of surgical treatment in patients with IA (including RA) are in agreement with previous studies. However, so far relatively few studies specifically addressing this subject have been published.

Studies on the incidence of RA in Norway suggest a steady incidence during recent years of ~25–28 new cases per 100,000 inhabitants per year (11). Studies from the US and Japan, however, indicate a decrease in the incidence of RA in the last 4–5 decades (12,13). Because the vast majority of our patients had RA (86%), a decrease in the incidence of RA might have contributed to the reduction in the need for orthopedic surgery in these patients, as the number of patients at risk decreased.

A recent article described a change in the course of disease activity in patients with RA towards a milder course during recent years (14). If this is true, it may represent another factor accounting for the fall in the use of surgical treatment of patients with RA. However, a study by Finckh et al suggested that the milder course of disease is due to improved medical treatment (15).

The present study was based on data from 2 databases, the NAR, which receives information on arthroplasties from the operating surgeons, and the NPR, which receives data from the hospitals' electronic administrative patient records. For such registers, some degree of miscoding must be expected. However, there is no reason to believe that the degree of miscoding should have changed during the study period.

In conclusion, the incidence of joint replacements and synovectomies among patients with chronic inflammatory joint disease decreased in the Norwegian population from 1994 to 2004. Potential reasons for this finding include changes in medical treatment, changes in the incidence or severity of IA, or other factors.

AUTHOR CONTRIBUTIONS

Dr. Fevang had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study design. Fevang, Lie, Havelin, Engesæter, Furnes.

Acquisition of data. Fevang, Lie, Havelin, Engesæter, Furnes.

Analysis and interpretation of data. Fevang, Lie, Havelin, Engesæter, Furnes.

Manuscript preparation. Fevang, Lie, Havelin, Engesæter, Furnes.

Statistical analysis. Fevang, Lie.

REFERENCES

1. Wolfe F, Zwillich SH. The long-term outcomes of rheumatoid arthritis: a 23-year prospective, longitudinal study of total joint replacement and its predictors in 1,600 patients with rheumatoid arthritis. Arthritis Rheum 1998;41:1072–82.
2. Dixon T, Shaw M, Ebrahim S, Dieppe P. Trends in hip and knee joint replacement: socioeconomic inequalities and projections of need. Ann Rheum Dis 2004;63:825–30.
3. Flugsrud GB, Nordsletten L, Espehaug B, Havelin LI, Meyer HE. Risk factors for total hip replacement due to primary osteoarthritis: a cohort study in 50,034 persons. Arthritis Rheum 2002;46:675–82.
4. Weiss RJ, Stark A, Wick MC, Ehlin A, Palmblad K, Wretenberg P. Orthopaedic surgery of the lower limbs in 49,802 rheumatoid arthritis patients: results from the Swedish National Inpatient Registry during 1987 to 2001. Ann Rheum Dis 2005; 65:335–41.
5. Pedersen AB, Johnsen SP, Overgaard S, Soballe K, Sorensen HT, Lucht U. Total hip arthroplasty in Denmark: incidence of primary operations and revisions during 1996–2002 and estimated future demands. Acta Orthop 2005;76:182–9.
6. Da Silva E, Doran MF, Crowson CS, O'Fallon WM, Matteson EL. Declining use of orthopedic surgery in patients with rheumatoid arthritis? Results of a long-term, population-based assessment. Arthritis Rheum 2003;49:216–20.
7. Havelin LI. The Norwegian Joint Registry. Bull Hosp Jt Dis 1999;58:139–47.
8. Mahomed NN, Barrett JA, Katz JN, Phillips CB, Losina E, Lew RA, et al. Rates and outcomes of primary and revision total hip replacement in the United States Medicare population. J Bone Joint Surg Am 2003;85-A:27–32.
9. Havelin LI, Engesaeter LB, Espehaug B, Furnes O, Lie SA, Vollset SE. The Norwegian Arthroplasty Register: 11 years and 73,000 arthroplasties. Acta Orthop Scand 2000;71:337–53.
10. Furnes O, Espehaug B, Lie SA, Vollset SE, Engesaeter LB, Havelin LI. Early failures among 7,174 primary total knee replacements: a follow-up study from the Norwegian Arthroplasty Register 1994–2000. Acta Orthop Scand 2002;73:117–29.
11. Uhlig T, Kvien TK, Glennas A, Smedstad LM, Forre O. The incidence and severity of rheumatoid arthritis: results from a county register in Oslo, Norway. J Rheumatol 1998;25:1078–84.
12. Doran MF, Pond GR, Crowson CS, O'Fallon WM, Gabriel SE. Trends in incidence and mortality in rheumatoid arthritis in Rochester, Minnesota, over a forty-year period. Arthritis Rheum 2002;46:625–31.
13. Shichikawa K, Inoue K, Hirota S, Maeda A, Ota H, Kimura M, et al. Changes in the incidence and prevalence of rheumatoid arthritis in Kamitonda, Wakayama, Japan, 1965–1996. Ann Rheum Dis 1999;58:751–6.
14. Welsing PM, Fransen J, van Riel PL. Is the disease course of rheumatoid arthritis becoming milder? Time trends since 1985 in an inception cohort of early rheumatoid arthritis. Arthritis Rheum 2005;52:2616–24.
15. Finckh A, Choi HK, Wolfe F. Progression of radiographic joint damage in different eras: trends towards milder disease in rheumatoid arthritis are attributable to improved treatment. Ann Rheum Dis 2006;65:1192–7.