Temporal trends in primary total hip and knee arthroplasty surgery: results from a UK regional joint register, 1991–2004

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ABSTRACT

INTRODUCTION The aim of this study was to evaluate temporal trends in the prevalence of primary total hip and knee replacements (THRs and TKRs) throughout the Trent region from 1991 to 2004.

PATIENTS AND METHODS The Trent Regional Arthroplasty Study records details of primary THR and TKR prospectively and data from the register were examined. Age and gender population data were provided by the Office for National Statistics.

RESULTS A total of 26,281 THRs and 23,606 TKRs were recorded during this period. Analysis showed that females had an increased incidence rate ratio (IRR) for both primary THR (IRR = 1.29; 95% CI 1.26–1.33; $P < 0.001$) and TKR (IRR = 1.17; 95% CI 1.14–1.20; $P < 0.001$). Patients aged 74–85 years had the largest IRR for both primary THR (IRR = 6.7; 95% CI 6.4–7.0; $P < 0.001$) and TKR (IRR = 15.3; 95% CI 14.4–16.3; $P < 0.001$).

CONCLUSIONS The prevalence of primary TKR increased significantly over time whereas THR remained steady in the Trent region between 1991 and 2004.

KEYWORDS

Total hip replacement – Total knee replacement – Prevalence – Register – England

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Total hip and knee replacements (THRs and TKRs) are considered to be cost-effective¹ and reliable at dramatically enhancing the quality of life and maintaining independence to patients with arthritis.² Improvements in the health of the population have had a positive effect on survivorship and it is expected that the volume of total hip and knee replacements in the UK will continue to increase.³

There has been an increase in the rate of THRs and TKRs over the last few decades in Scandinavia,^{4–6} Australia⁷ and the US.⁸ In Scandinavia, the number of procedures that have been performed are readily obtainable from a national arthroplasty registry that was initiated in the late 1970s.⁹ The Trent Arthroplasty Register was established in 1990 to evaluate the practice of hip and knee replacements in the Trent region and determine outcomes in a generalist setting in the UK.

The aim of this study was to evaluate the temporal trends in the prevalence of primary THRs and TKRs in the Trent region from 1991 to 2004.

Patients and Methods

The Trent Regional Arthroplasty Study (TRAS) collected prospective data on all total hip and knee replacements performed in this health region. The operating surgeon recorded demographic, medical and operative details for each patient. These data were validated by a peripatetic clerk who visited each hospital. In 1990, the region had a population of 3.9 million (1991 census) served by 24 hospitals. In 2005, the population had risen to 4.0 million (2001 census) served by 21 hospitals.

The number of primary hip and knee replacements registered for each year in each of the administrative areas, which make up the region, (Derbyshire, Leicestershire, Lincolnshire, Nottinghamshire, and South Yorkshire) were determined. Population data according to age and gender for this period were provided by the Information Centre for health and social care according to the catchment areas for the Primary Care Trusts (PCTs). Additional population data were provided by the Office for National Statistics (ONS) on

Figure 1 Procedural rates of primary total hip and knee replacements (THRs and TKRs) from 1991 to 2004. The procedural rates were calculated as the register count per 100,000 persons in the population defined by the ONS.

the basis of the 1991 and 2001 census in conjunction with intra-census projections and estimates.

Statistical analysis

Statistical analysis was performed using STATA v.9.2 (STATA Corp., Texas, USA). The rate of primary THR and TKR per 100,000 was calculated by dividing the number of procedures in the register by the corresponding catchment population from the ONS for a particular age, gender and year.

The number of procedures performed in a given year and for a particular age–gender group was assumed to follow a Poisson distribution. The annual change in the procedural rate of primary THR and TKR was modelled with use of a Poisson regression with age, gender, diagnosis and calendar year as co-variables. Two-way interactions between gender, diagnosis, age and calendar year were included in the regression model. Results are presented as incidence rate ratios (IRRs). An IRR of 1.05 indicates that a one unit change for a co-variate, *e.g.* gender, leads to a 5% increase in the relative incidence of primary procedural rate.

The effects of gender, age and diagnosis on procedural rates of primary THR and TKR during the 14-year period (1991–2004) were evaluated. The frequency of primary THR and TKR was categorised by gender (male and female), five age groups (45–55, 56–65, 66–75, 76–85, and 86 or more years old) and by three diagnosis groups (osteoarthritis, rheumatoid arthritis and trauma).

Results

A total of 26,281 THRs and 25,606 TKRs were recorded in the register during the 14-year period from 1991–2004.

Figure 2 Procedural rates of primary total hip replacement by gender.

The rate of primary THR remained steady, whereas the rate of primary TKR increased significantly between 1991–2004. The rate of primary THR per 100,000 persons increased by 16% and the corresponding rate of primary TKR increased by 42% during the 14-year period.

Initially, there was a large difference between the prevalence of THR and TKR in the early 1990s. This difference diminished with time, leading to very similar prevalence between THR and TKR from 2001 onwards. The number of primary THRs increased from 1618 in 1991 to 2258 in 2004, while the number of primary TKRs increased from 1064 in 1991 to 2165 in 2004. With the population according to the ONS taken into account, the overall mean rate of primary THR and TKR was 118 and 106 procedures per 100,000 persons per year respectively (Fig. 1).

Figure 3 Procedural rates of primary total knee replacement by gender.

Figure 4 Procedural rates of primary total hip replacement by diagnosis.

Overall trends

The rates of primary THR and TKR were 28% and 22%, significantly higher respectively for females than males ($P < 0.0001$; Figs 2 and 5). The rates of primary THR and TKR were also significantly higher for osteoarthritis compared to rheumatoid arthritis and trauma ($P < 0.001$). The rate of primary THR for osteoarthritis was 110 per 100,000 persons compared to 5.7 and 2.3 per 100,000 persons for rheumatoid arthritis and trauma, respectively (Fig. 4). The rate of primary TKR for osteoarthritis was 95 per 100,000 persons compared to 10 and 1.2 per 100,000 persons for rheumatoid arthritis and trauma, respectively (Fig. 5). The rates of primary THR and TKR for rheumatoid arthritis and trauma did not change significantly over time. The rates for primary THR and TKR in the 76–85-year-old age group were significantly

Figure 5 Procedural rates of primary total knee replacement by diagnosis.

higher than those in the other age-groups ($P < 0.001$; Figs 6 and 7). The rate of primary THR and TKR in the youngest age group (45–55 age group) did not change significantly over time.

Temporal trends for total hip replacement

We analysed the procedural rate of primary THR with a Poisson regression model. The overall adjusted prevalence during the 14-year period did not change significantly (IRR = 1.0; 95% confidence interval [CI] 0.99–1.0; $P = 0.875$). The results for gender, diagnosis and age were all significant over time (all $P < 0.001$). Females had an increased IRR (29%) for primary THR compared to males over time (IRR = 1.29; 95% CI 1.26–1.35). Osteoarthritis remained the main diagnosis for undertaking a primary THR with an IRR of 0.051 compared to rheumatoid arthritis (95% CI

Figure 6 Procedural rates of primary total hip replacement by age group.

Figure 7 Procedural rates of primary total knee replacement by age group.

Table 1 Incidence rate ratios (IRRs) of co-variables for primary THR rate

Co-variate	IRR	95% CI	P-value
Year	1.0	0.99–1.0	0.875
Females	1.29	1.26–1.33	< 0.001
Osteoarthritis	–		
Rheumatoid arthritis	0.051	0.048–0.054	< 0.001
Trauma	0.021	0.020–0.023	< 0.001
45–55 age group	–		
56–65 age group	3.6	3.4–3.7	< 0.001
66–75 age group	6.3	6.0–6.5	< 0.001
76–85 age group	6.7	6.4–7.0	< 0.001
Greater than 85 age group	2.9	2.7–3.2	< 0.001

Females compared to males.

Rheumatoid arthritis and trauma compared to osteoarthritis.

All age-groups compared to 45–55 age group.

Table 2 Incidence rate ratios (IRRs) of co-variables for primary TKR rate

Co-variate	IRR	95% CI	P-value
Year	1.025	1.021–1.028	< 0.001
Female	1.17	1.14–1.20	< 0.001
Osteoarthritis	–		
Rheumatoid arthritis	0.10	0.098–0.11	< 0.001
Trauma	0.013	0.012–0.015	< 0.001
45–55 age group	–		
56–65 age group	6.2	5.8–6.6	< 0.001
66–75 age group	14.1	13.3–15.0	< 0.001
76–85 age group	15.3	14.4–16.3	< 0.001
Greater than 85 age group	5.4	4.9–5.9	< 0.001

Females compared to males.

Rheumatoid arthritis and trauma compared to osteoarthritis.

All age-groups compared to 45–55 age group.

0.048–0.054). The IRR of primary THR increased with age to a maximum of 6.72 (95% CI 6.43–7.05) in the 76–85-year-old age group. A summary of the Poisson regression analysis for primary THR is provided in Table 1.

Temporal trends for total knee replacement

We analysed the procedural rate of primary TKR with a Poisson regression model. The overall adjusted prevalence during the 14-year period increased significantly by 2.5% (IRR = 1.025; 95% CI 1.021–1.028; $P < 0.001$). The results for gender, diagnosis and age were all significant over time (all $P < 0.001$). Females had an increased IRR (17%) for primary TKR compared to males over time (IRR = 1.17; 95% CI 1.14–1.20). Osteoarthritis remained the main diagnosis for undertaking a primary TKR with an IRR of 0.10 compared to rheumatoid arthritis over time (95% CI 0.098–0.11). The IRR of primary TKR increased with age to a maximum of 15.3 (95% CI 14.4–16.3) in the 76–85-year-old age group. A summary of the Poisson regression analysis for primary TKR is provided in Table 2.

Discussion

To our knowledge, this study represents the first in the literature to evaluate trends in primary THR and TKR rates within a region in England, using a regional arthroplasty register. The accuracy of our register has been previously assessed. Over 97% of total joint replacements performed in the Trent region were captured onto the register and the inaccuracies recorded were less than 1.8%.¹⁰ This high rate of compliance and low level of inaccuracy is due to a peri-

operative clerk who visits the hospitals in the region to scrutinise records.

The National Joint Registry (NJR) has been collecting information on both THR and TKR in England and Wales since April 2003,¹¹ having been set up following a report into the 3M Capital Cemented Hip System which suggested that a national hip register be established.¹² The potential uses of an arthroplasty register have been well appreciated following the early experiences with the Trent Regional Arthroplasty Study¹⁰ in the UK and with successful overseas registers, particularly in Scandinavia.^{4–6,9,13,14}

Our results show a significant increase in the rate of TKR within the Trent region over the last 14 years, with a steady prevalence in the rate of primary THR. This could represent an increased catchment population over the last 14 years, but may also represent increases in both service provision and patient demand. The rate of joint replacement in the 45–55-year-old age group has not increased markedly over time, but a suggestion of a slight increase in the rate of primary THR in this age group might be emerging over the last 3 years from our data. This may be attributed to a trend for increasingly aggressive surgical intervention in these younger patients with osteoarthritis, particularly with regard to resurfacing arthroplasty of the hip.

Our results show that osteoarthritis remains the main reason for joint replacement and the main cause for the significant increase in TKR over this period. The rate of joint replacement for rheumatoid arthritis and trauma has remained constant over this period. It is possible that the rate of THR for trauma in the form of fractured neck of femur may well rise over the next few years following

recent publications recommending THR over other options, but this is not evident from our study.^{15,16}

Our study compares favourably with those of other studies, particularly in the US.¹⁷ Dixon *et al.*¹⁸ from the UK showed increases in the rate of primary THR and TKR in the period 1991–2001 with large increases in the rate of revision joint replacements. Dixon *et al.*¹⁸ used Hospital Episode Statistics (HES) data held by the Department of Health to evaluate the trends in THR and TKR in England. The trends obtained in these studies can help to project service requirements in the future, allowing better planning of the use of health resources.¹⁹ Dixon *et al.*¹⁸ predicted that TKRs would be more common than THRs in England by 2010¹⁸ and this has occurred in 2005.¹¹ Combined with increasingly operating on a younger population, this will have significant impacts on the rate of revision joint replacement in the future. This is likely to have a significant effect on health budgets and service provision.²⁰

Study limitations

We did not evaluate trends after 2004 since the NJR was established. The NJR has been collecting data from April 2003 and compliance with the TRAS data collection might have decreased after this period. TRAS collects data on joint replacements performed in the private sector. Independent Sector Treatment Centres were only established in the region post 2004. A further limitation of the study is that up until 1997, under a scheme known as ‘GP fund holding’, patients could be referred to any hospital nation-wide. This could possibly explain the sudden increases in the procedural rates of both primary THR and TKR during this period. More recently, under a current scheme called ‘Patient Choice’, patients are offered a choice of up to five hospitals for treatment, which may be out of their usual PCT catchment area, especially if they live near the PCT boundary. Therefore, we may have not included patients that had joint replacements outside the hospitals within their catchment area or may have included patients who had joint replacements within the Trent region but were from other regions.

Conclusions

The trends reported in our study have important ramifications with regards to the number of THR and TKR expected to be performed in the future. The number of primary TKRs performed is increasing and the greater number of primary joint replacements will result in a greater number of revision joint replacements. The NJR continues to collect data for joint replacements in England and Wales. Future projections of primary joint replacements should be more accurate and provide trends for different health providers. Our results can be used as a preliminary study for future trend evaluations by the NJR in the forthcoming years.

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