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Trends in prevalence and implant types in the Nova Scotia Joint Database Registry between 2005 and 2021

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Aims

The aim of this study is to evaluate the change in incidence rate of shoulder arthroplasty, indications, and surgeon volume trends associated with these procedures between January 2003 and April 2021 in the province of Nova Scotia, Canada.

Methods

A total of 1,545 patients between 2005 and 2021 were analyzed. Patients operated on between 2003 and 2004 were excluded due to a lack of electronic records. Overall, 84.1% of the surgeries (n = 1,299) were performed by two fellowship-trained upper limb surgeons, with the remainder performed by one of the 14 orthopaedic surgeons working in the province.

Results

Total shoulder arthroplasty (TSA) was the most frequent procedure (32.17%; n = 497), followed by stemmed hemiarthroplasty (SHA) (27.7%; n = 428). The most frequent indication for primary shoulder arthroplasty was degenerative osteoarthritis (58.1%; n = 882), followed by acute proximal humerus fracture in 15.11% (n = 245), and rotator cuff arthropathy in 14.18% (n = 220). The overall rate of revision was 7.7% (2.8% to 11.2%). The number of TSAs and reverse shoulder arthroplasties (RSAs) has been increasing since 2016. The amount of revision cases is proportional to the number of operations performed in the same year throughout the study period.

Conclusion

The incidence of shoulder arthroplasty in the Maritime Provinces has increased over the last 16 years. Revision rates are similar the those found in other large database registries. Reverse shoulder arthroplasty prevalence has increased since 2016.

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Introduction

Shoulder arthroplasty has significantly grown in the last decade, currently positioned as the third most commonly replaced joint after hip and knee worldwide.[1] There are now a broad variety of indications for this procedure, not only primary osteoarthritis (OA) in the elderly, but also younger adult patients dealing with rheumatoid arthritis, avascular necrosis, inflammatory arthritis, post-traumatic arthritis, and chronic instability, among others.[2]

Different designs and varieties of shoulder arthroplasty are available, such as stemmed (SHA) and resurfacing hemiarthroplasty (RHA), total shoulder arthroplasty (TSA), and reverse shoulder arthroplasty (RSA), all of which have been shown to provide substantial pain relief and functional improvement.[3]

The exponential growth of shoulder arthroplasty has been associated with a corresponding increase in revision rates. Since 2002, there has been an increase of approximately 392% in revision shoulder

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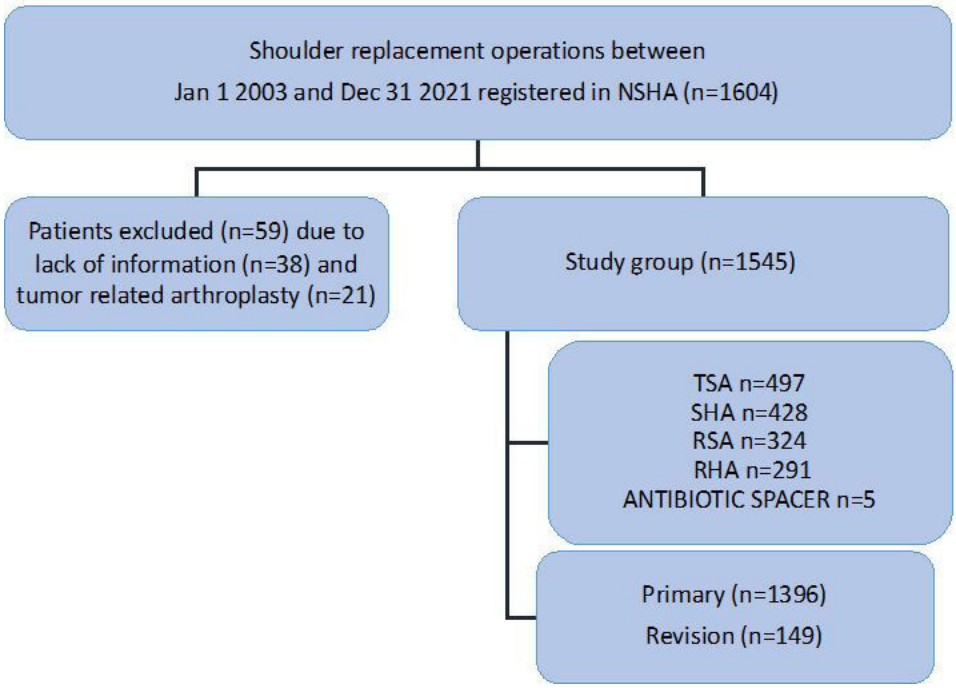

Fig. 1

Flowchart of patient selection from the Joint Database Registry and data included in the study. NSHA, Nova Scotia Health Authority; RHA, resurfacing hemiarthroplasty; RSA, reverse shoulder arthroplasty; SHA, stemmed hemiarthroplasty; TSA, total shoulder arthroplasty.

Table I. Demographic data of the pooled cohort.

Characteristic	Overall	Primary surgery	Revision surgery	p-value*
Total, n	1,545	1,396	149	
Age group, n (%)				
< 55 yrs	179 (11.59)	152 (10.89)	27 (18.12)	0.008
55 to 64 yrs	420 (27.18)	372 (26.65)	48 (32.21)	0.146
65 to 74 yrs	549 (35.53)	507 (36.32)	42 (28.19)	0.048
≥ 75 yrs	397 (25.7)	365 (26.15)	32 (21.48)	0.215
Sex, n (%)				
Female	821 (53.14)	746 (53.44)	75 (50.34)	0.471
Male	724 (46.86)	650 (46.56)	74 (49.66)	0.471
Side, n (%)				
Right	846 (54.76)	760 (54.44)	86 (57.72)	0.447
Left	699 (45.24)	636 (45.56)	63 (42.28)	0.447
Type of procedure, n (%)†				
TSA	497 (32.17)	446 (31.95)	51 (34.23)	0.400
SHA	428 (27.7)	397 (28.44)	31 (20.81)	0.077
RHA	291 (18.83)	291 (20.85)	0 (0)	< 0.001
RSA	324 (20.97)	262 (18.77)	62 (41.61)	< 0.001

*Chi-squared test.
†Five patients in the revision group recieved an antibiotic spacer.
RHA, resurfacing hemiarthroplasty; RSA, reverse shoulder arthroplasty; SHA, stemmed hemiarthroplasty; TSA, total shoulder arthroplasty.

arthroplasty in the USA.[4] It is reported that patients aged under 60 years have a four-times higher risk of revision compared to patients aged over 85 years old.[5]

Several short- to mid-term studies have been performed using data from large registry databases in Europe and Australia, most of which report on survivorship, complications after revision, and reoperation rates.[6-14] However, there is no consensus of the definition of revision, and therefore revision rates differ between the studies, which may lead to a misinterpretation of the data.[15] Furthermore, the main reported revision indications differ around the world: glenoid arthritis

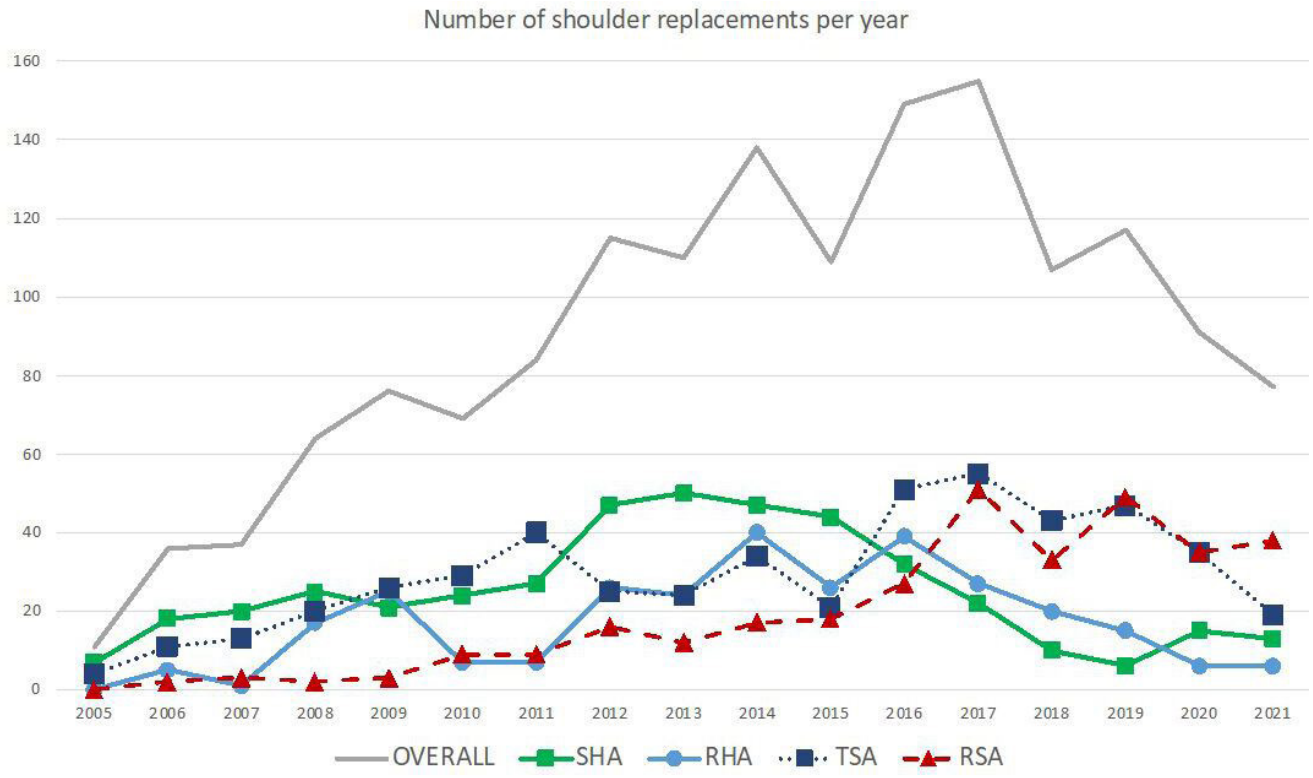

Fig. 2

Line graph illustrating the annual number of shoulder arthroplasties for type of implant. RHA, resurfacing hemiarthroplasty; RSA, reverse shoulder arthroplasty; SHA, stemmed hemiarthroplasty; TSA, total shoulder arthroplasty.

is the main indication in North America, while rotator cuff deficiency is the main indication in the European data.[1]

The North American literature on shoulder arthroplasty is isolated to some areas in the USA, organized by either healthcare insurance providers or at a single centre.[3,16-20] Given the lack of overall recent long-term registry literature in shoulder arthroplasty, in addition to the paucity of any Canadian data, the aim of this study is to evaluate the change in incidence rate of shoulder arthroplasty, the use of shoulder arthroplasty for specific indications, and the surgeon volume trends associated with these procedures, between the inception of the database (January 2003) and 2021 in the Maritime Province of Nova Scotia, Canada.

Methods

After institutional ethics board approval, an analysis was conducted from the prospectively collected patients from the Joint Database Registry at the Halifax Infirmary (part of the Queen Elizabeth II Health Sciences Centre), which is the referral centre for shoulder arthroplasty in the Maritime Provinces of Canada.

The inclusion criteria contained all patients who required a primary or revision shoulder arthroplasty including RHA, SHA, TSA, and RSA in the period from 2003 to 2021. Revision surgery was defined as removal of previous arthroplasty components and implantation of new components. Polyethylene exchange and the addition of a glenoid component in SHA were also included.

Table II. Frequency of diagnosis in primary arthroplasty.

Diagnosis	n (%)
Degenerative OA	811 (58.09)
Acute fracture	211 (15.11)
Rotator cuff arthropathy	198 (14.18)
Inflamatory disease	58 (4.15)
Post-traumatic OA	58 (4.15)
Avascular necrosis	50 (3.58)
Other	10 (0.72)

OA, osteoarthritis.

The exclusion criteria involved patients with any type of bony or soft-tissue tumour that involved the shoulder joint and required resection, and reconstruction or a pathological fracture that required a shoulder arthroplasty of any type. The lack of sufficient electronic information from 2003 to 2004 led to the elimination of all the patients operated in this period (Figure 1).

Statistical analysis. Pooled descriptive analysis of collected data was used to understand patient demographic details such as age, sex, operative side, procedure performed, and revision rates. Indications for surgery were

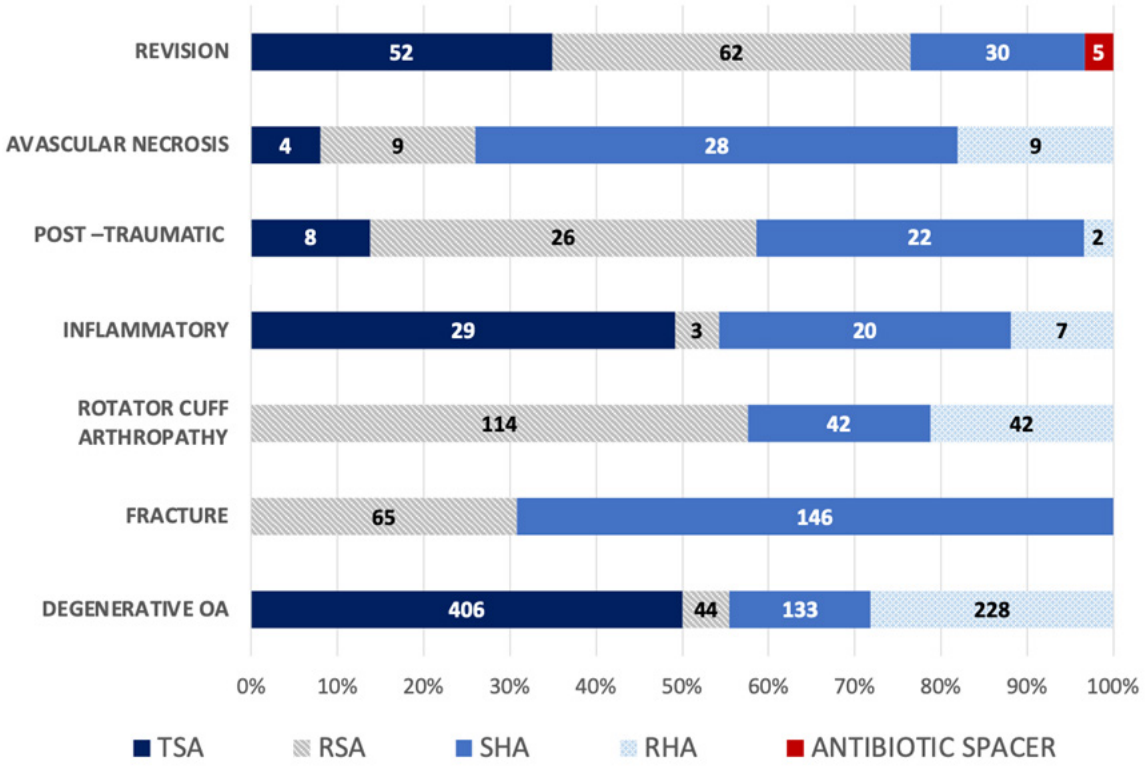

Fig. 3

Distribution of number of cases presented by diagnosis and type of implant. RHA, resurfacing hemiarthroplasty; RSA, reverse shoulder arthroplasty; SHA, stemmed hemiarthroplasty; TSA, total shoulder arthroplasty.

included in the case of primary procedure. Chi-squared tests were used to determine statistical significance. Statistical analyses were performed using SPSS v. 27 (IBM, USA). The threshold for significance was set at $p < 0.05$.

Results

Following the application of the inclusion and exclusion criteria, a total of 1,545 patients from 2005 to 2021 were analyzed (Figure 1). All patients had their shoulder arthroplasties performed with a standard deltopectoral approach at the Halifax Infirmary, Queen Elizabeth II Health Sciences Centre in Canada. Overall, 84.1% of the surgeries (n = 1,299) were executed by two fellowship-trained upper limb surgeons, while the other procedures were performed by one of the 14 orthopaedic surgeons working in the same centre.

The mean age was 66.9 years (standard deviation (SD) 10.2 years) for all the included patients with a male:female ratio of 1:1.13. The majority of the shoulder arthroplasties were performed in patients aged 65 to 74 years (35.53%; n = 549). TSA was the most frequent procedure with 32.17% (n = 497), followed by SHA with 27.7% (n = 428) (Table I).

The most frequent indication for primary shoulder arthroplasty was degenerative OA (58.09%; n = 811), followed by acute proximal humerus fracture and rotator cuff arthropathy (15.11% (n = 211) and 14.18% (n = 198), respectively) (Table II). Of the patients with degenerative OA, 50.1% of were treated with TSA (n = 406) and 5.4% with RSA (n = 44).

The overall rate of revision was 7.7% (2.8% to 11.2%). The majority were revised to RSA in 41.6% (n = 62). Only 3.4% (n = 5) required a staged procedure with antibiotic spacer for infection. The percentage of revision cases performed during each of the study years was in accordance with the surgeries done every year, remaining proportional to the number of cases (Table I).

Overall, the amount of shoulder procedures performed per year has risen since 2005, reaching its highest point in 2017 with a total of 155 procedures. An increasing trend can be identified for TSA and RSA, which is more noticeable since 2016 and ongoing, whereas a significant decreasing focus on SHA and RHA can be seen (Figure 2).

SHA was the most frequent procedure from 2005 to 2008), before TSA started increasing over the following three years. Since 2016, both TSA and RSA had similar peaks (Figure 2). RSA had a more constant pattern of

growth since the beginning of the database and became the most frequently performed surgery in 2021.

The overall number of procedures dropped from 2019 to 2021 due to the loss of elective surgical procedures during the COVID-19 pandemic. There was a reciprocal change in the amount of RSA versus TSA over that same timeframe, likely related to the increased use of RSA for trauma.

Discussion

Shoulder arthroplasty has been increasing worldwide due to a higher demand in the number of patients requiring this procedure. It is estimated to have had a seven-fold rise since 2015 in patients over the age of 55 years.[21] Our data show a significant growth for an overall seven-fold increase in all the included data, but a rapid 13-fold increase in the period between 2005 and 2017.

Despite the significant increase in the number of procedures during these years, patients aged 65 to 74 years remained the main group treated with shoulder arthroplasty. Contrary to a projected model for the USA,[21] patients younger than 55 years in our study did not have a significant increase in the rate of surgery or revision.

Rosen et al[22] reported results from Israel in the period of 2006 to 2014 with similar trends to our data. They had a noticeable increase in RSA in 2014, with a proportional decline of SHA in the same year. This could be related to an expansion in RSA indications, allowing shoulder surgeons to use it more frequently.[18]

Degenerative OA was identified as the main indication for shoulder arthroplasty in our population. Overall, 50.1% of these patients were treated with TSA and only 5.4% with RSA (Figure 3). We think that the main reason for this pattern is due to a low frequency of large glenoid defects in our population with degenerative OA. When analyzing the type of implant used by age group, it was observed that 60% of these cases were treated with RHA in younger patients (< 55 years) whereas in the next age group (55 to 64 years) both TSA and RHA are used in similar frequency (40.4 and 43.3%, respectively). This finding changes for patients older than 65 years, where the use of TSA is predominant (59.2% for 65 to 74 years and 59.5% for > 75 years).

With regard to revision rates, Rasmussen et al[8] reported a revision rate of 10% from the Danish Shoulder Arthroplasty Registry for TSA and SHA. The Australian Joint Replacement Registry described a one-year revision rate of 6.1%, 5.2%, and 6.8% following TSA, RSA, and SHA respectively, in 2021.[23] Our revision rates are similar with an overall frequency of 7.7% (n = 149) for all implant types. It is important to note that a large proportion of the included population were treated with SHA and RHA (46.3%) and required a single-stage revision procedure due to glenoid erosion whereas two-stage revision surgeries were infrequent (five cases).

This is an observational study based on a database registry. Our findings indicate how the prevalence and types of shoulder arthroplasty usage have changed with the passage of time. Our aim was not to compare the results of different methods of treatment, report outcome, revision rates, or survivorship. There are several limitations to this study. First, there was a lack of preoperative and postoperative functional scores available to compare patient outcomes. Second, this is a single-centre prospective database analysis, and there may be an information bias due to patients emigrating from the province, resulting in some patients being lost to follow-up. Therefore, we suggest an attempt at establishing a national database, or expanding the existing Canadian Joint Replacement Registry to include shoulders rather than just hips and knees, to encourage further study of the overall survivorship of the implants.

In summary, shoulder arthroplasty has an increasing incidence over the last 16 years. Stemmed and unstemmed hemiarthroplasty procedures are decreasing in frequency and being replaced by total and reverse shoulder arthroplasty: reverse shoulder arthroplasty prevalence has increased since 2017. Revision rates are similar to other large database registries.

Take home message

- Stemmed hemiarthroplasty and resurfacing hemiarthroplasty are becoming more limited worldwide.
- Reverse shoulder arthroplasty is being positioned as the main shoulder arthroplasty performed in recent years.

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- D. G. Johnston: Conceptualization, Supervision, Validation, Visualization, Writing – review & editing.
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