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# Comparison of Patients Undergoing Primary Shoulder Arthroplasty Before and After the Age of Fifty

By Matthew D. Saltzman, MD, Deana M. Mercer, MD, Winston J. Warme, MD,  
Alexander L. Bertelsen, PAC, and Frederick A. Matsen III, MD

*Investigation performed at the Department of Orthopedics and Sports Medicine, University of Washington Medical Center, Seattle, Washington*

**Background:** The reported outcomes of shoulder arthroplasty in patients under the age of fifty years are worse than those in patients over fifty. While there are several possible explanations for this finding, we explored the possibility that patients who had a primary shoulder arthroplasty when they were under fifty years of age differed from those who had the procedure when they were over fifty with respect to their pre-arthroplasty self-assessed comfort and function, sex distribution, and specific type of arthritis.

**Methods:** The study group consisted of patients with glenohumeral arthritis who were treated with a primary shoulder arthroplasty by the same surgeon between 1990 and 2008. For each decade of age, the sex distribution, the pre-arthroplasty self-assessed shoulder comfort and function, and the prevalence of twelve different diagnoses were documented. We reviewed the series for three potential causes of worse outcomes in patients under fifty years of age as compared with those over fifty years of age: (1) a higher percentage of women, (2) a lower score for pre-arthroplasty self-assessed comfort and function, and (3) more complex pathological conditions.

**Results:** Patients under the age of fifty years were not more likely than those over fifty to be female or to have a lower pre-arthroplasty self-assessed comfort and function score, but they did have more complex pathological conditions, such as capsulorrhaphy arthropathy, rheumatoid arthritis, and posttraumatic arthritis. Only 21% of the younger patients had primary degenerative joint disease, whereas 66% of the older patients had that diagnosis. This difference was significant ( $p < 0.000000001$ ).

**Conclusions:** Surgeons performing shoulder arthroplasty in individuals under the age of fifty should be prepared to encounter pathological conditions such as capsulorrhaphy arthropathy, rheumatoid arthritis, and posttraumatic arthritis rather than primary osteoarthritis, which is more common in individuals older than fifty. The pathoanatomy in these younger patients may complicate the surgery, the rehabilitation, and the outcome of the shoulder arthroplasty.

Shoulder arthroplasty is most commonly performed for glenohumeral osteoarthritis in individuals over the age of sixty years<sup>1-3</sup>. Historically, <10% of shoulder arthroplasties have been performed in individuals under the age of fifty<sup>4</sup>. The outcomes of shoulder arthroplasty have been noted to be worse than expected for patients under fifty years of age<sup>5-7</sup>. While recently there have been additional reports of shoulder arthroplasty in younger individuals<sup>8-11</sup>, a PubMed literature review on March 22, 2009, revealed no direct comparison of the characteristics of young patients undergoing shoulder arthroplasty with those of older patients undergoing this procedure. We were

particularly interested in comparing the sex distribution, preoperative self-assessed comfort and function, and distribution of preoperative diagnoses between the younger and older age groups because it has been observed that these factors may affect the outcome of reconstructive surgery<sup>5,10,12-20</sup>.

Specifically, we reviewed the series for three potential causes of worse outcomes of shoulder arthroplasty in individuals under the age of fifty: (1) a higher percentage of women, (2) worse pre-arthroplasty self-assessed comfort and function, and (3) a higher prevalence of diagnoses that are more complex than straightforward primary degenerative joint disease.

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**TABLE I Age and Sex Distribution by Diagnosis**

Diagnoses	Women <50 Yr	Men <50 Yr	Women >50 Yr	Men >50 Yr	Total
Capsulorrhaphy arthropathy	19	39	8	40	106
Degenerative joint disease	5	31	168	399	603
Posttraumatic arthritis	9	16	29	18	72
Osteonecrosis	7	11	13	4	35
Rheumatoid arthritis	13	5	43	8	69
Other inflammatory arthritis	8	2	13	6	29
Cuff tear arthropathy	0	1	52	44	97
Postinfectious arthritis	1	1	2	3	7
Glenoid dysplasia	0	1	2	3	6
Instability arthritis	2	0	2	0	4
Charcot arthropathy	1	0	0	0	1
Giant cell tumor	0	0	0	1	1
Total	65	107	332	526	1030

### Materials and Methods

One thousand and forty-five consecutive patients with glenohumeral arthritis who were treated with a primary shoulder arthroplasty by the same surgeon (F.A.M. III) between 1990 and 2008 were initially included in the study group. The age, sex, results of the preoperative Simple Shoulder Test (SST), and diagnosis were documented by the surgeon at the time of the surgical procedure and entered at that time into a database approved for clinical research by our human subjects committee. The SST self-assessment of shoulder comfort and function is well established and has been used extensively in other studies<sup>21-24</sup>. The necessary and sufficient criteria for the various diagnoses have been previously published and were consistently applied by the surgeon during the period of this investigation<sup>17,25</sup>. The decision to perform a shoulder arthroplasty was made jointly by the patient and surgeon after a detailed discussion about the alternatives and risks of the procedure. A variety of arthroplasty procedures were used in this population, but the choice of procedure was not analyzed because a correlation of the arthroplasty type with the outcome was not a purpose of this study. For each decade of age, we assessed the prevalence of twelve different diagnoses, the sex distribution, and the self-assessed shoulder comfort and function prior to the primary shoulder arthroplasty. Fifteen of the records were incomplete, and the necessary data could not be determined; these patients were excluded from the analysis. This left 1030 patients for analysis.

Because five diagnoses (postinfectious arthritis, glenoid dysplasia, instability arthritis, Charcot arthropathy, and giant cell tumor) were recorded for fewer than eight patients each, these patients (nineteen in total) were excluded from further analysis; six of these patients were under fifty and thirteen were over fifty at the time of the operation.

Because this investigation was not a clinical trial, it was not necessary to register it in a public trials registry.

### Statistical Analysis

Chi-square analyses were used to evaluate differences in SST scores according to sex and decade of age. The SST scores for male and female patients for each decade of age were analyzed with use of the unpaired t test with assumption of unequal variance. Significance was defined as  $p < 0.05$ .

### Source of Funding

No external funding was received for this investigation.

### Results

The distributions of diagnoses by age and by sex are shown in Table I. Seventeen percent of the patients were under and 83% were over fifty years of age. Patients under the age of fifty were not more likely to be female than those over fifty years of age. Thirty-eight percent of the patients under fifty and 39% of those over fifty were female. This difference was thought to be clinically irrelevant and thus no statistical analysis was performed.

**TABLE II Total SST Score by Decade and Sex\***

Decade	Women	Men	P Value
3	2.0 ± 3.1	3.9 ± 2.2	0.29
4	2.3 ± 1.9	3.4 ± 2.5	0.13
5	2.1 ± 2.3	4.3 ± 2.7	<0.001
6	2.7 ± 2.5	4.1 ± 2.8	<0.001
7	1.9 ± 2.0	3.9 ± 2.8	<0.001
8	2.1 ± 2.2	3.7 ± 2.8	<0.001
9	1.7 ± 2.1	3.1 ± 2.5	0.01
10	0.8 ± 0.5		

\*Values are given as the mean and the standard deviation.

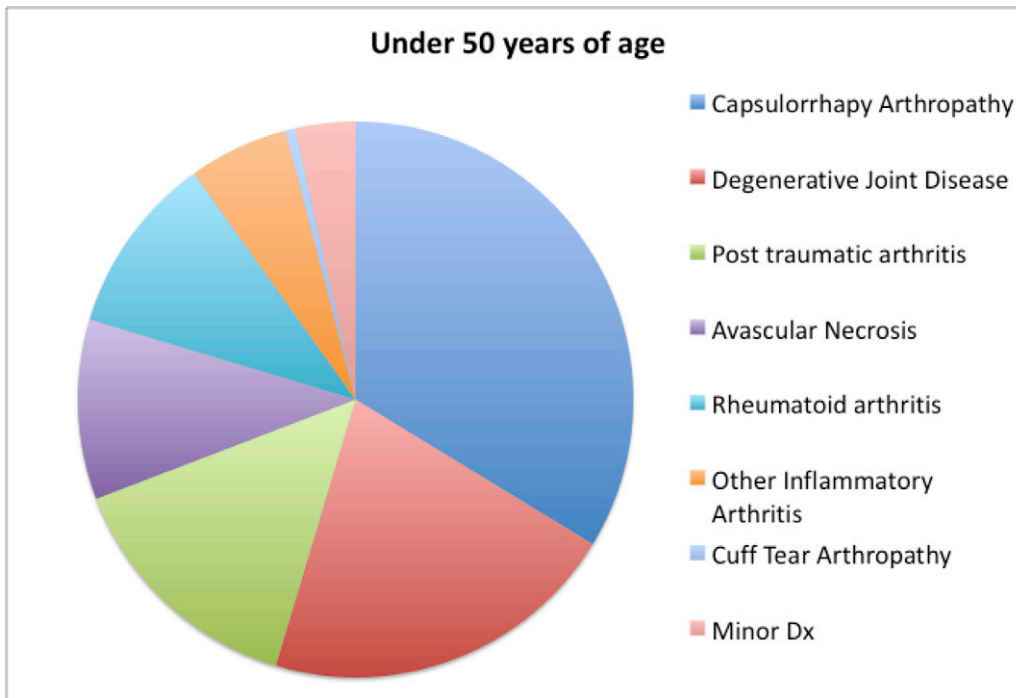


Fig. 1-A

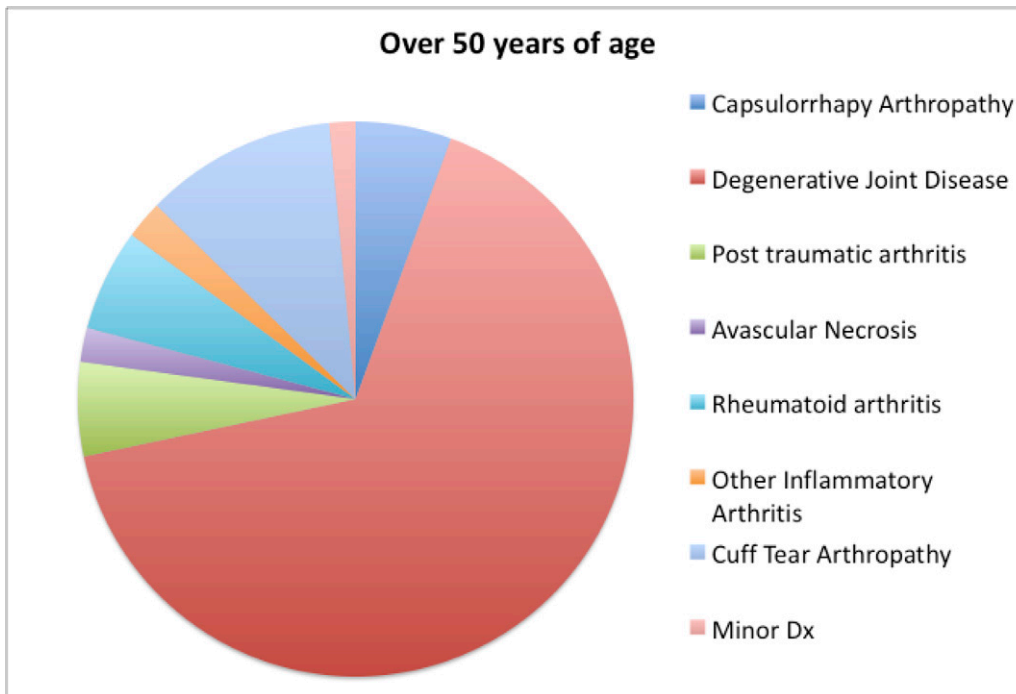


Fig. 1-B

Distribution of eight diagnoses by age in patients under fifty years of age (Fig. 1-A) and those over fifty years of age (Fig. 1-B). Minor Dx = minor diagnoses, including postinfectious arthritis, glenoid dysplasia, instability arthritis, Charcot arthropathy, and giant cell tumor; fewer than eight patients had each of these diagnoses.

The mean pre-arthroplasty self-assessed comfort and function (SST) score (and standard deviation) for the patients under fifty years of age ( $3.37 \pm 2.66$  points) was not worse than that for the patients over fifty years of age ( $3.15 \pm 2.71$  points)

(Table II). Because this difference was thought to be clinically irrelevant, no statistical analysis was performed. It is of note that the pre-arthroplasty SST scores for women were consistently lower than those for men in the same decade of life. It is

also of note that the pre-arthroplasty SST scores for women and those for men were remarkably consistent across the age groups.

Patients under fifty years of age had a higher prevalence of diagnoses that were more complex than straightforward primary degenerative joint disease. Of the 172 patients under fifty, 136 (79%) had a diagnosis other than primary degenerative joint disease in comparison with 291 (34%) of the 858 patients over fifty (chi-square  $p < 0.000000001$ ) (Figs. 1-A and 1-B) (Table I).

## Discussion

Shoulder arthroplasty is most commonly used in individuals over the age of fifty years to treat primary glenohumeral osteoarthritis. The outcomes are generally good from the perspective of both the patient and the surgeon<sup>26-36</sup>. Shoulder arthroplasty is also used to manage destruction of the glenohumeral joint from a variety of causes in younger individuals. The reported outcomes of shoulder arthroplasty in younger individuals are inferior to those for their older counterparts. Sperling et al. reviewed the results of seventy-eight Neer shoulder hemiarthroplasties and thirty-six Neer total shoulder arthroplasties performed in patients who were fifty years of age or younger<sup>6</sup>. Sixty-two shoulders treated with a hemiarthroplasty and twenty-nine treated with a total shoulder arthroplasty had a complete preoperative evaluation and complete operative records and had been followed for a minimum of fifteen years or until revision, and they were included in the clinical analysis. While there was significant ( $p < 0.0001$ ) long-term pain relief and improvement in active abduction and external rotation after these procedures, the results, assessed with use of the Neer rating system, were not good. There were six excellent, nineteen satisfactory, and thirty-seven unsatisfactory results after the hemiarthroplasties and six excellent, nine satisfactory, and fourteen unsatisfactory results after the total shoulder arthroplasties. The authors concluded that "care should be taken, and alternative methods of treatment should be actively considered, when either a hemiarthroplasty or a total shoulder arthroplasty is offered to patients who are fifty years old or less." Other articles have confirmed the challenges of performing shoulder arthroplasty on younger patients<sup>5,10</sup>.

Because surgeons will continue to be consulted by patients under fifty who have glenohumeral arthritis, it is important to identify factors that may contribute to suboptimal outcomes. Possible factors are that, in comparison with their older counterparts, younger patients have (1) relatively greater impairment of shoulder function before surgery; (2) a different sex distribution, leading to different perceptions of outcome; (3) different diagnoses, including more complex pathological conditions; (4) increased demands and activity that increase the risk of loosening and wear; (5) increased expectations, making them at greater risk for dissatisfaction; and (6) increased longevity, enabling more problems to appear over time. Identification of such factors would enable the surgeon to have a more informed preoperative discussion with a

younger patient who is considering arthroplasty. In this study, we explored the first three of these factors.

It has been previously recognized that women tend to report lower levels of comfort and function than men for the same diagnoses<sup>13,16,17,19,20</sup>. We reviewed our series of patients to determine if more women than men were under fifty years old, as such a discrepancy may contribute to the perception of a worse outcome. The proportion of women was essentially the same in the younger and older age groups. Additionally, we reviewed the possibility that individuals under the age of fifty have greater self-assessed disability before surgery, which might predispose them to the occurrence of a worse outcome. However, the patients under the age of fifty in our study did not have lower scores on the preoperative SST.

We also reviewed the possibility that the diagnoses of individuals under the age of fifty who undergo shoulder arthroplasty include a greater number of pathological conditions, such as capsulorrhaphy arthropathy (arthritis that occurs following a previous surgical stabilization procedure), that are more difficult to manage than straightforward degenerative joint disease. Capsulorrhaphy arthropathy was the diagnosis for 34% of the patients under fifty and only 6% of those in the older group. Rheumatoid arthritis was the diagnosis for 10% of the patients under fifty and only 6% of the older patients. Posttraumatic arthritis was the diagnosis for 15% of the younger patients and only 5% of those who were older. In contrast, only 21% of the younger patients had primary degenerative joint disease, whereas 66% of the older patients had this diagnosis. More complex pathological conditions are likely to have greater abnormalities of soft tissue and bone that can make surgery more difficult and compromise the outcome of shoulder arthroplasty in individuals under the age of fifty.

While previous studies have suggested that an age of less than fifty years is a predictor of worse outcomes after shoulder arthroplasty<sup>5,6</sup>, the findings of the present study suggest that the preoperative diagnosis may be a more important factor. For example, an older patient with capsulorrhaphy arthropathy may have a worse outcome than an older individual with degenerative joint disease; however, the outcome may be similar to that of a younger individual with the same diagnosis. Future studies should be performed to evaluate whether patients under the age of fifty have lower outcome scores than their older counterparts when preoperative diagnosis is controlled for.

While the data do not suggest that a difference in sex distribution predisposes patients to inferior outcomes, the consistency of the difference in the pre-arthroplasty self-assessed comfort and function between the women and men indicates that stratification by sex may still be important in clinical outcome studies of shoulder arthroplasty.

These findings need to be interpreted in light of certain limitations. First, this series represents the experience of only one surgeon. Second, we did not compare the outcomes of the shoulder arthroplasty with the preoperative characteristics of the patient. Third, this study did not address all of the pre-

operative characteristics that may differ between patients younger and older than fifty years of age. Fourth, the patients in this study underwent a variety of arthroplasty procedures selected on the basis of our approach to shared decision-making; there may be different indications and combinations of procedures in other practices.

Despite these limitations, it is clear that there was a significant difference in the distribution of diagnoses between the younger and older patients in this population treated with primary shoulder arthroplasty. However, the younger group did not have a higher prevalence of women or a lower preoperative score for self-assessed shoulder comfort and function.

In discussing shoulder arthroplasty with younger patients, surgeons should explain that more complex pathological conditions, such as capsulorrhaphy arthropathy, rheumatoid arthritis, and posttraumatic arthritis, may complicate the surgical procedure and compromise its effectiveness in comparison with the situation with primary degenerative joint disease, which is more commonly seen in older individuals. It is possible that the preoperative diagnosis has at least as much influence on the outcome of the procedure as does the age of the patient. In future studies comparing the results of primary shoulder arthroplasty between younger and older individuals,

it will be important to stratify patients according to diagnosis and sex as well as age. ■

Matthew D. Saltzman, MD  
Department of Orthopaedic Surgery,  
Northwestern University,  
676 North Saint Clair, 13th floor,  
Chicago, IL 60611.  
E-mail address: mdsaltzman@gmail.com

Deana M. Mercer, MD  
Winston J. Warme, MD  
Alexander L. Bertelsen, PAC  
Frederick A. Matsen, III, MD  
Department of Orthopedics and Sports Medicine,  
University of Washington Medical Center,  
Box 356500, 1959 N.E. Pacific Street,  
Seattle, WA 98195.  
E-mail address for D.M. Mercer: mercerd@u.washington.edu.  
E-mail address for W.J. Warme: warmewj@u.washington.edu.  
E-mail address for A.L. Bertelsen: alexbert@u.washington.edu.  
E-mail address for F.A. Matsen III: matsen@u.washington.edu

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