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Long-term activity restrictions after shoulder arthroplasty: an international survey of experienced shoulder surgeons

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Hypothesis: Shoulder arthroplasty is being performed with increasing frequency, and patients' athletic participation after shoulder arthroplasty is on the rise. However, little data exist regarding appropriate long-term activity restrictions. We hypothesize that European and North American surgeons both recommend increasing long-term activity restrictions, moving from hemiarthroplasty to total shoulder arthroplasty (TSA) to reverse total shoulder arthroplasty (RTSA), and that both groups impose similar restrictions on their patients.

Materials and methods: An online survey was sent to members of the American Shoulder and Elbow Surgeons (ASES) and the European Society for Surgery of the Shoulder and Elbow (SECEC). Participants received a list of 37 activities and classified their postoperative recommendations for each activity as allowed, allowed with experience, not allowed, or undecided.

Results: The participation rate was 18%, including 47 North American surgeons and 52 European surgeons. All patients were allowed to participate in nonimpact activities, including jogging/running, walking, stationary bicycling, and ballroom dancing. Sports requiring light upper extremity involvement, including low-impact aerobics, golf, swimming, and table tennis, were allowed after hemiarthroplasty and TSA, and were allowed with experience after RTSA. Sports with fall potential, including downhill skiing, tennis, basketball, and soccer, were allowed with experience after hemiarthroplasty and TSA, and undecided or not allowed after RTSA. Higher-impact sports, such as weightlifting, waterskiing, and volleyball, were undecided after hemiarthroplasty and TSA and were not allowed after RTSA. European surgeons were more conservative than American surgeons in their recommendations after hemiarthroplasty and TSA, but good agreement between the 2 groups was noted regarding restrictions after RTSA.

Conclusion: Restrictions should be based on the type of arthroplasty performed and patients' preoperative experience.

Level of evidence: Level V, Survey Research, Expert Opinion.

Keywords: Total shoulder arthroplasty; reverse total shoulder arthroplasty; shoulder hemiarthroplasty; activity restrictions; survey

Shoulder arthroplasty is being performed with increasing frequency for a variety of indications throughout the world. Numerous studies have been published detailing

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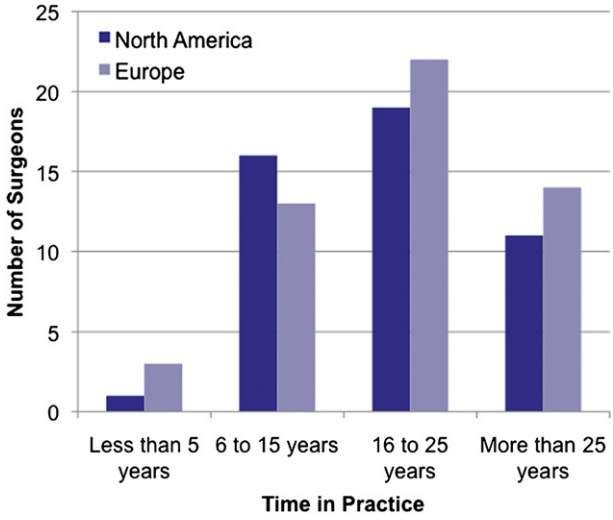

Figure 1 Distribution of surgeons participating in the survey based on number of years in practice. No significant differences are noted between North American and European surgeons.

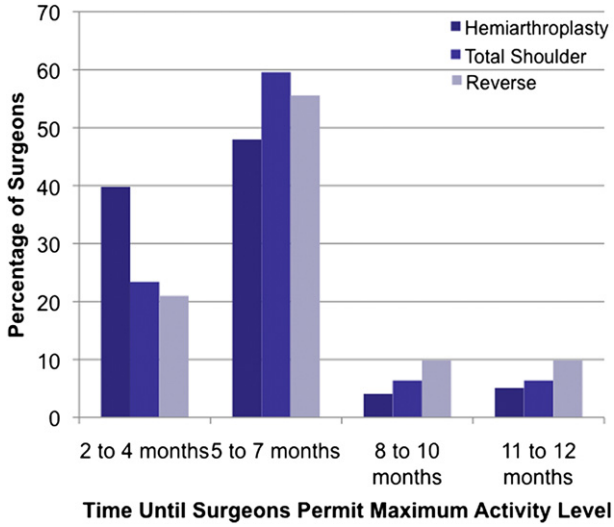

Figure 2 The time after which surgeons allow patients to return to their maximum permitted activity level after hemiarthroplasty, total shoulder arthroplasty, or reverse total shoulder arthroplasty.

rehabilitation protocols based on patient factors, surgical indications, and implant selection. Several recent studies have shown that most patients maintain their athletic participation after hip or knee arthroplasty,[2,10] but much less is known about activity level after shoulder arthroplasty. One recent study of patients undergoing shoulder arthroplasty demonstrated increased athletic participation after shoulder arthroplasty and noted that 64% of patients cited a desire to return to sports as one of the reasons they underwent the procedure.[8] Several studies have shown relatively high levels of return to golf after shoulder arthroplasty.[1,5]

A relative paucity of data exist regarding appropriate long-term activity restrictions after shoulder arthroplasty. Significantly more has been published on activity restriction after hip and knee arthroplasty, with authors focusing primarily on return to golf and tennis. Surveys of the Hip Society and the American Association of Hip and Knee Surgeons have documented increasing physician acceptance of higher activity levels after joint replacement.[4,6] Generally, high-impact activities should be avoided due to concerns over loosening, but low-impact sports are well accepted by surgeons.[7]

To our knowledge only 1 previous survey of experts in the field has been performed of long-term restrictions after shoulder arthroplasty.[4] Most published recommendations are based on individual surgeon experience.[3,9] We hypothesize that surgeons recommend increasing long-term activity restrictions, moving from hemiarthroplasty to total shoulder arthroplasty (TSA) to reverse total shoulder arthroplasty (RTSA). We do not anticipate significant variations in these recommendations based on whether surgeons practice in North America or Europe.

Materials and methods

Approval for this study was obtained from Duke University Medical Center Institutional Review Board (Approval No. Pro00019667).

Survey population

With the support of the American Shoulder and Elbow Surgeons (ASES) and the European Society for Surgery of the Shoulder and Elbow (SECEC), an online survey (Survey Monkey, www.suveymonkey.com, Portland, OR) was designed to assess surgeon preferences on long-term activity restrictions after shoulder arthroplasty. A link to the survey was sent by e-mail to the 315 members of the ASES and the 322 members of the SECEC with an e-mail address on file as of January 1, 2010.

Survey details

The survey collected each participant's practice location and the number of years each had been in practice. Participants were asked if they performed shoulder hemiarthroplasty, TSA, or RTSA and were questioned further about only the procedures that they performed. For each procedure, surgeons were asked how many they perform annually and were asked to define the number of months after surgery at which they would release the patient to maximum activity level. Participants were presented with a list of 37 activities and asked to classify their recommendations for each activity into 1 of 4 categories: (1) allowed, (2) allowed with experience, (3) not allowed, or (4) undecided. These classifications are similar to those used by previous authors and were chosen to facilitate comparison with earlier work.[3,4]

Statistical analysis

All survey responses were collected and tabulated. Statistical analysis proceeded as described by Klein et al.[6] From the number of survey respondents who performed each procedure (hemiarthroplasty, n = 98; TSA, n = 94; RTSA, n = 81), a power analysis for a 1-sample proportion test determined that 67% of respondents for hemiarthroplasty, 67% of respondents for TSA, or 69% of respondents for RTSA would have to select any 1 of the 4 categories to achieve statistical significance for that activity.

Table I Activity recommendations after hemiarthroplasty

Activity	Allowed, %			Allowed with experience, %			Not allowed, %			Undecided, %		
	North America	Europe	All	North America	Europe	All	North America	Europe	All	North America	Europe	All
Racquetball	**58**	18	36	29	**51**	**41**	9	29	20	4	2	3
Jogging/running	**98**	**90**	**94**	2	8	5	0	2	1	0	0	0
American football	16	8	11	9	0	4	**75**	**71**	**73**	0	22	11
Baseball/softball	**61**	18	**37**	27	31	31	5	**41**	24	7	10	8
Aerobics												
High-impact	**66**	25	**43**	25	**37**	32	7	**37**	22	2	0	1
Low-impact	**95**	**78**	**86**	5	20	13	0	0	0	0	2	1
Martial arts	**40**	12	25	36	14	25	22	**61**	**43**	2	12	7
Tennis												
Singles	**60**	33	**46**	36	**41**	39	4	25	15	0	0	0
Doubles	**76**	37	**55**	24	**41**	33	0	20	10	0	2	1
Basketball	**69**	16	**40**	22	37	31	7	**45**	28	2	2	2
Stairclimber	**98**	**61**	**79**	2	16	9	0	18	9	0	6	3
Hiking	**96**	**63**	**78**	4	25	16	0	6	3	0	6	3
Skiing												
Downhill	**51**	34	42	42	**56**	**49**	4	10	7	2	0	1
Cross-country	**82**	**45**	**61**	18	39	31	0	16	8	0	0	0
Snowboarding	40	25	32	**42**	27	**35**	16	**43**	31	2	4	3
Weightlifting	**45**	12	27	41	8	25	14	**74**	**45**	0	6	3
Ice skating	**73**	39	**54**	25	**41**	35	0	18	9	2	2	2
Rollerblading	**71**	**39**	**53**	22	29	28	7	24	15	0	8	4
Bowling	**82**	**55**	**68**	13	22	17	4	18	11	0	6	3
Road cycling	**87**	**82**	**84**	13	14	14	0	4	2	0	0	0
Rowing	**80**	**37**	**56**	16	**37**	28	2	20	11	2	6	5
Walking	**98**	**96**	**97**	2	2	2	0	2	1	0	0	0
Ballroom dancing	**93**	**88**	**91**	7	10	8	0	0	0	0	2	1
Pilates	**82**	**66**	**73**	13	18	16	0	4	2	4	12	8
Golf	**91**	**64**	**77**	9	34	22	0	2	1	0	0	0
Swimming	**91**	**84**	**87**	9	14	11	0	2	1	0	0	0
Lacrosse	**41**	16	27	23	16	20	32	31	**32**	5	**37**	21
Elliptical trainer	**98**	**38**	**66**	2	16	10	0	8	4	0	38	20
Stationary bicycle	**95**	**94**	**95**	5	4	4	0	2	1	0	0	0
Fencing	**73**	26	**47**	20	**52**	39	0	12	6	7	10	8
Football (soccer)	**60**	26	**41**	24	**34**	30	13	**34**	25	2	6	4
Table tennis	**89**	**61**	**73**	11	25	20	0	12	6	0	2	1
Waterskiing	**42**	10	24	36	24	30	20	**57**	**40**	2	10	6
Volleyball	**56**	14	33	36	24	30	9	**59**	**36**	0	4	2
Team handball	**53**	8	29	29	16	22	9	**65**	**39**	9	10	9
Track and field												
Sprinting	**64**	**48**	**55**	24	29	28	7	17	12	4	6	5
Throwing	**44**	14	28	31	24	29	18	**56**	**37**	7	6	6

NOTE. The most frequent recommendation for each activity is listed in bold face.

For each activity surveyed, the percentage of respondents selecting each category was compared with the required percentage for statistical significance. Any category that exceeded the required percentage was determined to be the overall recommendation for that activity. For activities in which no category received the requisite percentage of respondents, further analysis was preformed with χ^2 tests. Responses in the ''allowed'' and ''allowed with experience'' categories were combined and compared with the sum of responses in the ''not allowed'' and ''undecided'' categories. If the combined ''allowed'' and ''allowed with experience'' responses significantly ($P < .05$) exceeded the combined ''not allowed'' and ''undecided'' responses, the overall recommendation was ''allowed with experience.'' Similarly, if the combined ''not allowed'' and ''undecided'' responses significantly ($P < .05$) exceeded the combined ''allowed'' and ''allowed with experience'' responses, the overall recommendation was ''not allowed.'' If the difference between the groups was not statistically significant, ''undecided'' was the overall recommendation.

When the effect of practice location was compared with activity restriction, ''allowed'' and ''allowed with experience'' responses were pooled and compared with ''not allowed'' responses for each activity using a χ^2 test.

Table II Activity recommendations after total shoulder arthroplasty

Activity	Allowed, %			Allowed with experience, %			Not allowed, %			Undecided, %		
	North America	Europe	All	North America	Europe	All	North America	Europe	All	North America	Europe	All
Racquetball	**37**	12	22	**37**	41	**39**	22	**45**	35	5	2	3
Jogging/running	**90**	**82**	**86**	10	12	11	0	4	2	0	2	1
American football	10	2	5	7	4	5	**83**	**86**	**85**	0	8	4
Baseball/softball	**36**	14	24	33	27	30	31	**53**	**43**	0	6	3
Aerobics												
High-impact	**53**	16	33	19	33	27	23	**51**	**38**	5	0	2
Low-impact	**93**	**67**	**78**	7	29	19	0	2	1	0	2	1
Martial arts	17	6	11	34	15	24	**49**	**69**	**59**	0	10	5
Tennis												
Singles	**40**	29	33	38	**43**	**42**	19	29	24	2	0	1
Doubles	**64**	33	**48**	33	**43**	38	2	24	14	0	0	0
Basketball	38	8	22	**40**	31	35	17	**61**	**41**	5	0	2
Stairclimber	**95**	**59**	**77**	5	18	12	0	16	9	0	6	3
Hiking	**98**	**60**	**77**	2	25	15	0	8	4	0	6	3
Skiing												
Downhill	44	31	36	**49**	**53**	**51**	7	16	12	2	0	1
Cross-country	**74**	37	**53**	26	**41**	35	0	20	11	0	2	1
Snowboarding	22	16	18	**46**	24	36	32	**57**	**45**	0	2	1
Weightlifting	24	6	14	**48**	14	29	29	**80**	**57**	0	0	0
Ice skating	**56**	22	37	39	**53**	**48**	5	24	15	0	0	0
Rollerblading	**48**	31	**38**	38	**35**	37	12	33	23	2	0	1
Bowling	**67**	**47**	**57**	24	33	28	10	18	14	0	2	1
Road cycling	**76**	**73**	**75**	19	23	21	2	4	3	2	0	1
Rowing	**65**	29	**45**	21	**39**	31	9	24	17	5	8	7
Walking	**100**	**90**	**95**	0	6	3	0	4	2	0	0	0
Ballroom dancing	**95**	**79**	**87**	5	15	10	0	4	2	0	2	1
Pilates	**84**	**51**	**66**	9	24	20	2	11	7	5	11	8
Golf	**93**	**59**	**75**	5	35	21	3	6	4	0	0	0
Swimming	**81**	**81**	**82**	17	15	15	0	4	2	2	0	1
Lacrosse	25	9	16	13	15	15	**58**	**38**	**47**	5	**38**	22
Elliptical trainer	**98**	30	**62**	2	21	13	0	11	5	0	**38**	20
Stationary bicycle	**95**	**88**	**91**	2	8	5	2	4	3	0	0	0
Fencing	**62**	23	**41**	33	**38**	37	0	17	9	5	21	13
Football (soccer)	**40**	21	29	26	33	30	35	**46**	**41**	0	0	0
Table tennis	**90**	**55**	**71**	10	27	19	0	14	8	0	4	2
Waterskiing	27	2	13	32	29	30	**39**	**65**	**53**	2	4	3
Volleyball	33	6	18	**45**	22	32	19	**69**	**47**	2	2	2
Team handball	**34**	8	20	32	10	20	22	**79**	**54**	12	2	7
Track and field												
Sprinting	**60**	**36**	**46**	17	**36**	29	21	21	21	2	6	4
Throwing	31	8	18	**36**	20	28	29	**67**	**49**	5	4	4

The number of procedures performed annually and time to maximum activity level were compared between the North American and European groups using a Wilcoxon ranked sum test. The relationship between the number of procedures performed annually and the time to maximum activity level was evaluated using linear regression.

Results

Participation rate

The 637 e-mailed invitations to society members yielded 101 completed online surveys. The participation rates were similar between the groups, reaching 18.4% (58 of 315) among ASES members and 17.4% (56 of 322) among SECEC members. Thirteen of those who participated were members of both societies. The overall participation rate was about 18%, but cannot be precisely determined because we do not know how many of the surgeons invited to participate were members of both societies.

Demographics

Survey respondents included 47 surgeons practicing in North America, 52 surgeons practicing in Europe, and 1 surgeon

Table III Activity recommendations after reverse total shoulder arthroplasty

Activity	Allowed (%)			Allowed with experience (%)			Not allowed (%)			Undecided (%)		
	North America	Europe	All	North America	Europe	All	North America	Europe	All	North America	Europe	All
Racquetball	11	2	6	14	17	15	**76**	**79**	**78**	0	2	1
Jogging/running	**78**	**69**	**74**	0	21	11	22	10	15	0	0	0
American football	0	2	1	0	2	1	**100**	**90**	**95**	0	5	3
Baseball/softball	11	2	6	17	10	13	**72**	**81**	**777**	0	7	4
Aerobics												
High-impact	24	12	18	19	12	15	**57**	**74**	**66**	0	2	1
Low-impact	**62**	**45**	**53**	22	31	28	16	19	18	0	5	3
Martial arts	5	2	4	11	7	10	**84**	**76**	**78**	0	15	8
Tennis												
Singles	11	10	10	11	26	20	**75**	**60**	**67**	3	5	4
Doubles	16	14	15	27	26	28	**54**	**52**	**53**	3	7	5
Basketball	11	0	5	17	10	14	**69**	**86**	**77**	3	5	4
Stairclimber	**84**	**46**	**65**	11	12	11	5	29	18	0	12	6
Hiking	**73**	**50**	**61**	16	24	20	11	19	15	0	7	4
Skiing												
Downhill	11	12	11	30	43	38	**57**	**43**	**49**	3	2	3
Cross-country	32	21	26	**35**	36	**35**	30	**40**	**35**	3	2	3
Snowboarding	3	10	6	17	21	20	**81**	**67**	**72**	0	2	1
Weightlifting	8	2	5	24	0	11	**68**	**95**	**82**	0	2	1
Ice skating	32	19	25	**43**	33	**39**	24	**45**	35	0	2	1
Rollerblading	16	17	16	35	24	30	**43**	**56**	**49**	5	2	4
Bowling	32	29	32	24	27	25	**43**	**41**	**42**	0	2	1
Road cycling	**51**	**50**	**50**	16	31	25	32	19	25	0	0	0
Rowing	30	17	23	22	24	23	**41**	**52**	**46**	8	7	8
Walking	**97**	**93**	**95**	3	5	4	0	2	1	0	0	0
Ballroom dancing	**84**	**67**	**75**	16	21	19	0	10	5	0	2	1
Pilates	**46**	**41**	**43**	16	22	20	27	2-	23	11	17	14
Golf	**54**	38	**45**	16	**40**	30	30	21	25	0	0	0
Swimming	32	**55**	**45**	**41**	26	33	22	14	18	5	5	5
Lacrosse	3	3	3	3	10	6	**89**	**58**	**73**	5	30	18
Elliptical trainer	**76**	**32**	**52**	19	10	15	5	29	18	0	29	15
Stationary bicycle	**95**	**79**	**86**	5	10	8	0	10	5	0	2	1
Fencing	16	7	11	32	27	30	**46**	**44**	**44**	5	22	14
Football (soccer)	8	7	8	14	12	14	**76**	**76**	**75**	3	5	4
Table tennis	38	31	35	**41**	**40**	**40**	22	24	23	0	5	3
Waterskiing	5	0	3	5	7	8	**89**	**88**	**88**	0	5	3
Volleyball	8	0	4	14	10	11	**73**	**88**	**81**	5	2	4
Team handball	16	0	8	11	5	8	**70**	**90**	**81**	3	5	4
Track and field												
Sprinting	22	12	16	14	32	24	**65**	**46**	**54**	0	10	5
Throwing	5	0	3	10	11	11	**84**	**86**	**84**	0	5	3

each practicing in Asia and South America. Nearly all participants had been in practice for more than 5 years, with more than half in practice for greater than 15 years (Figure 1). No significant difference in experience level was noted between the North American and European surgeons.

Of the 101 participants, 98 (97%) performed hemiarthroplasty, 94 (93%) performed TSA, and 81 (80%) performed RTSA. Those performing hemiarthroplasty performed an average of 21 per year, those performing TSA performed an average of 30 per year, and those performing RTSA performed an average of 25 per year. No correlation was noted between the number of procedures performed annually and the time until maximum allowed activity level was permitted.

Overall recommendations

Hemiarthroplasty

Most respondents permitted patients to proceed to their maximum allowed activity level within 7 months of

Table IV Summary of recommendations

Activity	Hemiarthroplasty	Total shoulder arthroplasty	Reverse total shoulder arthroplasty
Jogging/running	Allowed	Allowed	Allowed
Walking	Allowed	Allowed	Allowed
Ballroom dancing	Allowed	Allowed	Allowed
Stationary bicycle	Allowed	Allowed	Allowed
Low-impact aerobics	Allowed	Allowed	Allowed with experience
Stairclimber	Allowed	Allowed	Allowed with experience
Hiking	Allowed	Allowed	Allowed with experience
Road cycling	Allowed	Allowed	Allowed with experience
Golf	Allowed	Allowed	Allowed with experience
Swimming	Allowed	Allowed	Allowed with experience
Table tennis	Allowed	Allowed	Allowed with experience
Pilates	Allowed	Allowed with experience	Allowed with experience
Bowling	Allowed	Allowed with experience	Undecided
Elliptical trainer	Allowed with experience	Allowed with experience	Allowed with experience
Cross-country skiing	Allowed with experience	Allowed with experience	Allowed with experience
Ice skating	Allowed with experience	Allowed with experience	Allowed with experience
Doubles tennis	Allowed with experience	Allowed with experience	Undecided
Downhill skiing	Allowed with experience	Allowed with experience	Undecided
Rollerblading	Allowed with experience	Allowed with experience	Undecided
Rowing	Allowed with experience	Allowed with experience	Undecided
Fencing	Allowed with experience	Allowed with experience	Undecided
Racquetball	Allowed with experience	Allowed with experience	Not allowed
High-impact aerobics	Allowed with experience	Allowed with experience	Not allowed
Singles tennis	Allowed with experience	Allowed with experience	Not allowed
Basketball	Allowed with experience	Allowed with experience	Not allowed
Football (soccer)	Allowed with experience	Allowed with experience	Not allowed
Track and field (sprinting)	Allowed with experience	Allowed with experience	Not allowed
Baseball/softball	Allowed with experience	Undecided	Not allowed
Snowboarding	Allowed with experience	Undecided	Not allowed
Weightlifting	Undecided	Undecided	Not allowed
Waterskiing	Undecided	Undecided	Not allowed
Volleyball	Undecided	Undecided	Not allowed
Track and field (throwing)	Undecided	Undecided	Not allowed
Martial arts	Undecided	Not Allowed	Not allowed
Lacrosse	Undecided	Not Allowed	Not allowed
Team handball	Undecided	Not Allowed	Not allowed
American football	Not Allowed	Not Allowed	Not allowed

hemiarthroplasty, with 40% allowing this level in 2 to 4 months, and 48% allowing this level in 5 to 7 months (Figure 2). Recommendations for each activity are listed in Table I. Low-impact activities, such as walking, hiking, low-impact aerobics, golf, and swimming, were generally allowed. Activities associated with a possibility of falling, including downhill and cross-country skiing, basketball, football (soccer), and tennis, were allowed with experience. Higher-impact activities, such as volleyball, weightlifting, waterskiing, and lacrosse, were undecided, and American football was not allowed.

Total shoulder arthroplasty

Sixty percent of respondents allowed their patients to advance to their maximum allowed activity level 5 to 7 months after TSA, and 23% allowed this activity level at 2 to 4 months (Figure 2). Recommendations for each activity are reported in Table II, but were similar to hemiarthroplasty in most cases, and low-impact activities were still generally allowed. Bowling and Pilates, which were allowed with hemiarthroplasty, were allowed with experience after TSA. Baseball/softball and snowboarding were undecided, compared with allowed with experience in the hemiarthroplasty group. Martial arts, lacrosse, and team handball were not allowed.

Reverse total shoulder arthroplasty

Fifty-six percent respondents permitted patients to proceed to their maximum allowed activity level after 5 to 7 months after RTSA, 22% allowed this level of activity 2 to 4 months after, and an additional 20% required at least 8 months before this level of activity was allowed (Figure 2). Recommendations for each activity are reported in Table III. Restrictions after RTSA were much more conservative than those after hemiarthroplasty and

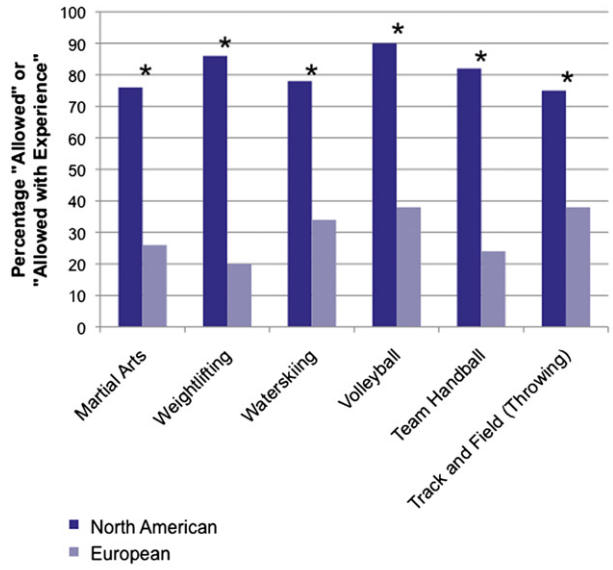

Figure 3 Activities in which North American and European surgeons offered significantly different opinions after hemiarthroplasty. $*P < .0001$.

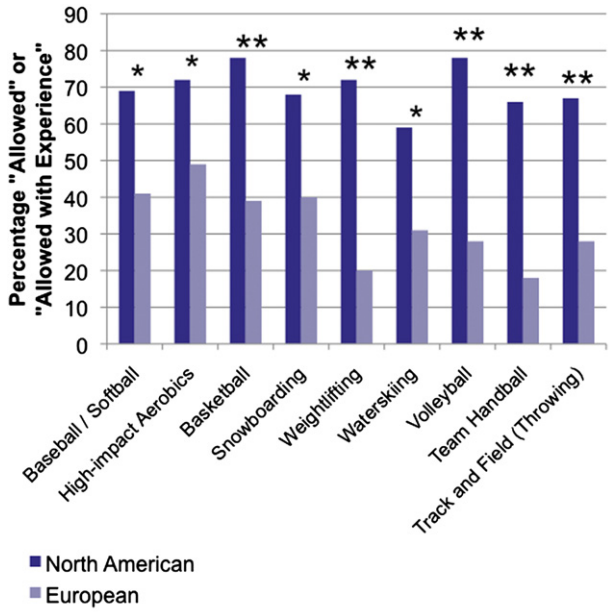

Figure 4 Activities in which North American and European surgeons offered significantly different opinions after total shoulder arthroplasty. $*P < .05$; $**P < .0001$.

TSA. Jogging/running, walking, stationary bicycling and ballroom dancing were allowed. Numerous other low-impact activities, such as hiking, golf, table tennis, and cross-country skiing, were allowed with experience. Surgeons were undecided about doubles tennis, bowling, downhill skiing, and rowing, among other activities. Numerous activities were not allowed, including all of those not allowed with TSA, as well as singles tennis, football (soccer), weightlifting, basketball, and track and field.

Differences in recommendations based on arthroplasty type

Recommendations were considerable more restrictive for RTSA than for hemiarthroplasty or TSA. This trend is summarized in Table IV, which presents recommendations for all 3 procedures for each activity.

Comparison between North American and European Surgeons

Hemiarthroplasty

Approximately the same number of hemiarthroplasties were performed annually by North American (19) and European surgeons (22; $P = .12$). There was no significant difference in the mean time until maximum allowed activity level was permitted (North America, 5.2 months; Europe, 5.4 months; $P = .77$).

North American surgeons generally allowed higher maximum activity levels after hemiarthroplasty than European surgeons. There were 6 activities that most American surgeons indicated were ''allowed'' or ''allowed with experience'' and that most European surgeons indicated were ''not allowed:'' martial arts, weightlifting, waterskiing, volleyball, team handball, and track and field (throwing). These differences were statistically significant ($P < .05$) in all cases (Figure 3).

Total shoulder arthroplasty

North American surgeons who performed TSA performed 48 procedures annually compared with 26 procedures by their European counterparts, which was a significant difference ($P < .00001$). There was no significant difference in the mean time until maximum allowed activity level was permitted (North America, 5.7 months; Europe, 6.0 months; $P = .60$).

As with hemiarthroplasty, North American surgeons generally allowed higher maximum activity levels than European surgeons after TSA. There were 9 activities that most American surgeons indicated were ''allowed'' or ''allowed with experience'' and that most European surgeons indicated were ''not allowed:'' baseball/softball, high-impact aerobics, basketball, snowboarding, weightlifting, waterskiing, volleyball, team handball, and track and field (throwing). These differences were noted to be statistically significant in all 9 cases (Figure 4).

Reverse total shoulder arthroplasty

North American and European surgeons performed approximately the same number of RTSAs annually (North America, 29; Europe, 22; $P = .35$). The difference in the mean time until maximum allowed activity level was permitted was not significant (North America, 6.3 months; Europe, 6.1 months; $P = .76$). There were no activities that a significant number of surgeons from one continent ''allowed'' or ''allowed with experience'' that were ''not allowed'' by surgeons from the other continent.

Table V Comparison of recommendations after total shoulder arthroplasty

Activity	Current study	Clifford and Mallon, 2005*	Healy et al, 2001†
Jogging/running	Allowed	Acceptable	Allowed
Walking	Allowed	Acceptable	Allowed
Ballroom dancing	Allowed	Acceptable	Allowed
Stationary bicycle	Allowed	Acceptable	Allowed
Low-impact aerobics	Allowed	Acceptable	Allowed
Stairclimber	Allowed		
Hiking	Allowed	Acceptable	
Road cycling	Allowed	Acceptable	Allowed
Golf	Allowed	Acceptable	Allowed with experience
Swimming	Allowed	Possible	Allowed
Table tennis	Allowed	Possible	
Pilates	Allowed with experience		
Bowling	Allowed with experience	Possible	Allowed
Elliptical trainer	Allowed with experience		
Cross-country skiing	Allowed with experience	Acceptable	Allowed
Ice skating	Allowed with experience	Acceptable	Allowed with experience
Doubles tennis	Allowed with experience	Possible	Allowed
Downhill skiing	Allowed with experience	Acceptable	Allowed with experience
Rollerblading	Allowed with experience	Acceptable	Undecided
Rowing	Allowed with experience	Possible	Undecided
Fencing	Allowed with experience	Not recommended	Undecided
Racquetball	Allowed with experience	Possible	Undecided
High-impact aerobics	Allowed with experience		Undecided
Singles tennis	Allowed with experience	Possible	Undecided
Basketball	Allowed with experience	Not recommended	
Football (soccer)	Allowed with experience	Possible	Undecided
Track and field (sprinting)	Allowed with experience		
Baseball/softball	Undecided	Not recommended	Undecided
Snowboarding	Undecided		
Weightlifting	Undecided		Undecided
Waterskiing	Undecided	Not recommended	
Volleyball	Undecided	Not recommended	Undecided
Track and field (throwing)	Undecided		
Martial Arts	Not allowed	Not recommended	
Lacrosse	Not allowed	Not recommended	Undecided
Team handball	Not allowed		Undecided
American football	Not allowed	Not recommended	Not allowed

* As reported in Clifford PE, Mallon WJ. Sports after total joint replacement. Clin Sports Med 2005;24:175-86.
† As reported in Healy WL, Iorio R, Lemos MJ. Athletic activity after joint replacement. Am J Sports Med 2001;29:377-88.

Discussion

There has been relatively little previous work regarding return to athletics after shoulder arthroplasty. The most complete previously published recommendations, by Healy et al[4] in 2001, were based on a 1999 survey of 35 members of the ASES. The authors used a similar classification system to that used in the current study for 42 different activities. Similarly, Clifford and Mallon[3] published activity recommendations in 2005 based on the perceived level of impact of sporting activities as determined by the authors. Activities were classified as "acceptable," "possible," or "not recommended." Activity recommendations from these 2 publications are compared with the results of the current study in Table V. General agreement is noted on most low-impact activities among the 3 studies. The current study provides recommendations on a number of activities that were classified as "undecided" in the Healy et al study, possibly due to the larger number of participants in the current study. It is also possible that surgeons' opinions have evolved in the decade since Healy et al performed their survey.

Strengths of the current study include the inclusion of data from a large number of surgeons; the extensive experience demonstrated by the participating surgeons; the presence of separate recommendations for hemiarthroplasty, TSA, and RTSA; and the inclusion of recommendations from surgeons in numerous counties. Until higher-level evidence is available, surgeons can use the results of this survey along with

their own experience and training when considering postoperative restrictions for their own patients.

One weakness of this study is the relatively poor response rate (approximately 18%). Surveys frequently have low response rates, but the low rate in this study does expose the data to possible selection bias because the respondents to the survey may not be an accurate representation of all surgeons performing shoulder arthroplasty.

Another weakness stems from the international basis of the study. Because the popularity of various sports varies by country, respondents in one region may be more familiar with certain sports than others, affecting the quality of their recommendations. For example, the elliptical trainer was no doubt unfamiliar to the numerous Europeans who responded ''undecided'' and was possibly unfamiliar to a number of others. Similarly, many American surgeons are not familiar with team handball. Perhaps more weight should be given to the American surgeons' recommendations regarding the elliptical trainer and to the European surgeons' recommendations regarding team handball.

In addition, by the nature of the study design, we were not able to compare patient populations in Europe with those in North America. There may be underlying factors that affect activity recommendations, including patient age, preoperative activity levels, and postoperative expectations. Similarly, societal factors, such as differences in the health care systems and the general attitudes of surgeons toward return to sport after arthroplasty in the two regions, likely influence decision making.

A further limitation of this survey is that we do not address the actual activity level attained by patients after shoulder arthroplasty, nor do we know what injuries or problems, if any, patients experienced after their return to sport. The ideal study design to answer these questions would be a prospective cohort study in which patient activity level and complications were both tracked after shoulder arthroplasty.

Finally, the recommendations in this study are quite general and will not necessarily apply to every patient. The presence of an associated rotator cuff tear, performance of the procedure for fracture rather than a degenerative condition, the patient's bone quality, and numerous other factors may alter recommendations for any given patient.

Conclusions

The recommended activity level after shoulder arthroplasty should be based on the type of arthroplasty performed as well as on the patient's preoperative athletic experience. Surgeons should take these and other factors into account when discussing postoperative activity restrictions with patients considering shoulder arthroplasty.

Disclaimer

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