

Sports Activity After Reverse Total Shoulder Arthroplasty With Minimum 2-Year Follow-Up

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Abstract

There is limited information on activity levels of patients with reverse total shoulder arthroplasty (RTSA). We conducted a study of the types of sporting activities in which 78 patients with RTSA could participate. Mean follow-up was 4.8 years.

Mean (SD) age at surgery was 75.3 (7.5) years. Seventy-five percent of the patients were women. Sixty-one percent underwent surgery for cuff tear arthropathy, 31% for revision of previous arthroplasty or internal fixation, 7% for complex fractures, and 1% for tumor. Mean (SD) postoperative ASES (American Shoulder and Elbow Surgeons) Standardized Shoulder Assessment Form score was 77.5 (23.4).

After surgery, mean active forward elevation was 140°, mean external rotation was 48°, and mean internal rotation was to S1. Four patients played golf; none were able to play tennis. Eighteen patients (23.1%) engaged in 24 high-intensity activities, such as hunting, golf, and skiing; 48.7% engaged in moderate-intensity activities, such as swimming, bowling, and raking leaves; and 28.2% engaged only in low-intensity activities. Regarding reasons for their limited activity, 59% of the patients cited medical problems, 19.2% cited shoulder limitations, 2.5% cited fear of injury, and 19.2% reported not being limited.

RTSA results in good pain relief and motion, with a variety of postoperative overhead activities enjoyed by some patients who are not limited by comorbidities.

The treatment of patients with severe shoulder pain and disability combined with a nonfunctional rotator cuff was a clinical challenge until the development of the reverse total shoulder arthroplasty (RTSA).¹⁻³ Massive rotator cuff tears can leave patients with a pseudoparalytic upper extremity and may result in advanced arthritis of the joint because

of altered mechanical and nutritional factors.⁴ In this setting, simply replacing the arthritic joint with standard total shoulder arthroplasty (TSA) is not recommended because it does not address the functional deficits, and it has poor long-term outcomes.^{3,5} RTSA works by changing the center of rotation of the shoulder joint so that the deltoid muscle can be used to elevate the arm.^{6,7} The 4 rotator cuff muscles are not required for forward elevation or stability of this constrained implant.^{6,8}

Current indications for RTSA are cuff tear arthropathy, complex proximal humerus fractures, and revision from hemiarthroplasty or TSA with rotator cuff dysfunction. Patients with advanced cuff tear arthropathy have minimal forward elevation and pseudoparalysis. Previous studies have shown mean preoperative forward flexion of 55° and mean ASES (American Shoulder and Elbow Surgeons) Standardized Shoulder Assessment Form score of 34.3.⁹ Thus, minimal overhead activity is possible without RTSA. Advances in the RTSA technique have led to promising results (excellent functional improvement), but there is limited information regarding the activity levels patients can achieve after surgery.^{7,9-11}

We conducted a study of the types of sporting activities in which patients with RTSA could participate. We hypothesized that, relative to historic controls, patients with RTSA could return to low-intensity sporting activities with improvement in motion and ASES scores.

Materials and Methods

After this study received institutional review board approval, patients who had undergone RTSA at our institution between January 1, 2004 and December 31, 2010 were identified by the billing codes used for the procedure. Each patient who had RTSA performed during the study period was included in the study. Charts were then reviewed to extract demographic data, preoperative diagnosis, surgery date, operative side, dominant side, type of implant used, operative complications, and subsequent revisions. A questionnaire (Appendix) was designed and used to assess activity, functional status, pain, and satisfaction levels after RTSA. Patients had to be willing and able to complete this questionnaire in order to be included in the study.

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The questionnaire included demographic questions; a list of 42 activities patients could choose from to describe their current activity level, activities they were able to perform before the surgery, and activities they wish they could perform; a list of reasons for any limitations; and questions about overall pain, strength, and satisfaction with the procedure. In addition, there was an open-ended question for activities that may not have been listed. The questionnaire also included a validated method for assessing shoulder range of motion (ROM) at home, where patients rated their overhead motion according to standardized physical landmarks, including the level of the shoulder, chin, eyebrows, top of head, and above head.¹²⁻¹⁴ Also provided was the ASES Standardized Shoulder Assessment Form, which features a 100-point visual analog scale for pain plus functional ability questions, with higher scores indicating less pain and better function.^{15,16} The minimal clinical significance in the ASES score is 6.4 points.^{17,18} Scores were recorded and analyzed. Student t test was used to calculate statistical differences between patients who had primary RTSA performed and patients who underwent revision RTSA.

Study personnel contacted patients by telephone and direct mailing. Patients who could not be reached initially were called at least 4 more times: twice during the weekday, once during the evening, and once on the weekend. Patients who could not be contacted by telephone were then cross-referenced with the

Social Security database to see if any were deceased. Response data were tabulated, and patients were stratified into high-, moderate-, and low-intensity activity.

One of the 3 senior authors (Dr. Ahmad, Dr. Bigliani, Dr. Levine) performed the 95 RTSAs: 84 Zimmer (Warsaw, Indiana), 7 DePuy (Warsaw, Indiana), 4 Tornier (Minneapolis, Minnesota). The DePuy and Tornier implants were used when a 30-mm glenoid peg was required (before Zimmer offered this length in its system). The procedure was done with a deltopectoral approach with 20° of retroversion. In revision cases, the same approach was used, the hardware or implants were removed, and the position of the humeral component was determined based on the pectoralis major insertion and the deltoid tension. In 80% of cases, the subscapularis was not repaired; in the other 20%, it was. Whether it was repaired depended on tendon viability and surgeon preference, as subscapularis repair status has been shown not to affect functional outcome.¹⁹⁻²¹ No combined latissimus transfers were performed. Patients wore a sling the first 4 weeks after surgery (only wrist and elbow motion allowed) and then advanced to active shoulder ROM. Eight weeks after surgery, they began gentle shoulder strengthening.

Results

One hundred nine consecutive patients underwent RTSA at a single institution. Fifteen patients subsequently died, 14 could not be contacted, and 2 declined, leaving 78 patients available for clinical follow-up. Mean follow-up was 4.8 years (range 2-9 years). Mean (SD) age at surgery was 75.3 (7.5) years. Seventy-five percent of the patients were women. Sixty-one percent underwent surgery for cuff tear arthropathy, 31% for revision of previous arthroplasty or internal fixation, 7% for complex fractures, and 1% for tumor. Of the 24 revisions, 15 were for failed hemiarthroplasty, 3 were for failed TSA with rotator cuff dysfunction, 4 were for fracture with failed internal fixation, and 2 were for failed RTSA referred from other institutions. The dominant shoulder was involved 62% of the time. Preoperative active forward shoulder elevation was less than 90° in all patients. There were 10 complications: 2 dislocations that were closed-reduced and remained stable, 1 dislocation that required revision of the liner, 1 aseptic loosening in a patient who has declined revision, 2 dissociated glenosphere baseplates, 2

Table 1. Clinical Data Reported by Patients Who Underwent Primary RTSA and Patients Whose Previous Implant Was Revised to RTSA

	Mean	SD	Range	P< ^a
Primary Patients				
Pain, on scale from <i>no pain</i> (1) to <i>severe pain</i> (10)	1.9	1.8	1-8	.01
Satisfaction, on scale from <i>not satisfied</i> (1) to <i>very satisfied</i> (10)	8.6	1.9	1-10	.05
Forward flexion	147.2°	42.2°	45°-180°	.05
External rotation	54.9°	24.9°	0°-90°	.001
Internal rotation, spinal level	L1	—	T4-S1	—
Strength, on scale from <i>normal strength</i> (1) to <i>paralysis</i> (10)	2.4	1.8	1-7	.01
ASES total score	83.3	19.6	32-100	.001
Revision Patients				
Pain, on scale from <i>no pain</i> (1) to <i>severe pain</i> (10)	3.3	2.9	1-10	—
Satisfaction, on scale from <i>not satisfied</i> (1) to <i>very satisfied</i> (10)	7.4	2.9	1-10	—
Forward flexion	122.7°	55.9°	45°-180°	—
External rotation	34.6°	25.7°	0°-90°	—
Internal rotation, spinal level	S1	—	T4-S1	—
Strength, on scale from <i>normal strength</i> (1) to <i>paralysis</i> (10)	3.6	2.2	1-8	—
ASES total score	62.5	25.9	23-98	—

Abbreviations: ASES, American Shoulder and Elbow Surgeons, Standardized Shoulder Assessment Form; RTSA, reverse total shoulder arthroplasty.

^aReported P is statistical difference between values for primary and revision patients.

deep infections that required 2-stage exchanges, 1 deep infection that required a 2-stage exchange that was then complicated by dissociation of the glenosphere baseplate requiring revision, and 1 superficial infection that resolved with oral antibiotics.

After surgery, mean active forward elevation was 140°, mean active external rotation was 48°, and mean active internal rotation was to S1. Mean (SD) postoperative ASES score was 77.5 (23.4). Satisfaction level was high (mean, 8.3/10), and mean pain levels were low: 2.3 out of 10 on the visual analog scale and 44.0 (SD, 11.7) on the ASES pain component. Strength was rated a mean of good. Table 1 lists the clinical data for the primary and revision surgery patients.

Eighteen patients (23.1%) returned to 24 different high-intensity activities, such as hunting, golf, and skiing; 38 patients (48.7%) returned to moderate-intensity activities, such as swimming, bowling, and raking leaves; and 22 patients (28.2%) returned to low-intensity activities, such as riding a stationary bike, playing a musical instrument, and walking (Table 2). Four patients played golf before and after RTSA, but neither of the 2 patients who played tennis before RTSA were able to do so after. Patients reported they engaged in their favorite leisure activity a mean of 4.8 times per week and a mean of 1.5 hours each time.

A medical problem was cited by 58% of patients as the reason for limited activity. These patients reported physical decline resulting from cardiac disease, diabetes, asthma/chronic obstructive pulmonary disease, or arthritis in other joints. Reasons for activity limitation are listed in Table 3. Post-RTSA activities that patients could not do for any reason are listed in Table 4. Activity limitations that patients attributed to the RTSA are listed in Table 5.

The majority of patients (57.7%) reported no change, from before RTSA to after RTSA, in being unable to do certain desired activities (eg, softball, target shooting, horseback riding, running, traveling). Sixteen patients (20.8%) reported being unable to return to an activity (eg, tennis, swimming, baseball, kayaking) they had been able to do before surgery. Most (69%) of those patients reported being unable to return to a moderate- or high-intensity activity after RTSA, but 81.8% were able to return to different moderate- or high-intensity activities.

Revision patients, who reported lower overhead activity levels, constituted 73% of the patients who felt their shoulder mechanically limited their activity, despite the fact that revisions constituted only 25% of the cases overall. Mean active ROM was statistically lower for revision patients than for primary patients ($P < .05$). Mean ASES score was statistically lower for the revision group ($P < .001$) and represented a clinically significant difference. Mean pain level was low (3.3) and satisfaction still generally high (7.4), but

pain, satisfaction, and strength were about 1 point worse on average in the revision group than in the primary group.

Discussion

In the United States and other countries, RTSA implant survivorship is good.^{9,22} In this article, we have reported on post-

Table 2. Patient-Reported Post-RTSA Activities, by Activity Level

Activity Level	% of Patients	Patient-Reported Post-RTSA Activities		
High	23.1%	Golf, 18 holes	Shoveling snow	Chopping wood
		Golf, 9 holes	Hunting/shooting	Downhill skiing
		Motorcycle riding	Basketball	Woodworking
		Free weights	Softball	Power-washing
		Canoeing/kayaking		
Moderate	48.7%	Treadmill	Fishing	Painting
		Jogging	Bowling	Raking leaves
		Swimming	Weight machines	Billiards
		Hiking	Aerobics	Physical therapy
		Yoga	Pilates	
Low	28.2%	Stationary bike	Musical instrument	Walking
		Cooking	Dancing	Housework
		Baking	Gardening	Knitting
		Sewing	Driving	Traveling
		Photography		

Abbreviation: RTSA, reverse total shoulder arthroplasty.

Table 3. Patient-Reported Reasons for Post-RTSA Activity Limitations

Reason	%
Other medical problems	59
Not limited at all	19
Limited by shoulder	19
Fear of injury	2.5
Doctor's orders	0

Abbreviation: RTSA, reverse total shoulder arthroplasty.

Table 4. Post-RTSA Activity Limitations, All Reasons

Activity Level	Activities Patients Wanted to Do But Were Unable to Do After RTSA		
High	Tennis	Baseball	Horseback riding
	Golf	Basketball	Downhill skiing
	Canoeing/kayaking	Hunting/shooting	Badminton
Moderate	Jogging	Bowling	Lifting heavy things
	Swimming	Road biking	
Low	Dancing	Driving	Walking without a walker
	Housework	Grocery shopping	Putting on a coat
	Sewing	Traveling	Walking up stairs
	Reaching overhead	Brushing hair	

Abbreviation: RTSA, reverse total shoulder arthroplasty.

Table 5. Activity Limitations Patients Attributed to RTSA

Activity Level	Activities That RTSA Patients Wanted to Do But Were Unable to Do Because of Shoulder		
High	Tennis Golf	Baseball Basketball	Hunting/shooting Canoeing/kayaking
Moderate	Swimming	Lifting heavy things	
Low	Dancing Housework	Putting on a coat Brushing hair	Reaching overhead Walking without a walker

Abbreviation: RTSA, reverse total shoulder arthroplasty.

RTSA activity levels, on the significant impact of comorbidities on this group, and on the negative effect of revisions on postoperative activity. Patients in this population reported that concomitant medical problems were the most important factor limiting their post-RTSA activity levels. Understanding and interpreting quality-of-life or functional scores in this elderly group must take into account the impact of comorbidities.²³

Patients should have realistic postoperative expectations.²⁴ In this study, some patients engaged in high-intensity overhead activities, such as golf, chopping wood, and shooting. However, the most difficulty was encountered trying to return to activities (eg, tennis, kayaking, archery, combing hair) that required external rotation in abduction.

Patients who had a previous implant (eg, hemiarthroplasty, TSA, failed internal fixation) revised to RTSA had lower activity levels and were 9 times more likely than primary patients to report having a mechanical shoulder limitation affecting their activity. Revision patients also had worse forward elevation, external rotation, pain, and satisfaction.

This study is limited in that it is retrospective. Subsequent prospective studies focused on younger patients who undergo primary RTSA may be useful if indications expand. In addition,

Patients should have realistic postoperative expectations. . . . [T]he most difficulty was encountered trying to return to activities (eg, tennis, kayaking, archery, combing hair) that required external rotation in abduction.

tion, subscapularis status and especially infraspinatus status may affect activity levels and could be analyzed in a study. Another limitation is that we did not specifically record detailed preoperative data, though all patients were known to have preoperative forward elevation of less than 90°.

In general, the primary measure of success for RTSA has been pain relief. Some studies have also reported on strength and ROM.^{2,20,25,26} A recent study using similar methodology

demonstrated comparable ROM and low pain after RTSA, though revisions were not included in that study.²⁶ In contrast to the present study, no patient in that study was able to play tennis or golf, but the reasons for the limited activity were not explored. In both studies, post-RTSA sports were generally of lower intensity than those played by patients after anatomical TSA.²⁷

Overall, the majority of patients were very satisfied with their low pain level after RTSA. In addition, many patients not limited by other medical conditions were able to return to their pre-RTSA moderate-intensity recreational activities.

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 The Appendix is available online at www.amjorthopedics.com.

This paper will be judged for the Resident Writer's Award.

Appendix: Study Questionnaire



COLUMBIA UNIVERSITY MEDICAL CENTER
Department of Orthopaedic Surgery
Study of Reverse Total Shoulder Arthroplasty Outcomes

All information will be kept strictly confidential

DEMOGRAPHIC INFORMATION:

Name:	
Today's Date:	Gender: M F
Age:	DOB:
Hand dominance: R L Ambi	
Shoulder replaced: R L	
Occupation (fill in blank):	
Which status describes your current employment status?	
<input type="checkbox"/> Currently working <input type="checkbox"/> On leave of absence <input type="checkbox"/> Homemaker <input type="checkbox"/> Student <input type="checkbox"/> Retired (not due to illness) <input type="checkbox"/> Disabled/retired (due to illness) <input type="checkbox"/> Unemployed <input type="checkbox"/> Other	
What is your current marital status?	
<input type="checkbox"/> Single <input type="checkbox"/> Married <input type="checkbox"/> Divorced <input type="checkbox"/> Widowed	

Please circle below all the activities that you participate in:

Tennis – singles	Tennis – doubles	Golf – 9 holes or 18 holes
Cooking	Baking	Sailing
Driving	Sewing	Gardening
Stationary biking	Treadmill	Leaf raking
Musical instrument	Jogging	Bowling
Dancing	Swimming	Woodwork
Fishing	Hiking	Metalwork
Downhill ski	Aerobics	Yoga
Cross-country ski	Pilates	Diving
Snow shoveling	Road biking	Free weights
Chopping wood	Hunting/shooting	Canoe/kayak
Weight machines	Basketball	Baseball
Karate/Judo	Rowing	Boxing

ACTIVITIES:

- Do you play tennis or golf? (Y/N)
- For the activities listed above, which is your favorite?
 - How many times per week do you engage in that activity?
 - How many hours per session of that activity?
 - How skilled are you at the activity:
 1. Unable
 2. Good
 3. Pretty good
 4. Amazing
- Are there any other activities not listed that you have been able to get back to after your shoulder replacement?

Appendix continued

- 4) What activities do you wish you could do, but can't? Why not? (Circle all that apply)
 1. Fear of injury 2. Doctor's orders 3. Shoulder unable 4. Other medical problem
- 5) Prior to surgery, were you able to do this? (CIRCLE ONE) Y/ N
 a) List some activities you were able to do:
 i. _____
 ii. _____
 iii. _____
- 6) How satisfied are you with your current shoulder replacement? (CIRCLE ONE)
 a) Very satisfied
 b) Satisfied
 c) Not satisfied

American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES)

Please answer the following questions for your currently affected (operative or imminently operative) shoulder ONLY. Please do not leave any questions unanswered.

With respect to your currently problematic shoulder...		
2. Put on a coat		0 1 2 3
4. Wash back/do up bra in back		0 1 2 3
6. Comb hair		0 1 2 3
8. Lift 10 lbs. above shoulder		0 1 2 3
10. Do usual work	List:	0 1 2 3

Question #1:

0 = no pain
 10 = pain as bad as it can be

Questions #2-11:

0 = Unable
 1 = Very difficult
 2 = Somewhat difficult
 3 = Not difficult

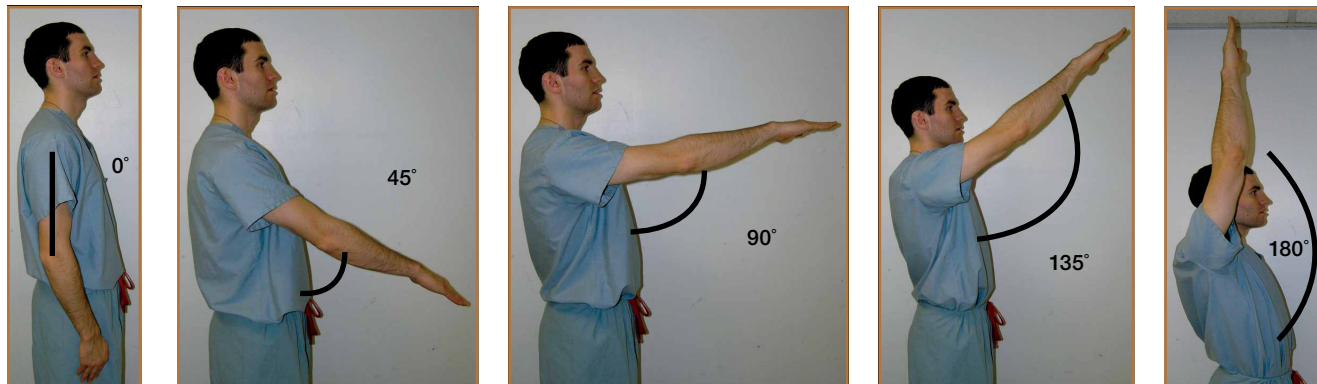
RANGE OF MOTION:

Circle the picture that most closely matches how high you can raise your arm.

How high can you raise your arm with a reverse total shoulder replacement?

Directions:

- Stand up straight with your back against the wall.
- Keep your elbow straight and raise your arm as high as you can.



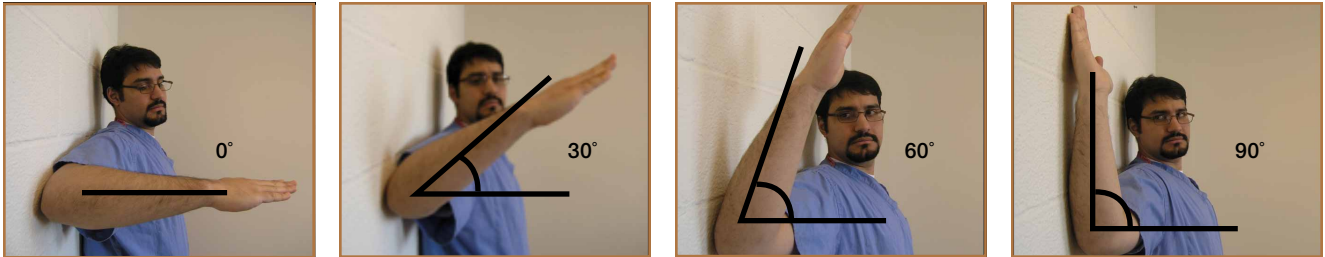
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Appendix *continued*

How much can you rotate your arm with the reverse total shoulder replacement?

Directions:

- 1) Stand up straight with your back against the wall.
- 2) Keep your elbow against the wall at shoulder height and rotate your arm up towards the wall.



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Circle the picture that most closely matches how high you can raise your arm.

How far up your back can you reach with the arm with a reverse total shoulder replacement?

Directions:

- 1) Stand up straight.
- 2) Reach behind your back and up as high as you can.



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Appendix continued

PAIN, STABILITY, AND STRENGTH:

Please assess pain on a scale from 1 to 10

	No Pain		Slight		Occasionally Moderate		Moderate		Severe	
Level of pain overall	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Level of pain at night	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pain without activity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pain with activity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate your level of satisfaction after surgery on a scale of 1 to 10

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	2	3	4	5	6	7	8	9	10

Does your shoulder feel unstable (as if it is going to dislocate)?

Stable		Feels unstable		Slips (subluxates)			Very unstable (dislocates)		
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	2	3	4	5	6	7	8	9	10

Please rate the overall strength of the shoulder:

Normal		Good		Fair	Poor	Very poor		Paralysis	
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	2	3	4	5	6	7	8	9	10