CONTRALATERAL SHOULDER INSTABILITY FOLLOWING ANTERIOR REPAIR

AN EPIDEMIOLOGICAL INVESTIGATION

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We reviewed 188 patients at one to 20 years (mean 9.5) after surgery for anterior shoulder instability. Twenty-one had shown bilateral instability at the time of surgery, and 26 of the remaining 167 subsequently developed instability of the contralateral shoulder, giving an overall incidence of 24% bilateral involvement. Fourteen of these patients ultimately required bilateral surgery.

The onset of contralateral instability was at one month to 15 years (mean 5.7 years) after anterior repair of the operated shoulder, the cumulative incidence increasing with time ($p < 0.01$). The incidence was significantly higher in those under 15 years at the time of initial dislocation or under 18 at the time of surgery. One-half of the patients with contralateral instability had signs of posterior instability at follow-up.

Other predisposing factors included having sustained the initial injury to the operated shoulder as a result of minimal trauma, and persistence of a sensation of instability in the operated shoulder. Factors which were not statistically significant included sex, dominant side, athletic activity, work history, and whether the initial surgery was for recurrent subluxations or dislocations.

The high prevalence of bilateral shoulder instability suggests an intrinsic abnormality such as capsular and ligamentous laxity or muscle imbalance and warrants further investigation.

Although the incidence of acute anterior shoulder dislocation has been reported for various populations (Hovelius 1978, 1982; Simonet et al 1984), we have been unable to find any long-term study which gives the incidence or prevalence of instability of the contralateral shoulder in patients who have been treated for unilateral anterior shoulder instability. Bilateral involvement at the time of presentation has been reported to be present in 10% to 12% of patients (Moseley and Övergaard 1962; Rowe 1988), but it would be useful to know what percentage of the remaining cases subsequently develop contralateral instability.

Morrey and Janes (1976) first reported that patients

with bilateral shoulder instability were more likely to have recurrence after surgical repair, and hypothesised that this was due to inherent joint laxity. There is a tendency to rationalise such postoperative instability on the basis that the trauma could have caused a normal shoulder to dislocate or subluxate, but little is known regarding the risk of instability in the contralateral shoulder, though this could provide an obvious and important control for the results of various surgical treatments. Knowledge of the prevalence of bilaterality would also help elucidate the importance of inherited factors in the pathogenesis.

We aimed to determine the prevalence and epidemiology of bilateral shoulder instability in a population of patients operated on for recurrent anterior shoulder instability, both at the time of first presentation and in the long-term.

PATIENTS AND MATERIALS

We reviewed the records of 257 patients who had undergone one of two standard surgical procedures for recurrent anterior shoulder dislocations or subluxations from April 1967 to March 1986, and were able to contact 188 of them, who had had a total of 200 anterior repairs.

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0301-620X/91/6257 \$2.00
J Bone Joint Surg [Br] 1991; 73-B: 941-6.

Eight of these patients (4.2%) had bilateral repairs, four others had required repeat operations on the same shoulder during the study period.

We excluded 20 patients (11%) who had had bilateral symptoms of shoulder instability at the time of presentation and one patient who refused to be interviewed. The remaining 167 patients had strictly unilateral instability at the time of surgery, never having experienced instability in their contralateral shoulders. Each of these 167 patients was interviewed and a detailed history was taken of symptoms of instability, as defined below, in the contralateral shoulder. Of these, 129 patients were also examined and radiographed. All records, reviews, interviews, examinations and radiographic interpretations were performed by one author (SO'D) according to a pre-determined protocol that involved entering 156 variables into a computer database.

Statistical analyses were performed on a microcom-

puter using appropriate parametric methods (ANOVA, regression analyses) for continuous data and non-parametric tests (chi-square, Kruskal-Wallis, Friedman) for categorical data.

confidence interval, 19% to 31%). Six of the 167 patients (4%) in the study group eventually had bilateral surgical repairs. Combined with the eight patients initially excluded because they had had bilateral repairs, this yields a 7% rate for bilateral surgery.

Detailed results are presented in Tables I to VI, which give probabilities for the significance of various factors.

Severity of instability. Not all the patients who developed contralateral instability were disabled by it and not all had long-term or recurrent problems. Only ten of the 26 experienced a dislocation that required reduction, and most of these were reduced by the patients themselves. Dislocation was defined as an episode of instability that persisted long enough to require a manipulation to reduce it. Subluxations reduced spontaneously or with simple manoeuvring of the limb by the patient.

Twelve of the 26 patients experienced only one

Table I. Pre-operative details of the operated shoulder, by number and percentage of each group

	Total	Contralateral instability			
		None	Present	None	Present
Patients	167	141	84	26	16
Sex (p = 0.13)					
Male	134	116	87	18	13
Female	33	25	76	8	24
Side operated on (p = 0.98)					
Right	96	81	84	15	16
Left	71	60	85	11	15
Dominance (p = 0.80)					
Dominant	67	56	84	11	16
Non-dominant	100	85	85	15	15
Cause (p = 0.24)					
Sport	117	101	86	16	14
Fall	24	21	87	3	13
Work	2	2	100	0	0
Other or no injury	24	17	71	7	29
Initial injury (p = 0.04)					
Major	143	124	87	19	13
Minor	24	17	71	7	29

puter using appropriate parametric methods (ANOVA, regression analyses) for continuous data and non-parametric tests (chi-square, Kruskal-Wallis, Friedman) for categorical data.

RESULTS

Of the 167 patients with only unilateral instability at the time of initial repair, 26 (16%; 95% confidence interval, 10% to 21%) developed symptoms of instability in the other shoulder during follow-up of one to 20 years (mean 9.5). When these are added to the 20 patients who initially presented with bilateral involvement, then 46 of 188 patients (24%) experienced contralateral instability (95%

Fig. 1

The cumulative incidence of contralateral instability increased significantly in a logarithmic pattern (dotted line) with the length of follow-up ($r = 0.97$).

episode of instability. Four patients had two such episodes and ten (6% of the total) had three or more subluxations or dislocations.

Pre-operative factors (Table I). The incidence of contralateral instability was not influenced by whether the right or left side had initially been operated on, nor if it had been the dominant or nondominant shoulder nor by the sex of the patient. It did not matter whether the initial injury to the operated shoulder occurred at sport, during a fall, at work, or due to other causes. However, when the history suggested either a major or minor injury there

was a significant difference. Of those whose initial injury was considered minor, 29% developed contralateral instability as compared with 13% of those who had experienced a major injury ($p = 0.04$).

Age of patients (Table II). The mean age (± 1 SD) at the time of surgery was 26 years ± 10 , and at follow-up was 35 years ± 11 . The length of follow-up was similar in both groups of patients, and the onset of contralateral

patients at the time of initial injury and the subsequent development of contralateral instability ($r = 0.98$, $p = 0.02$, Fig. 2). Specifically, the 15 patients who were under 15 years of age at the time of the initial episode of instability had a significantly higher frequency of contralateral instability than did those who were 15 years or older ($p < 0.05$, Fig. 2). It was hardly surprising then, to find that those under 18 years of age at the time of

Table II. Period of follow-up and age at various stages for each group (mean $\pm$ SD and range)

	Total (n = 167) Mean (Range)	Contralateral instability	
		None (n = 141) Mean (Range)	Present (n = 26) Mean (Range)
Follow-up ($p = 0.11$)	9.5 $\pm$ 5 (1.1 to 20)	9.3 $\pm$ 5 (1.1 to 20)	10.8 $\pm$ 5 (2.2 to 19)
First dislocation ($p = 0.42$)	22 $\pm$ 9.5 (8 to 72)	22 $\pm$ 10 (8 to 72)	20 $\pm$ 9 (3 to 49)
Surgery ($p = 0.11$)	26 $\pm$ 10 (13 to 74)	26 $\pm$ 10 (15 to 74)	24 $\pm$ 10 (13 to 53)
Latest follow-up ($p = 0.67$)	35 $\pm$ 11 (19 to 75)	35 $\pm$ 11 (19 to 75)	34 $\pm$ 11 (20 to 67)

Fig. 2

Relationship between the age of the patients at initial dislocation or subluxation of the operated shoulder and the percentage with contralateral instability ($r = -0.98$, $p = 0.02$). Patients under 15 years at the time of the initial episode had a significantly higher frequency of contralateral instability than the remainder.

Fig. 3

Age at operation related to contralateral instability. Patients who were under 18 years at the time of surgery had a significantly higher frequency of contralateral stability ($p < 0.05$).

instability occurred one month to 15 years (mean 5.7 years) after the shoulder operation. The cumulative incidence increased significantly in a logarithmic pattern with the length of follow-up ($r = 0.97$, $p < 0.01$, Fig. 1).

While the average age at the times of first dislocation or subluxation, at operation, and at follow-up were not significantly different for the two groups, there was a strong negative correlation between the age of the

surgery showed more contralateral instability ($p = 0.004$, Fig. 3).

Occupation (Table III). Pre-operative and postoperative occupations did not differ with respect to the prevalence of contralateral shoulder instability, nor did it matter if their pre-operative occupations involved working overhead. Those whose work required overhead activities after operation were more likely to suffer from contralat-

eral symptoms. Many patients had signs of posterior instability and these were more likely to experience symptoms while working with the arms overhead or outstretched in front of the body.

Athletics (Table IV). Participation in non-throwing sports was not a significant factor, regardless of the level of pursuit of the sport. Interestingly there was slightly less contralateral instability in those who competed professionally or at a college level. Similarly, swimming at a competitive or recreational level did not influence the outcome.

Table III. Details of occupation, by number and *percentage* of each group

		Contralateral instability		
	Total (n = 167)	None (n = 141)		Present (n = 26)
Preoperative (p = 0.29)				
Office worker	40	34	85	6 15
Skilled labourer	24	22	92	2 8
Unskilled labourer	32	28	87	4 13
Professional athlete	4	4	100	0 0
Student	63	51	81	12 19
Retired/disabled	4	2	50	2 50
Current (p = 0.34)				
Office worker	74	67	91	7 9
Skilled labourer	49	38	78	11 22
Unskilled labourer	27	23	85	4 15
Professional athlete	1	1	100	0 0
Student	10	8	80	2 20
Retired/disabled	6	4	67	2 33
Overhead pre-operatively (p = 0.46)				
No	116	97	84	19 16
Yes	48	43	90	5 10
Overhead work on review (p = 0.04)				
No	98	88	90	10 10
Yes	69	53	77	16 23

Operated shoulder (Table V). The incidence of contralateral instability was exactly the same whether the patients had initially been operated on for recurrent subluxations or dislocations, regardless of whether or not any of the dislocations had been documented radiographically or reduced by a physician. Those whose operated shoulders continued to feel unstable were more likely to experience contralateral instability (27%) than those whose shoulders felt stable (11%, $p = 0.01$). However, actual recurrence of the subluxations or dislocations, revision for recurrence, the type of injury causing the recurrence, or the presence of a Hill-Sachs lesion in the operated shoulder were not of significance.

Final follow-up of the contralateral shoulder (Table VI). Generalised joint laxity was rare and no more common in the group with contralateral instability. Generalised joint laxity was diagnosed on two or more of hyperextension of the elbows, metacarpophalangeal joints, or knees, or thumb abduction to touch the forearm. The low

prevalence of joint laxity may possibly be related to the increased age of the patients at this late follow-up (mean age 35 years). Assessment at the initial injury may have given different results.

There was a strong association between the operated and contralateral shoulders with respect to the presence of anterior ($p = 0.0001$) or posterior ($p = 0.004$) apprehension signs (O'Driscoll 1991). This was also true of excessive anterior ($p = 0.03$) or posterior ($p = 0.005$) translation of the glenohumeral joint on physical examination at the time of final evaluation. This indicates a

Table IV. Athletic activity, by mean and *percentage* of each group

	Total (n = 167)	Contralateral instability	
		None (n = 141)	Present (n = 26)
Non-throwing activity (p = 0.73)			
None	22	17 77	5 13
Recreational	49	42 86	7 14
High school	48	40 83	8 17
College	34	30 88	4 12
Professional	14	13 93	1 7
Swimming (p = 0.37)			
None	44	40 91	4 9
Recreational	104	85 82	19 18
Competitive	19	16 84	3 16

tendency for the pattern of instability to be similar in the two shoulders of a given patient. Evidence of inferior instability with a positive sulcus sign was infrequently observed, and this may be explained by the age of the patients.

Of the 18 patients with excessive posterior translation of the contralateral shoulder, seven (39%) had developed contralateral instability as against only 14 (13%) of the 111 who did not have posterior instability ($p = 0.005$). Nearly one-half of the patients with contralateral instability had a positive posterior apprehension sign (O'Driscoll 1991) in that shoulder, while the remainder had positive anterior apprehension signs. Thus, of those patients with contralateral instability, about one-half have posterior and one-half anterior instability.

DISCUSSION

Of the 167 patients who had only unilateral shoulder instability at the time of initial operation and who were followed up after an average of almost ten years, 26 (16%) subsequently developed contralateral instability, half of them posterior and half anterior. When added to the 20 patients with initial bilateral instability, the overall prevalence was 24% of 188 patients, of whom one-third (7% of the total) eventually underwent surgical repair.

This is a higher proportion of bilaterality than previously reported. Rowe (1988) found 12%, Moseley and Övergaard (1962) 10% and Morrey and Janes (1976) 9% at ten years. Hovelius (1987) followed 257 patients prospectively for five years after their initial dislocations and reported bilateral involvement in 11%. A comparable figure for our series, on average having their operation after three years would be that at two years postoperatively, which was 14%. However, this prevalence continued to increase logarithmically to reach 25% at 13 years, and it is possible that similar figures might have been observed if Hovelius' study had been continued for over a decade. It has previously been noted that longer follow-up reveals higher rates of recurrence (Kazar and Relovszky 1969; Morrey and Janes 1976).

demonstrate a predilection for recurrence in athletes, but Simonet and Cofield (1984) reported a tendency towards this.

The typical patient who may show or develop bilateral instability is young, had the initial dislocation or subluxation caused by a relatively minor injury, has excessive posterior translation of the glenohumeral joint, and tends to have a persistent sensation of instability in the operated shoulder.

Rowe pointed out that there are *occasional* recurrences and *frequent* recurrences (Rowe and Sakellarides 1961). We found this also to be true of contralateral instability. Only about a third had frequent recurrences in the contralateral shoulder.

Conclusions. Patients operated on for recurrent anterior

Table V. Relationship to findings and results in the operated shoulder, by number and *percentage* in each group

	Total (n = 167)	Contralateral instability			
		None (n = 141)		Present (n = 26)	
Indication (p = 0.98)					
Recurrent dislocation	148	125	84	23	16
Recurrent subluxation	19	16	84	3	16
Persistence of sensation of instability (p = 0.01)					
No	119	106	89	13	11
Yes	48	35	73	13	27
Recurrence of subluxation or dislocation (p = 0.42)					
No recurrence	132	113	86	19	14
Recurrence	135	28	80	7	20
Injury causing recurrence (p = 0.19)					
Sport	17	14	72	3	18
Fall or work	6	6	100	0	0
Other or no injury	11	7	64	4	36
Revision operation (p = 0.27)					
No	156	133	85	23	15
Yes	11	8	73	3	27
Hill-Sachs defect (p = 0.27)					
No	43	36	84	7	16
Yes	84	70	83	14	17

Table VI. Findings in contralateral shoulder at final follow-up number and *percentage* in each group

	Total	Contralateral instability			
		None		Present	
Number examined	129	108	84	21	16
Generalised joint laxity (p = 0.85)					
Absent	114	95	83	19	17
Present	15	13	87	2	13
Anterior instability (p = 0.03)					
Absent	119	102	86	17	14
Present	10	6	60	4	40
Anterior apprehension (p = 0.0001)					
Absent	114	104	91	10	9
Present	15	4	27	11	73
Posterior instability (p = 0.005)					
Absent	111	97	87	14	13
Present	18	11	61	7	39
Posterior apprehension (p = 0.004)					
Absent	105	94	90	11	10
Present	24	14	58	10	42
Sulcus sign (p = 0.2)					
Absent	127	97	83	21	17
Present	2	1	50	1	50

The statistically significant trend towards higher rates of bilateral instability in younger patients has previously been observed or suggested (Rowe and Sakellarides 1961; Morrey and Janes 1976; Simonet and Cofield 1984; Hovelius 1987; Rowe 1988). We found that those under 15 years at initial injury or under 18 at surgery were about three times more likely to develop contralateral instability. The other important prognostic factors included the minor nature of the initial injury, overhead work in the current occupation, persistence of sensation of instability in the operated shoulder, and signs of posterior instability. Other factors were not statistically significant, but the relationship to athletic activity was complex. Hovelius (1987) also failed to

shoulder instability have a 19% to 31% probability of eventual involvement of the contralateral shoulder; predisposing factors are listed above. About a half of them have posterior and the other half anterior instability. However, only about a third of them have three or more such recurrences.

The high incidence of bilateral involvement and particularly of posterior instability, could be due to intrinsic abnormalities in the peri-articular soft tissues, or muscular imbalance or both, and warrants further investigation. It should be reported in future studies of shoulder instability, since it may serve as a control value, and probably indicates the type of patient population in a series.

We are grateful to Timothy J. O'Driscoll, MSc, for his advice on the statistical analyses and to Josephine M. Hill, BSc Eng, and Marjorie M. O'Driscoll for helping us to locate the patients who were so difficult to trace so many years after surgery.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

REFERENCES

- Hovelius L.** Shoulder dislocation in Swedish ice hockey players. *Am J Sports Med* 1978; 6:373-7.
- Hovelius L.** Incidence of shoulder dislocation in Sweden. *Clin Orthop* 1982; 166:127-31.
- Hovelius L.** Anterior dislocation of the shoulder in teenagers and young adults: five year prognosis. *J Bone Joint Surg [Am]* 1987; 69-A:393-9.
- Kazar B, Relovszky E.** Prognosis of primary dislocation of the shoulder. *Acta Orthop Scand* 1969; 40:216-24.
- Morrey BF, Jones JM.** Recurrent anterior dislocation of the shoulder: long-term follow-up of the Putti-Platt and Bankart procedures. *J Bone Joint Surg [Am]* 1976; 58-A:252-6.
- Moseley HF, Övergaard B.** The anterior capsular mechanism in recurrent anterior dislocation of the shoulder: morphological and clinical studies with special reference to the glenoid labrum and the gleno-humeral ligaments. *J Bone Joint Surg [Br]* 1962; 44-B:913-27.
- O'Driscoll S.** A reliable and simple test for posterior shoulder instability. *J Bone Joint Surg [Br]* 1991; 73-B:Suppl 1:50.
- Rowe CR.** *The shoulder*. New York, etc: Churchill Livingstone, 1988.
- Rowe CR, Sakellarides HT.** Factors related to recurrences of anterior dislocations of the shoulder. *Clin Orthop* 1961; 20:40-8.
- Simonet WT, Cofield RH.** Prognosis in anterior shoulder dislocation. *Am J Sports Med* 1984; 12:19-24.
- Simonet WT, Melton LJ, Cofield RH, Ilstrup DM.** Incidence of anterior shoulder dislocation in Olmsted County, Minnesota. *Clin Orthop* 1984; 186:186-91.