Intra-articular distension and steroids in the management of capsulitis of the shoulder

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Abstract

Objective—To determine whether there is any synergistic effect in the administration of intra-articular steroids with distension in the management of early capsulitis of the shoulder.

Design—Prospective randomised trial of three treatments—namely distension only, steroid only, and steroid with distension.

Setting—Academic department of orthopaedic and accident surgery at Queen's Medical Centre, Nottingham.

Subjects—47 patients (30 women) with capsulitis affecting 50 shoulders.

Interventions—Three intra-articular injections into the shoulder given at six week intervals by the same technique.

Main outcome measures—Passive range of abduction, forward flexion, and external rotation; results of shoulder dynamometry measuring work done and torque produced; pain levels at rest and with resisted movement.

Results—All patients reported improvement during the study. Analysis of the mean improvements in abduction and forward flexion showed these to be significantly greater in the steroid with distension and steroid only groups than in the distension only group (mean improvements in abduction (degrees/week (95% confidence interval)) 4.3 (3.4 to 5.2), 3.4 (2.4 to 4.5), and 1.0 (−0.8 to 2.8) in the three groups respectively; mean improvements in flexion (degrees/week (95% confidence interval)) 3.6 (3.2 to 4.0), 3.3 (2.3 to 4.3), and 1.5 (0.5 to 2.5) respectively). Shoulder dynamometry failed to show a significant difference among the treatment groups. No severe complications occurred as a result of the injections, but two patients reported facial flushing related to the use of steroids.

Conclusion—Intra-articular steroid injections have a useful role in the outpatient management of early capsulitis.

Introduction

Capsulitis of the shoulder, or frozen shoulder,¹ is an idiopathic condition unique to this joint. The condition was first described by Duplay in 1872, who called it *périarthrite scapulo-humérale*.² In this paper we use the term capsulitis of the shoulder to refer to an idiopathic painful condition of the shoulder affecting all active and passive movements of the joint but whose main characteristic is grossly restricted external rotation. It has been shown to be a self limiting condition,³ passing through three phases, usually over 12–24 months. These phases were described by Rowe and Leffert as “freezing, frozen, and thawing.”⁴ Uncommonly there may not be complete resolution of the shoulder stiffness in the long term.^{5–7} Nevertheless, as the mobility of the shoulder has been shown to diminish with age,⁸ probably in relation to decreased physical activity,⁹ this residual stiffness is often associated by the patient with normal aging and is rarely a cause of complaint.

Lee *et al* reported on the large variety of treatments for capsulitis and concluded: “The very diversity of these methods casts doubt on the efficacy of any.”¹⁰

The use of hydrocortisone injections for capsulitis was first reported by Murnaghan and McIntosh.¹¹ Hydrocortisone has now been replaced by newer, long acting insoluble derivatives in an attempt to prolong the anti-inflammatory effect and diminish systemic side effects. Published reports of the results of these injections indicated that there was little long term advantage with the use of steroid injections.^{10 12 13} But no paper was clear with regard to the precise anatomical site of the injection, which would affect the results.

The use of hydraulic distension in capsulitis was described after arthrographic investigations showed adhesions and a decreased joint space. Some patients had a dramatic improvement in their shoulder symptoms 48 hours after arthrography.¹⁴ Reports evaluating this method of treatment described results after relatively large (50 ml) intra-articular injections of saline.^{15 16} Wallace and Echeverri reported good results after intra-articular distension with an injection of steroid, local anaesthetic, and air (total volume 10 ml) in patients with capsulitis of the shoulder.¹⁷ We decided to investigate whether these good results were due to the action of the steroid alone or the distension alone or whether both intra-articular steroid and distension were required to obtain good results.

Patients and methods

Outpatients were referred by their general practitioners to a special clinic set up for this prospective randomised trial. Both shoulder girdles were fully assessed at the patient's initial visit, including a careful assessment of the cervical spine. Patients with diabetes mellitus or a myocardial infarction immediately before the onset of symptoms were excluded as these conditions may precipitate capsulitis and influence the patient's recovery.^{12 18} Furthermore, two of us (WW and DB) believed that capsulitis associated with these conditions was more resistant to treatment.

Entry into the study was based on the following criteria: abduction and forward flexion less than 90°; external rotation less than 20°; intact rotator cuff

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FIG 1—Typical trace from Cybex II shoulder dynamometer

FIG 2 (left)—Bony landmarks outlined in preparation for injecting left shoulder by posterior approach
FIG 3 (right)—Injection of steroid and local anaesthetic being given by posterior approach

clinically; normal shoulder radiographs. Patients were included regardless of the severity of pain when using the limb, at rest, or at night; a history of trauma; or the duration of symptoms. Active and passive abduction and forward flexion were measured with the patient standing upright against a wall and by using a hydrogoniometer (MIE Medical Research Ltd), and passive external rotation was measured with the elbow at 90° as described by Cyriax.¹⁹ Rotator cuff integrity was established by testing the power of the supraspinatus, infraspinatus, and subscapularis muscles. Standing anteroposterior and axial radiographs of the affected shoulder were taken. Osteoporosis of the shoulder was not an exclusion criterion, but radiological evidence of rotator cuff disease was.

ASSESSMENT

Patients were assessed in two main ways—namely, clinically and by shoulder dynamometry.

Clinical assessment

All clinical assessments were performed blind and took place at the first visit and at six and 12 weeks. The assessors for the first three visits were LJ, JF, and ND, who performed 105 (70%), 29 (19%) and 16 (11%) assessments respectively. WW performed a further blind assessment at 16 weeks on all patients entered into the study; 16 weeks was designated as the conclusion of the study and patients were then discharged.

At each visit the following details were recorded on a data sheet: (a) the patient's analgesic use (assessed by type(s) of analgesic and number of tablets taken daily); (b) severity of pain in relation to daily activities (scored on a six point scale from 0 (none) to 5 (severe; interferes with sleep)); (c) severity of pain with resisted shoulder movement (scored on a four point scale from 0 (none) to 3 (severe; with pain inhibition)); (d) range of active and passive abduction, forward flexion, and external rotation of the shoulder.

Shoulder dynamometry

Patients were assessed at two week intervals with an isokinetic shoulder dynamometer built in the Nottingham University Hospital workshop and based on the Cybex II instrument. Dynamometry was supervised by MB, who was unaware of the treatment group to which each patient belonged. The method used was that described by Barton *et al*²⁰ and verified by Robinson.²¹ Both arms were assessed three times in abduction and in flexion with the dynamometer speed set at 60°/s. The mean values of the following variables for each arm were calculated with a custom written computer program: (a) work done in abduction; (b) work done in flexion; (c) torque produced at 90°

abduction; (d) torque produced at 90° flexion. Work done, measured in Joules (J), was extrapolated from the area under the graph (fig 1). The torque produced at 90° abduction and 90° flexion was measured in newton meters (N.m) on the x axis (fig 1).

INTRA-ARTICULAR INJECTIONS

Management of capsulitis was by intra-articular injections administered via the posterior approach as described by Cyriax and Russell.²² The technique of injections is as follows:

The patient is seated on a chair facing away from the operator. The posterior corner of the acromion is identified and a point on the skin 1 cm inferior to it marked with a cross using the thumb nail (fig 2). The area of skin marked with the cross is cleaned with an alcohol impregnated swab. The operator then places his or her non-dominant index or long finger on the coracoid process anteriorly and thumb on the posterior corner of the acromion. A syringe with a 40 mm 21 gauge needle is held horizontally and inserted through the centre of the cross in the direction of the operator's finger on the coracoid process. Some resistance is felt as the capsule is pierced, and the patient usually complains of pain at that point. The needle is then stopped by the humeral head or passes between the head and the acromion process. If the humeral head is not encountered the operator should check the inclination of the needle in relation to the coracoid process. The injection is then given slowly (fig 3).

TREATMENT GROUPS

After their first assessment patients were prospectively randomised into three treatment groups stratified by sex. Patients who had bilateral capsulitis had each shoulder randomised separately. All injections were given immediately after assessments had been completed. All patients gave fully informed consent at the start of treatment.

The treatment groups were (a) distension only group (6 ml 0.25% bupivacaine + 3 ml air; total volume 9 ml); (b) steroid only group (triamcinolone acetonide (40 mg) alone; total volume 1 ml); (c) steroid and distension group (triamcinolone acetonide (40 mg) + 6 ml 0.25% bupivacaine + 3 ml air; total volume 10 ml).

Each patient was offered a total of three injections at six week intervals unless they either refused or had a dramatically improved range of movement and no pain at all. Ethical approval could not be obtained for a "no injection" group, so that the distension only group served as controls (though we recognised that there may well be potential benefit from this form of treatment). All patients were given an information sheet with a home exercise programme which also explained capsulitis, and no patient was referred for hospital physiotherapy. Any patient could be withdrawn from the study if his or her clinical progress was unsatisfactory and after discussion with WW. Withdrawal meant that patients were given intra-articular injections with steroids and distension and were followed up using the same protocol in tandem with the study. All patients were required to attend at least eight times in order to complete the study.

STATISTICAL ANALYSIS

The passive ranges of abduction, flexion, and external rotation were used for analysis as suggested by Binder *et al*⁷ and elsewhere.²³ The changes in passive range of movements and dynamometer variables for all patients in the study (until they either completed the study or were withdrawn) were used in the analysis. Summary statistics from the slopes of individual regression lines were calculated for the rate of change in shoulder movements and shoulder dynamometer variables. This then allowed for one way analysis of

variance of within patient differences of the regression slopes³⁴ for the three treatment groups by using the statistical package for the social sciences (SPSS-X). Other intergroup differences were analysed with the χ^2 test (SPSS-X).

Results

Fifty shoulders of 47 patients were entered into the study over two years. The ratio of left to right shoulders affected was 3:2, three patients having bilateral capsulitis. Thirty (64%) patients were women, and the non-dominant arm was affected in 30 (60%) shoulders. Patients were first seen between one and 24 months after the onset of symptoms (median six months). No patient gave a history of a fractured arm.

Table I gives an analysis of the complete study group. Three patients defaulted at between four and eight weeks for reasons unconnected with the study. One other patient was unable to continue dynamometric assessment after 10 weeks because of a cerebrovascular accident. There was no significant difference among the treatment groups with regard to age, duration of symptoms, sex distribution, dominance, or occupation (table I). The numbers of patients withdrawn from the study because of poor clinical progress were five (36%) from the distension only group, three (20%) from the steroid only group, and none from the steroid and distension group.

Table II shows the improvement in symptoms in all patients in the study with regard to pain at

rest and pain with resisted abduction (the improvement was similar for flexion and external rotation). There was a significant reduction in the numbers of patients taking analgesics during the study (27 (57%) patients taking analgesics at start of study; 10 (21%) patients taking analgesics at end ($\chi^2=15.64$; $p<0.001$)).

Range of movement—The results of analysis of variance of the rates of change in the shoulder movements for all patients in the treatment groups are shown in table III. The steroid and distension group achieved the greatest overall improvement in range of motion, but this was not significantly better than in the steroid only group. Both groups fared significantly better than the distension only group.

Dynamometry—In all patients the moment (torque) produced and work done improved over the 16 weeks of the study. Analysis of the rate of change failed to detect any significant differences among the treatment groups (tables IV and V). The treatment groups also showed no differences when they were further subdivided by sex and dominance.

Complications—No patient developed intra-articular sepsis or a suprascapular nerve palsy after the intra-articular injections. Two patients, however, developed temporary (<24 hours) facial flushing after their steroid injection. This was also reported by Patrick and Docherty,²⁵ but the mechanism remains unclear. The cerebrovascular accident in one patient was thought to be unrelated to the intra-articular steroid injections.

Discussion

All patients entered into this study improved during treatment as was shown by their decreased analgesic consumption and the improvement in painful symptoms. The relief of symptoms was not confined to any specific treatment group, so that intra-articular distension of a shoulder affected by capsulitis cannot be said to be placebo treatment. Table III shows that there was a significantly increased rate of improvement in passive shoulder abduction and forward flexion in the two groups of patients treated with intra-articular steroid injections. The mean improvement was greatest in the steroid and distension group. That external rotation did not follow this pattern may in part reflect inaccuracy in our method of measuring this movement.

Pain is difficult to assess and is often an inaccurate outcome measure. We found no significant difference among the three treatment groups in their degree of pain (table II) or use of analgesics over the study period. Anticipating this result, we tried to use a more objective and quantifiable shoulder assessment system by making dynamometric measurements of patients' shoulders. The readings, however, seem to have been influenced by many other factors, such as pain, motivation, minor illnesses, etc. Thus there was a large scatter of results leading to poor reproducibility in these patients.

Reliable intra-articular injection into the shoulder may be difficult (D S Barrett, S A Copeland, paper presented at second scientific meeting of British Elbow and Shoulder Society, March, 1990). The intra-articular injection of a small volume of steroid into the shoulder may be less reliable than when a larger volume containing air is injected. Air in the shoulder results in a "squelch" when the joint is subsequently moved. This was found after all 59 intra-articular shoulder injections performed personally by LJ in which air was a component. An air arthrogram can be obtained after injection but it was not possible to obtain ethical approval for this additional radiographic examination.

Manipulation of the shoulder under general

TABLE I—Distribution of 47 patients (50 affected shoulders) entered into study

	Treatment group		
	Distension only (14 patients)	Steroid only (15 patients)	Steroid and distension (18 patients)
Total shoulders	16	16	18
No in men	5	5	9
No in women	11	11	9
No of patients defaulted	2	1	0
Mean age (years)	53	52	55
Mean duration of symptoms (months)	6	6	8
Dominant side:			
Right	14	15	17
Left	2	1	1
Occupation:			
Manual	6	7	6
Non-manual	10	9	12

TABLE II—Improvement in pain over study period in all patients at rest and all patients with resisted abduction

Grade	Degree of pain	No of patients	
		At start of study	At end of study (after 16 weeks)
<i>All patients at rest</i>			
0	None	0	38
1	Slight or occasional	10	5
2	After unusual activity	6	2
3	Moderate (alters use)	5	1
4	Marked (limits activity)	5	1
5	Severe (loss of sleep)	21	0
<i>All patients with resisted abduction</i>			
0	None	15	39
1	Mild (slight ache)	24	4
2	Moderate (no pain inhibition)	4	4
3	Severe (pain inhibition)	4	0

TABLE III—One way analysis of variance of between group differences for mean improvement in shoulder range of abduction, flexion, and external rotation over study period for three injection regimens (50 shoulders)

Movement	Improvement in range of movement over 16 weeks (J/week (95% confidence interval))			F value	p Value
	Distension only	Steroid only	Steroid and distension		
Abduction	1.0 (-0.8 to 2.8)	3.4 (2.4 to 4.5)	4.3 (3.4 to 5.2)	6.98	<0.01
Flexion	1.5 (0.5 to 2.5)	3.3 (2.3 to 4.3)	3.6 (3.2 to 4.0)	6.56	<0.01
External rotation	1.2 (0.3 to 2.2)	1.7 (1.2 to 2.3)	2.1 (1.6 to 2.6)	2.76	>0.05

TABLE IV—One way analysis of variance of between group differences for mean improvement in work done for shoulder abduction and flexion over study period for three injection regimens (50 shoulders)

Movement	Improvement in work done over 16 weeks (J/week (95% confidence interval))			F value	p Value
	Distension only	Steroid only	Steroid and distension		
Abduction	0.4 (0.1 to 0.7)	0.8 (0.4 to 1.2)	0.9 (0.6 to 1.7)	1.92	>0.05
Flexion	0.7 (0.3 to 1.1)	1.0 (0.4 to 1.6)	0.9 (0.5 to 1.4)	0.56	>0.05

TABLE V—One way analysis of variance of between group differences for mean improvement in torque produced for shoulder abduction and flexion over study period for three injection regimens (50 shoulders)

Movement	Improvement in torque over 16 weeks (N.m/week (95% confidence interval))			F value	p Value
	Distension only	Steroid only	Steroid and distension		
Abduction	0.3 (0.0 to 0.6)	0.5 (0.2 to 0.9)	0.6 (0.1 to 1.2)	1.29	>0.05
Flexion	0.6 (0.3 to 0.9)	0.7 (0.3 to 1.1)	0.7 (0.5 to 0.8)	0.01	>0.05

anaesthesia with an intra-articular steroid and local anaesthetic injection has been recommended for capsulitis.^{26,27} This requires a more costly inpatient stay with general anaesthesia and immediate postoperative physiotherapy. There are also the risks of fracture of the humeral neck and rupture of the rotator cuff when the procedure is performed by an inexperienced surgeon. Our study indicates a positive role for intra-articular steroid injections in the early outpatient management of capsulitis of the shoulder.

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Impact of variability among surgeons on postoperative morbidity and mortality and ultimate survival

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Abstract

Objective—To assess the differences among surgeons in postoperative complications, postoperative mortality, and survival in patients undergoing surgery for colorectal cancer.

Design—Prospective study of patients with colorectal cancer managed by one of 13 consultant surgeons, none of whom had a special interest in colorectal surgery.

Setting—Royal Infirmary, Glasgow.

Patients—645 sequential patients with colorectal cancer presenting over the six years from 1974 to 1979.

Main outcome measures—Postoperative complications, postoperative mortality (within 30 days), and survival (up to 10 years); predictive factors for postoperative mortality and survival; and relative hazard rate ratios for individual surgeons.

Results—The proportion of patients undergoing apparently curative resection varied among surgeons from 40% to 76%; overall postoperative mortality varied from 8% to 30%. After curative resection postoperative mortality varied from 0% to 20%, local recurrence from 0% to 21%, and the rate

of anastomotic leak from 0% to 25%. Survival at 10 years in patients who underwent curative resection varied from 20% to 63%, two year survival in those who underwent palliative resection varied from 7% to 32%, and median survival in those who underwent palliative diversion varied from one to eight months. The hazard rate ratios among individual surgeons, taking into account the identified risk factors, varied from 0.56 to 2.03, from 0.17 to 1.92, and from 0.57 to 1.50 for curative resection, palliative resection, and palliative diversion, respectively.

Conclusion—There were significant variations in patient outcome among surgeons after surgery for colorectal cancer; such differences compromise survival. A considerable improvement in overall survival might be achieved if such surgery were undertaken by surgeons with a special interest in colorectal surgery or surgical oncology.

Introduction

Previous studies have drawn attention to the extent of the intersurgeon variability in surgery for colorectal cancer.^{1,2} Differences in surgeon related variables,

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