SUBACROMIAL BURSITIS*

A Classification and an Evaluation of the Results of Roentgen Therapy

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SUBACROMIAL bursitis of the shoulder and its allied disorders, tendinitis calcarea and periarthritis, have been recognized as clinical entities since the memorable work of Codman.[1] Among the many accepted forms of treatment for these conditions, roentgen therapy in the past decade has gained considerable prominence.[2 to 5] A series of 109 cases treated in the Department of Radiology, Royal Victoria Hospital, during the years 1940 to 1946 inclusive, forms the basis of the present article. During this period additional cases were treated, but have been excluded because of the lack of adequate data. In this survey a classification has been evolved which has been found to be of considerable assistance in the grouping of cases and in the assessment of the results of roentgen therapy. This classification, further, has now been adopted as a guide in the selection of cases for treatment.

CLASSIFICATION

Depending on the duration of symptoms and on the clinical findings, cases can be classified in five main groups, as follows: (1) acute bursitis—symptoms of one month or less; (2) subacute bursitis—history of one to three months; (3) chronic bursitis—over three months' duration; (4) chronic bursitis with acute exacerbation—a long and indefinite period of shoulder discomfort only, with a recent acute episode; (5) periarthritis—a lengthy history of pain and progressive loss in range of movement, and on examination a fixed shoulder with winging of the scapula on abduction.

As will be shown, for the purpose of selection of cases for treatment and the results to be expected, each group should be subdivided further on the basis of roentgenographic evidence of the presence or the absence of soft tissue calcification. Table I demonstrates the distribution of our case material as classified in the five major groups.

TABLE I.

CLASSIFICATION OF 109 CASES

Group	*No. cases*	*Percentage in series*
Acute bursitis	30	27.5
Subacute bursitis	20	18.3
Chronic bursitis	39	35.7
Chronic bursitis with acute exacerbation	12	11.0
Periarthritis	8	7.5
	109	100.0

PATHOLOGY

Codman,[1] Moseley[6] and others have used the term "rotator cuff" to describe the short rotator muscles of the shoulder girdle which insert into the greater and lesser tuberosities of the humerus. Degeneration resulting from minor repeated trauma may occur in the tendon of any of these, at or near their insertion into the periosteum of the humerus. Calcification in the degenerated tendon may be demonstrated in a proportion of cases. Such calcification, however, may be present for many years without clinical manifestation. The tendon of the supraspinatus is the most frequently involved. Symptoms seem to arise only when the floor of the overlying subacromial bursa is irritated by the degenerated or calcified tendon, thus inducing a bursitis. In long-standing cases, extra-articular fibrous adhesions may be formed with resultant marked limitation of movement—clinically known as periarthritis of the shoulder.

ETIOLOGY

The present series includes 109 shoulders presenting in 96 patients, 13 of whom had bilateral involvement. For statistical purposes, each shoulder is considered as a separate case. Of these 96 patients, 39 were males (40.8%) and 57 females (59.2%). The average age was 45 with a range of 17 to 70 years. Taking the group as a whole, 80% could be considered to belong to the non-labouring class. Among the females, however, housewives predominated. It is of interest that a history of previous moderate injury or severe unusual exertion, involving the affected shoulder, was obtained in 28%. Prior to consultation with the roentgen-therapist, 39% of the patients in this series had been subjected to one or more other forms of treatment, such as diathermy, novocain injections, hot packs, shoulder exercises and surgery.

SIGNS AND SYMPTOMS

The signs and symptoms of bursitis[1, 6, 7] of the shoulder are too well known to require a full

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description in a report of this nature. Suffice it to say that the *acute* cases complained of severe local excruciating pain, sometimes radiating down the arm and up into the neck. Objectively, local tenderness was present on pressure over the site of insertion of the involved tendon, and all movements were markedly limited because of aggravation of pain on motion.

The *subacute* group showed a clinical picture similar to the acute, but of less severity and longer duration. Several of these patients originally had had an acute onset, but their symptoms had partially subsided when first seen.

Chronic cases presented a long history of pain of a nagging character, usually associated with local tenderness over the greater tuberosity of the humerus, together with varying degrees of limitation of movement, particularly abduction and backward flexion of the shoulder.

Occasionally patients with chronic bursitis develop an *acute exacerbation,* in which the clinical picture becomes indistinguishable from the acute process. From the point of view of therapeutic management and results such cases are in a different category from the chronic case.

The patients with *periarthritis* gave the classical picture of a "frozen shoulder" with winging of the scapula on abduction and, except for minor degrees of external and internal rotation, show marked limitation of all movements.

ROENTGENOLOGIC SIGNS

Roentgen examinations in the antero-posterior projection with the humerus rotated externally and internally were carried out in each case, prior to the administration of roentgen therapy. Occasionally where the question of calcification in tendons other than the supraspinatus arose, views were also obtained in the supero-inferior or axillary projection. Calcification in the supraspinatus tendon always was seen best in internal rotation. In 65 cases (59.6%) of this series, calcific deposits were shown in the soft tissues of the shoulder. The usual site was the supraspinatus tendon near its insertion into the superior margin of the greater tuberosity (Fig. 1). In six cases, the calcium deposit was identified as lying in one or more of the remaining tendons of the rotator cuff (Fig. 2). The calcified deposits in 8 cases, however, presented a rounded lower margin which lay laterally below the tip of the greater tuberosity and therefore could not be within the tendon alone (Figs. 3, 4 and 5). It is considered that these deposits had ruptured from the tendon and extruded into the subacromial bursa. This interpretation has been confirmed in this Hospital by operation upon one of the present series and other cases. In size, the calcific shadows ranged from a tiny speck to a large mass, maximum 3.0 cm. in diameter. The smaller ones were commonly homogeneous in appearance and varying in density, whilst the larger masses were often fragmented and granular in character. Extension of the process medialward into the muscular portion of the supraspinatus was noted occasionally.

DIFFERENTIAL DIAGNOSIS

To exclude other factors producing shoulder pain, the necessity for a complete clinical and roentgenologic examination prior to institution of roentgen therapy must be emphasized. The importance of such investigation has been demonstrated by cases (not included in this series) which had been treated for bursitis on a presumptive diagnosis only. Subsequently the proper diagnosis of osteomyelitis, generalized arthralgia, or cervical spondylosis was established. Other local conditions to be considered in a differential diagnosis are minimal chip fracture of the greater tuberosity, acute arthritis, osteoarthritis of the shoulder and acromio-clavicular joints, metastatic disease of the shoulder girdle, rupture of the supraspinatus tendon and primary neoplasm. The possibility of pain referred to the shoulder from cardiac, cholecystic, pleural or mediastinal disease must also be entertained.

TREATMENT

Three different methods of roentgen therapy were employed in this series, using medium voltage in one, and high voltage radiation in the others.

1. With medium voltage, the technical factors were 135 kVP, 0.25 mm. Cu and 1.0 mm. Al filtration, 50 cm. F.S.D., H.V.L. of 6.0 mm. Al. Through a single circular field, 5 inches in diameter, centered over the greater tuberosity of the humerus, a total dose of 800-1,000 "r" measured in air was administered within 10 to 14 days, at the rate of 100 "r" per sitting. Treatments were given daily until some analgesic effect was obtained, and then on alternate days to completion. If complete relief of all

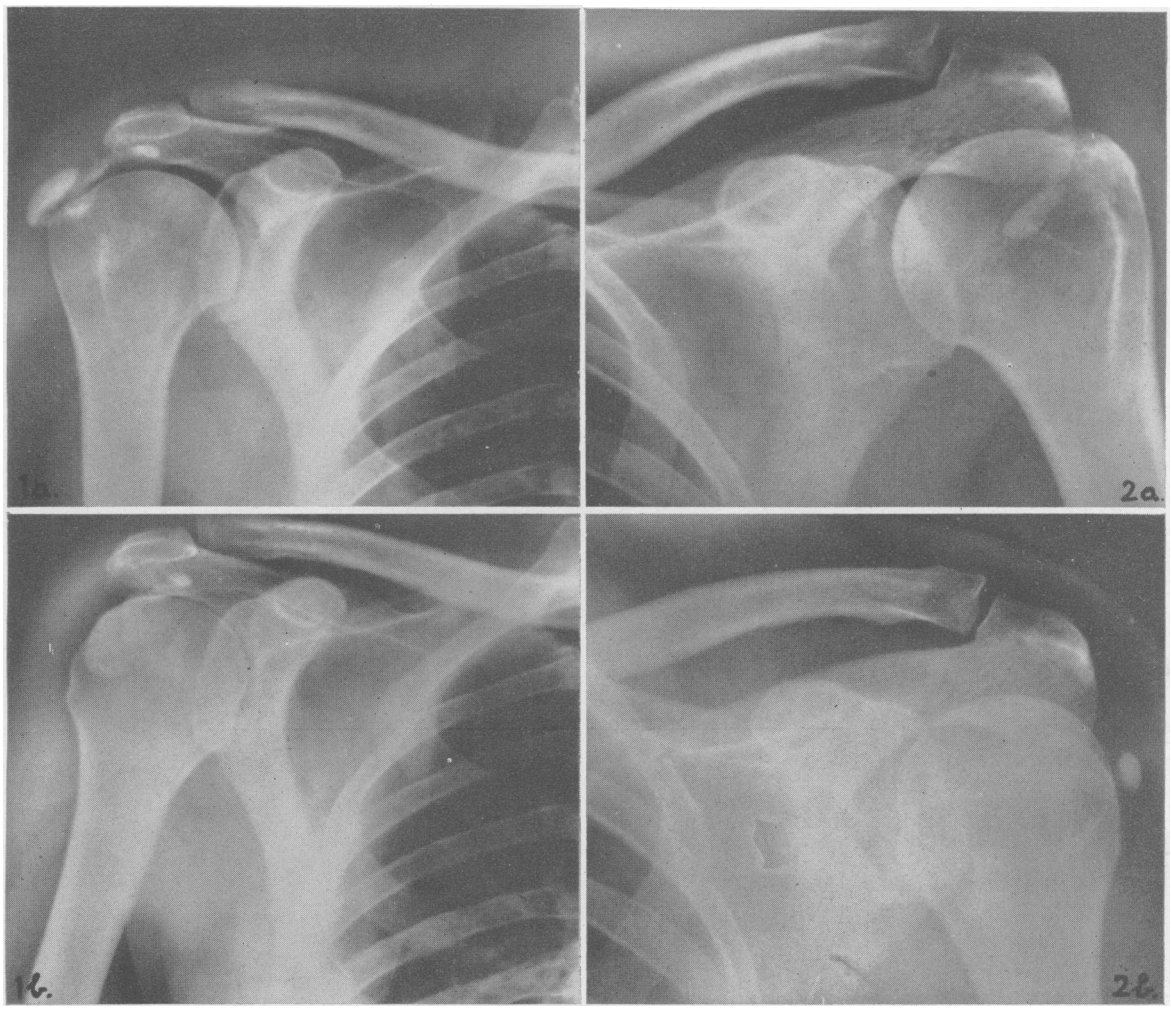

Fig. 1.—Antero-posterior projections of the right shoulder. (a) With the arm externally rotated, demonstrating extensive calcification in the supra-spinatus tendon. (b) With the arm internally rotated, the calcified deposit is still visible projected in the plane of the humeral head. **Fig. 2.**—Antero-posterior projection of the left shoulder. (a) With the arm externally rotated a dense area of calcification lies medial and slightly below the greater tuberosity. (b) With the arm internally rotated the calcified area now lies lateral to the posterior surface of the anatomical neck of the humerus and is therefore in the tendon of the infraspinatus.

Fig. 3.—Antero-posterior projection of the right shoulder demonstrating calcium within the subacromial bursa. Note the typical tear drop appearance of the lower portion of the calcium deposit in the bursa. In addition extensive calcification is partially obscured by the humeral head but does show as a dense mottling.

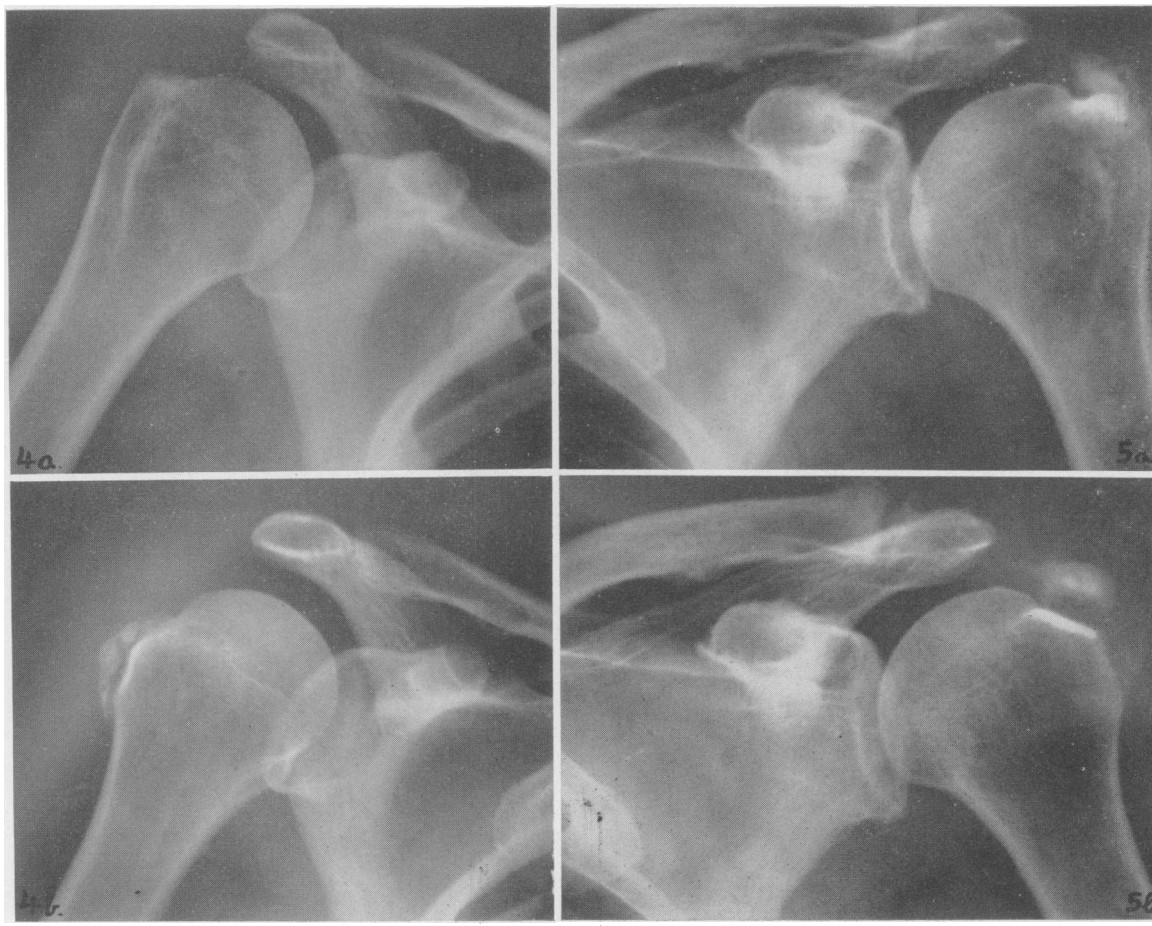

Fig. 4.—Antero-posterior projections. (a) In external rotation—calcium deposit is concealed by the humeral head. (b) In internal rotation—calcium deposit appears to be mostly in the bursa itself. **Fig. 5.**—Antero-posterior projection of the left shoulder with the arm (a) in external rotation; (b) in internal rotation. In this case both views demonstrate extensive dense calcification located in the supra-spinatus tendon together with faint non-homogeneous calcification lying lateral and inferior to the greater tuberosity, the latter indicating rupture into the bursa which then becomes outlined by the calcified deposit.

symptoms was accomplished before the end of the planned course, irradiation was discontinued. For the past two years this technique has been used routinely for the acute cases.

2. With high voltage radiation (200 kVP), either a rapid or a protracted method of administration was used, employing anterior and posterior shoulder ports 10 x 10 or 10 x 15 cm. in size. The other physical factors were 0.5 mm. Cu plus 1.0 Al filtration, 50 cm. F.S.D., H.V.L. of 1.13 mm. Cu.

(*a*) The "rapid" series comprised 3 treatments of 300 "r" (measured in air) each, over a period of 3 to 7 days. Frequently these patients demonstrated a severe recrudescence of symptoms and required codeine or occasional morphine for sedation.

(*b*) The protracted course consisted of a total dose of 1,200-1,500 "r" (measured in air) given over a period of 15 to 18 days, with an average dose per sitting of 150-200 "r". This technique has been used chiefly for the chronic cases.

It is our experience that an increase in severity of symptoms is to be anticipated a few hours following the first or the second application of x-radiation in all cases, but particularly in the acute. Adequate sedation during this stage is necesary, using acetyl-salicylic acid, plain or with small quantities of codeine. Rarely is morphine required. All patients are encouraged to begin systematic active exercise of the shoulder as soon as moderation of pain permits.

RESULTS OF ROENTGEN THERAPY

The results of therapy have been assessed in the present series on the basis of the immediate response at completion of the therapeutic course, and upon the status of the patient, six

months or more after the completion date, as determined by follow-up examination.

1. *Immediate results.*—These are tabulated in Table II. The acute and subacute bursitis, on the whole, responded well to roentgen therapy, confirming the results previously reported by several workers.[2, 3, 4] The analysis illustrates, however, that acute and subacute cases without calcification did not react as well as those with calcification. A critical re-survey of these cases fails to explain the poorer results. Hence, prior to accepting such patients for treatment, a very careful scrutiny of those patients who have no demonstrable calcification in the shoulder must be made, to ensure a proper diagnosis, and this is now the policy in this Department. Half the chronic group received our general policy to use 200 kV radiation in treating the obese and the chronic cases, no major difference in results was noted in the chronic cases treated with 200 kV as compared with the small group of chronic cases treated with the 135 kVP technique.

The response in the acute and subacute groups to the "rapid" form of administration at 200 kVP was not quite as good as that noted with the more protracted 135 kV method. In the chronic group, however, the response to the "rapid" method appeared to be somewhat better than with the protracted form of administration at 200 kV. The latter findings cannot be regarded as overly significant at this time owing to the relatively small number of cases in this group.

TABLE II.
IMMEDIATE RESULTS OF ROENTGEN THERAPY
109 CASES

Group	*No. cases*	*Complete relief*	*Marked relief*	*Partial relief*	*No relief*
Acute Bursitis		*Percentage*	*Percentage*	*Percentage*	*Percentage*
(*a*) With calcium in tendon	19	73.7	21.1	5.2	
(*c*) No demonstrable calcium in tendon	11	27.3	36.4	27.3	9.0
Subacute Bursitis					
(*a*) With calcium in tendon	9	33.3	55.5		11.2
(*b*) No demonstrable calcium present	11	18.2	36.4	27.2	18.2
Chronic Bursitis					
(*a*) With calcium in tendon	22	4.5	54.5	27.0	13.0
(*b*) No demonstrable calcium present	17	5.8	47.0	11.8	35.4
Chronic Bursitis with Acute Exacerbation					
(*a*) With calcium in tendon	10	50.0	40.0	10.0	
(*b*) No demonstrable calcium present	2	50.0		50.0	
Periarthritis					
(*a*) With calcium in tendon	5			20.0	80.0
(*b*) No demonstrable calcium present	3		33.3	33.3	33.3

Complete relief.—No symptoms, no limitation of movement.
Marked relief.—Occasional ache, very slight limitation of movement, slight inconstant local residual tenderness.
Partial relief.—Residual ache, commonly inconstant, limitation of movement (partial).
No relief.—Unchanged.

sponded favourably whether calcification was present or not. On the other hand, it is notable that chronic cases with an acute exacerbation of symptoms did almost as well as the acute group with calcification.

The results of treatment of periarthritis were generally disappointing, only one patient out of eight having shown moderate response.

RELATION OF IMMEDIATE RESPONSE TO METHOD OF IRRADIATION

An assessment of the immediate results on the basis of the method of irradiation has shown that the acute cases and also the chronic cases with exacerbation of symptoms, definitely appeared to do better when medium voltage (135 kV) radiation was used. Although it has

2. *Final results.*—In Table III are listed the final results in 56 cases followed for six months or more during the period 1940-47.

Generally, in the acute and subacute groups, the satisfactory immediate results lasted, whereas in a small percentage of the chronic ones, after an initial improvement, a relapse occurred. In many of the chronic cases, although pain had been relieved, improvement in range of motion of the shoulder was delayed and inadequate. It is our belief that much of this was due to insufficient early supervised exercise. Consequently, in all patients, as soon as partial relief of pain has been secured, supervised active exercises of the shoulder should be initiated, particularly abduction and external rotation, and persisted with as long

as any limitation of movement remains. By this method, we feel that a more satisfactory end result may be expected in the subacute and chronic groups.

Four cases (three chronic bursitis, one periarthritis) had an acute recurrence of symptoms. After a further course of roentgen therapy one of the chronic cases gained complete relief, but the case of periarthritis failed to improve. The second chronic case had complete relief after surgical evacuation of the bursa. The third improved gradually on a course of active shoulder exercises.

An effort has been made to determine the ultimate fate of the calcium deposits. Follow-up roentgen examination, at varying intervals from 6 months to 7 years, in 12 of the treated cases with known calcification about the shoulder demonstrated complete resolution in 6, and marked diminution in the degree of calcification in 3 others. Two cases remained unchanged. One demonstrated an increase in the amount of calcium. Any attempt to determine whether or not calcification has disappeared after x-ray therapy requires roentgenograms not only in the ordinary antero-posterior projections, but also with external and internal rotation of the humerus.

TABLE III.
FINAL RESULTS OF ROENTGEN THERAPY
FOLLOW-UP ON 56 CASES, 6 MONTHS OR MORE AFTER IRRADIATION

Group	*No. cases*	*Complete relief*	*Marked relief*	*Partial relief*	*No relief*
Acute Bursitis		*Percentage*	*Percentage*	*Percentage*	*Percentage*
(*a*) With calcium in tendon	9	100.0			
(*b*) No demonstrable calcium in tendon	4	50.0	25.0	25.0	
Subacute Bursitis					
(*a*) With calcium in tendon	5	60.0	20.0		20.0
(*b*) No demonstrable calcium present	4	25.0			75.0
Chronic Bursitis					
(*a*) With calcium in tendon	12	25.0	25.0	8.0	42.0
(*b*) No demonstrable calcium present	8	25.0	12.5	12.5	50.0
Chronic Bursitis with Acute Exacerbation					
(*a*) With calcium in tendon	7	57.0	43.0		
(*b*) No demonstrable calcium present	2	100.0			
Periarthritis					
(*a*) With calcium in tendon	4		25.0		75.0
(*b*) No demonstrable calcium present	1				100.0

SUMMARY AND CONCLUSIONS

A classification of subacromial bursitis, which is of value in selecting the cases suitable for roentgen therapy and in estimating the prognosis has been described.

In the selection of cases for roentgen therapy and in the evaluation of the immediate and late results, a careful clinical and radiologic examination is a necessary pre-requisite. Roentgenographically demonstrable calcium in the soft tissue seems to have a direct relationship to prognosis. Calcification, if present, usually is situated in the tendon alone, not in the bursa. The presence of a calcified deposit in the subacromial bursa may occasionally be demonstrated. Its typical tear-drop outline and site have been described.

Acute and *subacute bursitis* respond favourably to roentgen therapy. However, this survey has shown that in the absence of calcification, the response is not as satisfactory as when calcification is demonstrable. *Chronic bursitis* with acute exacerbation of symptoms may be expected to respond almost as well as the acute form.

Long standing *chronic bursitis* may be relieved considerably, but to a lesser degree.

In *periarthritis,* roentgen therapy is not recommended.

In all cases, as soon as sufficient relief from pain has been accomplished, active supervised exercises of the shoulder should be instituted and persisted with until complete range of movement is obtained. This particularly applies to the chronic cases.

Disappearance or marked diminution in the amount of calcification after roentgen therapy seems to be the rule in the limited number of cases followed.

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