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The Frozen Shoulder : Diagnosis and Treatment. Prospective Study of 50 Cases of Adhesive Capsulitis

M. WALDBURGER*, J.-L. MEIER**, C. GOBELET***

Summary **A prospective study of randomized analysis treatment of 50 cases of frozen shoulder was carried out in 3 Swiss medical centres. Three separate aetiological groups were studied: post-traumatic (40%), neurological (14%) and idiopathic (46%). An increased radioisotope bone scan (99 mTc diphosphonate) was found in 96% of cases, regardless of aetiology. The so-called idiopathic frozen shoulder showed a scapulo-humeral increase in radioisotope uptake in several areas (in 82% of cases) without involvement of the ipsilateral carpus. Clinically, the neurological type was associated with a shoulder-hand syndrome with positive bone scan of the shoulder and the wrist in all cases. The post-traumatic type showed a diffuse (in 50% of the cases) or at several circumscribed areas (also in 50%) increase in radioisotope uptake in the shoulder. In 45% of the post-traumatic type, there was also a shoulder-hand syndrome with uptake in the wrist also. A physical treatment and early mobilization, associated with the administration of subcutaneous salmon calcitonin for 21 days (100 U Calcitonin ® Sandoz) had a statistically significant increased effect on pain compared to treatment with physiotherapy alone by patients with post-traumatic frozen shoulders ($p < 0.02$). There was no significant difference, however, in the speed of recovery of function between the two treatment groups. These observations strengthen the hypothesis that adhesive capsulitis behave like an algoneurodystrophic process.**

Key words **Frozen Shoulder, Algoneurodystrophy, Radioisotope Uptake, Calcitonine.**

INTRODUCTION

Clinically, the frozen shoulder is characterized by progressive stiffness of the gleno-humeral joint, and by pain (according to the capsular pattern by Cyriax). This clinical evolution corresponds to an anatomico-pathological entity with progressive contraction of the joint capsule (1-5). This process leads to limitation of the whole shoulder complex, this limitation affecting both active and passive movement (6), which causes significant impairment of function. The natural history consists of an initial painful stage of several weeks duration, followed by a period in which the pain lessens but stiffness increases (7). Subsequent recovery of function is slow and at times incomplete (8-10).

There are several possible causes for this condition, which are, however, poorly understood. Certain idiopathic forms develop in the 45-60 year age group, predominantly in women during the menopause. Some authors identify predisposing factors such as cervical arthrosis and certain psychological events (11,12). While these factors are not uncommon in this age group, no cause/effect association has been demonstrated.

The aim of our prospective study was to analyse the different aetiological forms and the clinical, radiological and radioisotope bone scan changes in 50 cases presenting capsular contraction in its early stages. Furthermore, in a random study we have compared the effect of a physical method of treatment with or without subcutaneous injections of 100 U of salmon calcitonin.

* Service de Rhumatologie, Médecine Physique et Rééducation, Hôpital Cantonal, Fribourg; ** Service de Rhumatologie, Médecine Physique et Réhabilitation, Hôpital, Delémont; *** Service de Médecine Physique et Rééducation, Hôpital De Gravelone, Sion, Suisse.

Table I: *Mean initial pain score*

	Spontaneous pain	Pain during movement
Idiopathic	1.69 ± 0.87	2.69 ± 0.47
Post-traumatic	1.85 ± 1.03	2.65 ± 0.58
Neurological	0.42 ± 1.13	1.85 ± 1.34

Code: 0 = absent, 1 = mild, 2 = moderate, 3 = severe.

Table II: *Radiological demineralization*

	Mottled	Diffuse	Total
Idiopathic (23 cases)	3 (13%)	5 (22%)	8 (35%)
Post-traumatic (20 cases)	8 (40%)	2 (10%)	10 (50%)
Neurological (7 cases)	3 (43%)	0 (0%)	3 (43%)
Total (50 cases)	14 (28%)	7 (14%)	21 (42%)

Table III: *Increased radioisotope uptake (49 cases)*

	Localized (3 points)	Diffuse	Total
Idiopathic (23 cases)	19 (82%)	2 (9%)	21 (91%)
Post-traumatic (20 cases)	10 (50%)	10 (50%)	20 (100%)
Neurological (6 cases)	1 (17%)	5 (83%)	6 (100%)
Total (49 cases)	30 (61%)	17 (35%)	47 (96%)

MATERIALS AND METHODS

Out-patients and in-patients presenting with stiff painful shoulders with active and passive range of the gleno-humeral joint of less than 20% in lateral rotation, less than 70% in flexion and less than 70% in true abduction, of not more than three months duration were included. We excluded from the study cases of stiffness resulting from sub-acromial bursitis, osteoarthritis, gleno-humeral arthritis and osteonecrosis of the humeral head.

Initial clinical assessment recorded the active and passive range of movement (abduction, adduction, rotation, flexion, distance thumb-C7 from above and below) and severity of the pain at rest and during effort, by a score defined as follows: 0 no pain (absent), 1 mild, 2 moderate, 3 severe. Similar assessments were repeated at days 7, 21, 60 and 180.

Standard radiographs of the shoulder were taken at diagnosis. Two isotopic bone scans (99 mic disphosphonate), early (2 minutes) and late tracer accumulation (3 hours) with comparative index measurement were performed, at the time of diagnosis and two months later (day 60). Serum calcium, phosphorous, and alkaline phosphatase and an erythrocyte sedimentation rate (ESR-Westergren) were also determined.

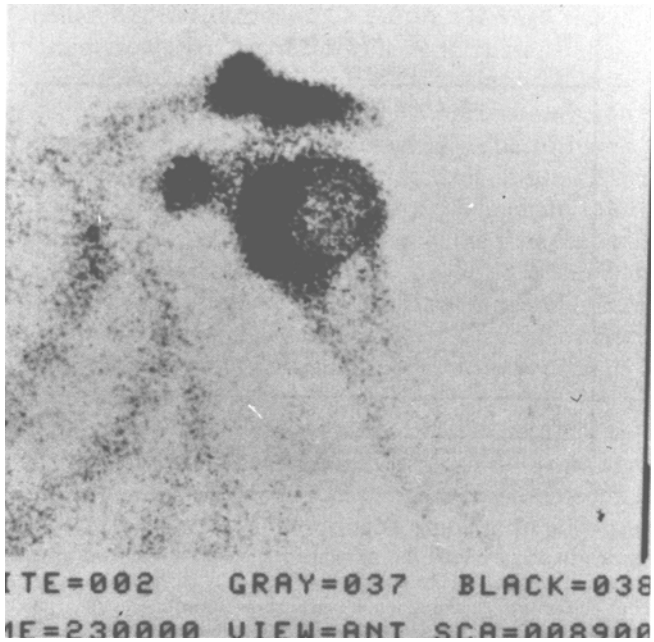

Fig. 1: Increased radioisotope uptake localized at three points

The patients were randomly allocated to one of two treatment groups. The first received active mobilization with electro-analgesia (TENS) and cryotherapy four times a week. The second group received the same physical treatment plus subcutaneous injections of salmon calcitonin (Calcitonin® Sandoz) 100 U daily for 21 days. The results were analysed statistically using the Z-test to compare the means with the two groups. In subgroups with less than 20 patients, the Wilcoxon-test was used. The level of statistical significance applied was 5% ($p < 0.05$).

RESULTS

Fifty patients fulfilled the entry criteria. One patient who went into a coma and one patient who discontinued the study because of side effects of calcitonin were excluded from the final analysis. The average age was 51.6 years (range 22-85); 32 women (63.3%) and 18 men (36.7%) were included. There was no statistical difference concerning age and duration of the condition in the two treatment groups.

The aetiology of the condition was: - 23 cases (46%) in which no definite aetiology could be detected; this

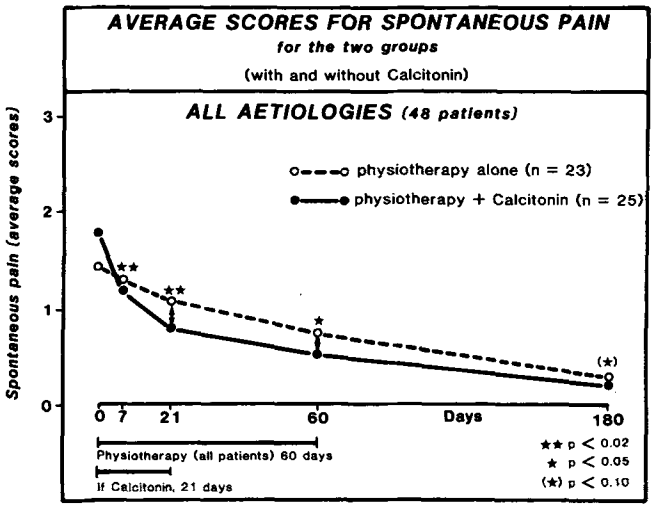

Fig. 2: Average scores for spontaneous pain for the two groups (with and without calcitonin) ($p<0.016$).
The sub-group analyses, however, show that only the post-traumatic frozen shoulder experienced a clear and rapid analgesic response to combined physiotherapy and calcitonin treatment (at day 21, $p<0.02$) (Fig. 3).

group was classified as idiopathic; - 20 cases (40%) in which the stiffness appeared after a trauma or a fracture of an upper limb bone ; - 7 cases (14%) in which the stiffness followed a cerebro-vascular accident.

The severity of the pain at rest was *initially* greater in the idiopathic and post-traumatic forms than in the neurological cases ($p<0.01$) (Table I),but there was no significant difference in pain during movement between the three groups.

The results of standard radiographic examination of the shoulder at the time of clinical diagnosis are shown in Table II. Abnormalities were found in 21/50 (42%) cases. There was patchy osteoporosis and resorption of subchondral bone in 3/23 (13%) of the idiopathic, 8/20 (40%) of the post-traumatic and 3/7 (43%) of the neurological cases. Diffuse demineralization was much less common, being present only in seven cases.

A significant increase in radioisotope uptake in bone was found in 47 cases (96%) of shoulders at both the initial examination and 2 months later (Table III). This increase was diffuse on the head of the humerus in about one third and localized in three zones in two-thirds of cases: the antero-medial border of the head of the humerus, the coracoid process, the acromio-clavicular joint. This pattern of uptake in three zones was, however, present in 82% of the idiopathic cases (Fig. 1). There was a diffuse increase in radioisotope uptake in the humeral head in 5/6 (83%) of the neurological cases, but this was of little significance because of the small number of patients. The post-traumatic frozen shoulder

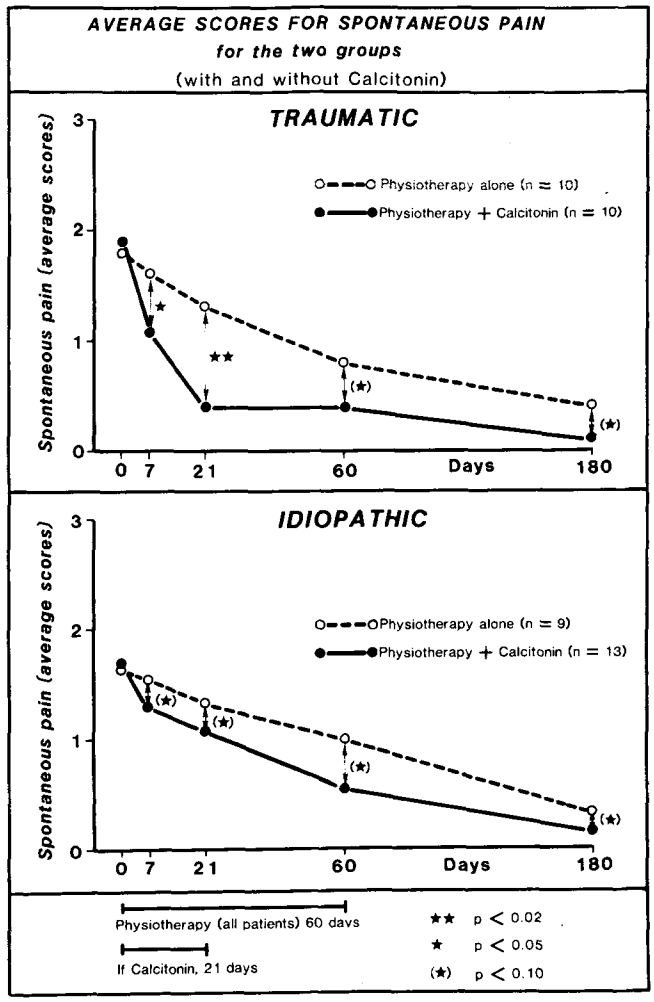

Fig. 3: Average scores for spontaneous pain for the two groups (with and without Calcitonin).

showed an equal number of increased uptake of diffuse (50%) and localized (50%) patterns. In this analysis, we did not take into account the characteristic localized and linear radioisotope uptake due to bone fracture in the upper extremity of the humerus (5 cases).

Clinical shoulder-hand syndrome was present in 26.5% of all cases. Radioisotope bone scans showed that 32.7% cases had increased uptake in the ipsilateral hand and wrist, especially in the neurological shoulders (100% of cases). The post-traumatic form was accompanied by wrist involvement in 45% of cases while no shoulder-hand syndromes were present in the idiopathic group.

Forty-eight patients completed the treatment and the comparative study. Regarding our randomnization, 23 patients had physiotherapy alone and 25 patients had physiotherapy combined with salmon calcitonin 100 U daily for 21 days. The group which received a combina-

tion of physiotherapy and injections of calcitonin in the early stages of the complaint experienced a significant reduction of pain, up to day 21, compared to the group treated with physiotherapy alone ; this was true for both pain at rest ($p<0.02$) (Fig. 2) and movement ($p = 0.025$). At day 21, the difference was even more significant for pain at rest ($p<0.016$).

However, the sub-group analyses show that only the post-traumatic frozen shoulder experienced a clear and rapid analgesic response to combined physiotherapy and calcitonin treatment (at day 21, $p<0.02$) (Fig. 3). The neurological group could not be analysed because the number of cases (six) was too small. Mobility improved in both groups but there was no significant statistical difference in the rapidity of recovery of function between them. This recovery was, however, far from complete ; 32% of the patients still presented some handicap and limitation of passive motion after 6 months of treatment. The isotope uptake after two months was still increased in 94% of patients, without any significant difference between the two groups.

About 20% of the group treated with calcitonin injections experienced local side-effects : erythema, redness, local heat and burning at the injection site. In 40% of the cases there were slight generalized side-effects : indigestion, flushing, headaches and vertigo. In one case the treatment had to be discontinued early, as calcitonin was producing severe malaise with vertigo and hypotension.

DISCUSSION

This prospective study of 50 cases of frozen shoulder enables us to define 3 main aetiologic groups : - the post-traumatic form, the neurological form (secondary to cerebro-vascular accident) and the so-called idiopathic form (where no cause could be identified). At the time of clinical diagnosis, the radiological appearance of the scapulo-humeral joint manifested diffuse demineralization in 14% of the cases. There was typical patchy osteoporosis and resorption of subchondral bone in 13% of the idiopathic form, 40% of the post-traumatic and 43% of the neurological form.

The examination by isotopic bone scan (99 mTc diphosphonate) at diagnosis showed both early and late increases in uptake in 96% of cases. This finding has been already demonstrated by Binder who described radionuclear scan assessment in 38 cases of defined clinical frozen shoulder with increased uptake in 92% of cases (13). The increased uptake in the head of the humerus was diffuse in all but one case of the neurological type of frozen shoulder, all of which also exhibited a shoulder-hand syndrome (14,15). In contrast, the idiopathic group was characterized by increased radioisotope uptake, localized at three sites. Thrall (16) previously described a slight increase in uptake at these three points, which could be physiologically due to handedness (left or right) or to muscular skeletal use or fractures. In cases of early stage of frozen shoulder, this increased radioisotope uptake could then be detected firstly (and more likely) at these 3 zones. No shoulder-hand syndrome was described in the idiopathic group. The post-traumatic group showed no particular pattern of uptake and shoulder-hand syndrome was present in about half of the patients.

Regardless of aetiology of the shoulder capsular contraction, physical analgesic treatment (TENS and cryotherapy) and early mobilization had a favourable effect on pain, both at rest and during movement. In post-traumatic frozen shoulder, the analgesic effect of combined treatment of physical medicine techniques associated with calcitonin injections was statistically significantly better and had a more rapid onset than physiotherapy alone. In both groups, however, calcitonin did not influence the amount and degree of radioisotope uptake at a second bone scan performed after 2 months of treatment (13). Furthermore, we did not find any significant difference in the speed of functional recovery between the different aetiologies whatever the treatment given.

Scintigraphic assessment in the reflex sympathetic dystrophy syndrome (RSDS) proved to be an early and specific diagnostic parameter (17,18). It has been proposed that frozen shoulder is a "forme frustre" of shoulder-hand syndrome and related to a reflex dystrophy syndrome of the upper extremity (19). Scanography of 12 knees with RSDS demonstrated thickening of the capsular and ligamentous system of the joint, leading to fibrosis (20) as in frozen shoulder. The clinical, radiological and scintigraphic behaviour of our cases of frozen shoulder seems similar to that of RSDS. Treatment effective in RSDS (21) also seems to improve patients with frozen shoulder.

CONCLUSION

An early radioisotope bone scan of the frozen shoulder consistently manifests increased uptake in the humerus regardless of aetiology, whether post-traumatic, neurological or idiopathic ; however, only 42% show radiological demineralization at that time. The shoulder limited by capsular contraction (adhesive capsulitis) most probably corresponds to the retractile phase of a RSDS, Steinbrocker stage II-III.

Classical treatment, such as that used in RSDS - early mobilization and physical treatment (TENS and cryo-

therapy) - results in satisfactory pain relief and improvement of function in the majority of cases. Even if early administration of calcitonin does not lead to more rapid recovery of function compared with the control group, treatment with this substance does produce a significantly more rapid and greater analgesic effect in the post-traumatic frozen shoulder.

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REFERENCES

1. Arlet, J. Les capsulites de l'épaule. Données cliniques. Mesures thérapeutiques. Ann Med Phys 1975, 18, 2, 188-95.
2. Hubault, A. Les rétractions capsulaires et leurs expressions cliniques. Problèmes actuels de rhumatologie, Zollikofer 1985, 200-11.
3. Lundberg, B.J. The frozen shoulder. Acta Orthop Scand 1969, suppl. 119.
4. Neviaser, J.S. Adhesive capsulitis of the shoulder : A study of the pathologic findings in periarthritis of the shoulder. J Bone Joint Surg 1945, 27, 211-22.
5. Troisier, O. Les capsulites de l'épaule ; techniques de mensuration des mouvements et applications cliniques. Rhumatologie 1958, 3, 113-24.
6. Troisier, O. L'épaule enraidie. Epaule et médecine de rééducation, Masson 9, 1984, 103-08.
7. Simmonds, F.A. Shoulder pain with particular reference to frozen shoulder. J Bone Joint Surg 1979, 31B, 426-32.
8. Binder, A.I., Bulgen, D.Y., Hazleman, B.L., Roberts, S. Frozen shoulder : a longterm prospective study. Ann Rheum Dis 1984, 43, 361-64.
9. Reeves, B. The natural history of frozen shoulder syndrome. Scand J Rheumatol 1975, 4, 193-96.
10. Sany, J., Caillens, J-P., Rousseau, J.R. Evolution lointaine de la rétraction capsulaire de l'épaule. Rev Rhum 1982, 49 (11), 815-19.
11. Lequesne, M., Auquier, L. Etiologie et pathogénie de la rétraction capsulaire de l'épaule. Rôle du système nerveux végétatif. Rev. Prat. 1968, 18, 2, 189-96.
12. Tewfik, E.R., Pinals, P.S. Frozen shoulder. Semin Arthritis Rheum 1982, 11, 4, 440-52.
13. Binder, A.I., Bugen, D.Y., Hazleman, B.L., Roberts, S. Frozen shoulder : an arthrographic and radionuclear scan assessment. Ann Rheum Dis 1984, 43, 365-69.
14. Roy, S., Oldham, R., Nichol, F.E. Frozen shoulder : adhesive capsulitis. Br Med J 1982, 284, 117-18.
15. Stodell, M.A., Sturrock, R.D. Frozen shoulder. Lancet 1981, 2, 527.
16. Thrall, J.H., Gh Ghaed, N., Geolien, G.E., Pinsky, S.M., John, M.C. Pitfalls in 99 mTc polyphosphate skeletal imaging. Am J Roetgenol 1974, 121, 739-47.
17. Kozin, F., Ryan, L.M., Carerra, G.F., Soin, J.S., Wortmann, R.L. The reflex sympathetic dystrophy syndrome (RSDS). III. Scintigraphic studies, further evidence for the therapeutic efficacy of systemic corticosteroids, and proposed diagnostic criteria. Am J Med 1981, 70, 23-30.
18. Aussedat, R., Tonnel, F., Pere, P., Hocquard, C., Pourel, J., Gaucher, A. Exploration scintigraphique au cours les algodystrophies sympathiques réflexes. In : Simon, L., Herisson Ch., Les algodystrophies sympathiques réflexes : Masson. 1987 : 46-54.
19. Steinbrocker, O., Spitzer, N., Friedman, H.H. The shoulder-hand syndrome in reflex dystrophy of the upper extremity. Ann Int Med 1948, 29, 22-52.
20. Doury, P., Pattin, S., Eulry, F., et al. Algodystrophie du genouet scanographie. Rev Rhum 1987, 54 (11) 725-29.
21. Gobelet, C., Meier, J.-L., Schaffner, W., Bischof-Delaloye, A., Gerster, J-C, Burckhardt, P. Calcitonin and reflex sympathetic dystrophy syndrome. Clin Rheumatol 1986, 5 (3), 382-88.

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Correspondence to : Dr. M. WALDBURGER,
Médecin-chef, Service de Rhumatologie, Médecine Physique et Rééducation, Hôpital Cantonal, 1700 Fribourg, Suisse.