TENNIS ELBOW IN INDUSTRY

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This paper briefly reviews the present state of knowledge concerning the various factors involved in the aetiology of tennis elbow and the possible pathological lesions underlying the condition.

Two series of cases are considered in greater detail. The first series, consisting of 37 cases, was treated by physical methods only, *viz.*, manipulation, ultrasonic radiation, and short wave diathermy. The results were disappointing since little more than half the number were improved by sonation although subsequent diathermy did improve the majority of those who did not respond. But physical treatment is shown to be time consuming and variable in its results.

The second series was treated by local infiltration of the painful area by hydrocortisone and, of the 38 cases, only one proved unsuccessful after one or two injections. The reduction in treatment-time and the fact that no special equipment is necessary are some of the obvious advantages in this form of treatment.

The paper concludes with a discussion on the rationale of treatment and some additional aetiological factors which are in favour of an inflammatory, rather than a traumatic, basis for the condition.

The first description of tennis elbow is attributed to Bernhardt (1896), who considered it to be an occupational neuralgia, but this concept is no longer held. The syndrome is characterized by pain and local tenderness of variable degree in the region of the lateral epicondyle of the humerus, the pain being aggravated by active contraction of the extensor muscles of the forearm. Tennis elbow occurs quite frequently in industry, and this paper describes the methods of treatment used in a well-equipped industrial medical department and compares the efficacy of those forms of treatment with particular reference to the duration of disability.

Aetiology

The aetiology of tennis elbow remains obscure.

Cyriax (1936) listed 26 conditions which could possibly produce symptoms of tennis elbow and went on to discuss four main varieties: (a) acute, due to indirect trauma; (b) subacute, due to indirect trauma; (c) chronic occupational; and (d) due to direct trauma. Since that time, the consensus of opinion has developed in favour of a tear between the tendinous common extensor origin and the periosteum of the lateral epicondyle (Cyriax, 1936;

Meherin and Cooper, 1950). Bosworth (1955), however, stated that the condition was not typical of a tear and suggested that the underlying pathology was degeneration in the orbicular ligament. This indicates that some form of trauma is the essential factor in causing the condition. Certain other authors (Furlong, 1953; Murley, 1954; and Garden, 1961) did not agree that trauma was the major factor, and the present situation is admirably summarized by Gondos (1958), who stated that 'the aetiology and pathogenesis remain obscure', and that 'the suggested therapy is approached through the concept of the underlying pathology. Therefore, the treatments are as varied as the concepts of the disease itself. Good results have been reported by different physiotherapeutic methods, manipulations and surgery.'

Pathology

Since tennis elbow is stated to be self-limiting, a relatively small number of cases have been dealt with by open surgery. Consequently few cases have been actually examined, and from these, conflicting statements have been made. Meherin and Cooper (1950) were able to demonstrate minute foci of degeneration in the tendon tissue, sometimes

accompanied by hyalinization. Furlong (1953) stated that, in addition to the above findings, small haemorrhages and patches of fibrosis were also present, whereas Murley (1954) was unable to demonstrate any macroscopic or microscopic abnormality.

Treatment

The treatment of tennis elbow has been of two types, conservative and surgical. Conservative treatment has ranged from rest in a cock-up splint to manipulation and physiotherapy. The physical methods have included short-wave diathermy, local infra-red, ultra-violet and x-ray therapy, and finally ultrasonic therapy, all of which have had their protagonists and some degree of success but are time-consuming both from the patient's and the physiotherapist's point of view. Aldes (1956) found ultrasonic therapy to be a distinct advance in treatment and he claimed to cure a number of cases which were refractory to other forms of physical treatment. The best results were obtained in the group where sonation was preceded by local infiltration of hydrocortisone. In my experience, results with hydrocortisone alone are as good as when combined with sonation.

Opinions regarding the efficacy of local hydrocortisone infiltration are also mixed; some authors state that it is a distinct advance in treatment (Cyriax and Troisier, 1953; Murley, 1954) whereas others maintain that it is no better than local procaine infiltration (Freeland and Gribble, 1954). The main grounds for criticism appear to lie in the relatively high relapse rate (Young, Ward, and Henderson, 1954) and the fact that it is somewhat erratic in its results (Garden, 1961).

Many surgical procedures have been tried, *e.g.*, division of the common extensor origin at the epicondyle, excision of the tender area, resection of the orbicular ligament, etc. The rationale of most operations is to relieve tension at the common extensor origin, and Garden (1961), believing that symptoms mainly arose from tension on the extensor carpi radialis brevis, performed subcutaneous tenotomy on that muscle in the forearm and relieved the symptoms in six patients. A logical extension of this operation was to lengthen the tendon in the forearm by a Z-shaped tenotomy. This latter procedure was effective in relieving pain and also resulted in no loss of power of dorsiflexion or weakness of grip. Garden advocated this open procedure as the method of choice in those patients requiring surgery.

Present Investigation

As stated earlier, the aim of this investigation was

to compare the relative efficacy of physiotherapy and local steroid infiltration with particular reference to the degree of improvement and the time required to effect that improvement.

In the period from December 1958 to June 1961, 44 patients with tennis elbow were treated by physical methods. The records of these patients have been examined and assessed, the criterion of cure being powerful painless flexion of the elbow against resistance with the forearm pronated and the wrist in dorsiflexion.

From June 1961 to the end of 1963, 38 cases occurred and were treated by infiltration of hydrocortisone into the tender area. In this series the criterion of cure remained the same but the method of assessment was by means of a 'weight test' (which is discussed below).

There might be some criticism on epidemiological grounds of the different methods of assessment in the two series. However, the assessment in both series was carried out by the same individual, the physiotherapist in charge of the case, and the criterion of cure left little room for observer error. The 'weight test' was developed for assessment of the second series because it was thought to reduce the subjective element (both the patient's and the physiotherapist's) to a greater degree than the former method of manual resistance.

1958-61 Series.—Of the 44 patients, seven did not continue attendance through to discharge and will not be considered further. In the 37 patients included the duration of the complaint varied from two to three days to several months. Ten patients could relate the onset of symptoms to direct trauma to the lateral epicondyle. The severity of the trauma varied from a very minor injury, *e.g.*, catching the elbow whilst walking through a door, to bruising of the epicondyle and soft tissues, *e.g.*, by a fall; moreover the trauma appeared to bear little relationship to the severity of symptoms. Of the 27 cases which occurred spontaneously, 13 had an occupation which involved gripping of tools with consequent tonic contraction of the extensor muscles of the forearm or a job in which there was repetitive supination and pronation of the forearm, *e.g.*, deseamers who grasp an oxy-acetylene torch, bricklayers who grasp a trowel and lift bricks, chippers who manipulate a pneumatic chipping hammer, etc. No precipitating factor could be elicited in the remaining cases although some did mention unaccustomed work. Seventeen of the 27 spontaneous cases had involvement of the right elbow. The age of the whole group varied from 28 to 61 years with an average of 44 years.

Treatment was as follows:—

(a) Manipulation was first attempted, the method of choice being the Mills manipulation since it is easier to obtain full relaxation with this procedure than with that advocated by Cyriax. A large number of patients were improved by manipulation but relief only lasted a matter of hours.

(b) This was followed by a course of ultrasonic therapy, a routine course of 14 daily treatments being given and each sonation of a maximum duration of 10 minutes.

(c) If there was no improvement after this course of treatment, it was considered unlikely that there would be any improvement with further sonation. The patient was then transferred to short-wave diathermy, the duration of which depended on response to treatment. Each session of diathermy lasted 25 to 30 minutes (see Table 1).

TABLE 1
RESULTS OF TREATMENT BY PHYSICAL METHODS
1958-61 SERIES

	Manipulation and Ultrasonic Treatment	Short Wave Diathermy
No. of patients	37	13
Cure	15	5
Improvement	4	6
Failure	18*	2
Mean duration of treatment per patient	2 hours 10 min.	5 hours
Cure or improvement (%)	51.4	84.6

*Thirteen cases in this group were transferred to short wave diathermy on completion of their course of sonation. The total duration of treatment time in the two and a half year period was 145 hours or 7.25 working days. Each patient was assessed by the physiotherapist during treatment, and the duration of symptoms from commencing treatment to discharge as cured or improved varied from three to 34 days with a mean duration of 15.5 days.

The Weight Test.—The diagnosis of tennis elbow rarely presents any difficulty. The patient complains of pain in the lateral aspect of the elbow, aggravated by lifting with the forearm pronated but the only constant physical sign is tenderness to pressure on or around the lateral epicondyle. Thus the condition is very much a subjective syndrome and the examiner is dependent largely upon the patient's complaints—a notoriously unreliable index—to determine the severity of the condition.

The weight test was devised to reduce the subjective element as far as possible. This is a simple test where the patient lifts a series of weights ($\frac{1}{2}$, 1, 2 and 4 lbs.) in that sequence. The weight is grasped by the tips of all five digits with the arm in full extension, the forearm pronated and the wrist in the neutral position. The elbow is then flexed to a right angle and slowly returned to its original position. The pain which occurs on lifting is classified as follows:—

- No increase in pain as compared with the resting position;
- + Increase in pain;
- ++ Acute pain but able to lift the weight;
- +++ Acute pain and failure to lift the weight.

Steroid Infiltration.—The point of maximum tenderness in the majority of patients was found to be on the antero-lateral aspect of the lateral epicondyle, and the easiest position for infiltration was with the elbow flexed to 90°, the forearm pronated and resting on a flat surface.

After accurate palpation and with due regard to sterility, 1 ml. (25 mg.) of hydrocortisone acetate was infiltrated into the tender area. It was noted that the patient complained, not of localized pain at the injection site but of its radiation down the extensor aspect of the forearm and sometimes into the fingers. This was a sign of some prognostic significance, since the further the pain radiated, the more complete was the disappearance of symptoms on follow-up. This was obviously due to the hydrocortisone being delivered to the area of maximum inflammatory activity. After treatment, the patient was warned to expect some exacerbation of pain for 24 to 36 hours, but to use the arm normally and report back in one week for re-appraisal of his symptoms by means of the weight test.

To obtain good results the importance of accurate localization of the point of maximum tenderness must be emphasized. Furlong (1953) stated that the most tender area lay between the head of the radius and the lateral humeral epicondyle. In the present series the most common site of pain was the antero-lateral aspect of the epicondyle. However, a stereotyped approach is not recommended; every patient should be examined carefully to determine the most tender point, and it is this care which gives rise to the best results.

1961-63 Series.—This group consisted of 38 patients, of whom 23 worked at a job which entailed constant gripping or repetitive movements. Twelve could relate the onset of symptoms to some definite trauma to the elbow. Of the 26 cases of spontaneous onset, 19 involved the right elbow. The average age of the group was again 44 with extremes of 28 and 58 years. All patients carried out the weight test detailed above, before and after treatment, and the results of the lifting test are summarized in Table 2.

The first case in this series is considered to be of interest and demonstrates clearly the efficacy of steroid therapy.

H.M. aged 58 worked as a slinger and had a two-weeks' history of pain in the right elbow, which

TABLE 2
RESULTS OF HYDROCORTISONE INFILTRATION
1961-63 SERIES

	First Infiltration	Second Infiltration
No. of patients	38	11
Cure	26	8
Improvement	4*	2
Failure	8*	1
Cure or improvement (%)	78.9	91

*Eleven of these patients were treated by a further injection. The twelfth case was so much improved that further treatment was not considered justified. The weight test, palpation of the tender area, skin cleansing, and infiltration occupied approximately 5 min. so that a total of 4 hours was spent in performing 49 injections with a high success rate. The average duration of symptoms was significantly less than 10 days since a proportion were free of pain for some days before reporting for assessment one week after treatment.

gradually increased in severity. No traumatic factor could be elicited. The routine course of physiotherapy was carried out with some transient improvement only. One month after cessation of all treatment, his condition was assessed by means of the weight test before and after hydrocortisone infiltration (Table 3).

TABLE 3
RESULTS OF HYDROCORTISONE IN AN INDIVIDUAL CASE

	$\frac{1}{2}$ lb.	1 lb.	2 lb.	4 lb.
Weight test	+	+	++	+++
Before hydrocortisone	+	+	++	+++
Four days after hydrocortisone	—	—	+	++
Seven days after hydrocortisone	—	—	—	+

At this stage he was able to do his job with little discomfort and no further treatment was warranted.

Discussion

There is little actual evidence to support the commonly held opinion that the initial lesion in tennis elbow is a tear at the common extensor origin. Certain facts have emerged from this investigation which indicate an alternative pathology.

If a tear is in fact the cause, one would expect a high incidence in heavy manual workers and also in young persons starting in industry. But this is not the case. Heavy manual workers form a minor proportion of cases (24% of all cases in the first series and 28% in the second) and the age of the youngest patient in the series is 28 years. The term 'tear' implies sudden parting of the fibres of the tendinous common extensor origin from the periosteum with the consequent onset of acute pain. This situation does not occur.

In the first series (1958-1961), 63% of the spontaneous cases had involvement of the right elbow and 48% performed work which entailed constant

gripping or repetitive supination and pronation. In the 1961-1963 series, 73% of spontaneous cases had right elbow involvement and 88% did this type of work. The numbers are very small and are therefore apt to be misleading. Comparison is also unreliable because of a difference in method in the two groups, namely, in the first the occupational background was not specifically inquired into (since it was a retrospective survey of case records), whereas in the second the occupational history was accurate. As a result of personal observation of the second series, it would appear that constant gripping and repetitive movements for prolonged periods are significant factors in the development of the condition although the evidence for this is less strong in the first group. In this type of work, the extensor muscle group is in a state of sustained tonic contraction since this action is necessary to 'set' the forearm and wrist in the position required for gripping.

Moreover, direct trauma to the epicondyle cannot cause a tear but can produce an acute periostitis which can become chronic and give rise to the symptoms of tennis elbow (Cyriax, 1936).

From this evidence, a reasonable hypothesis can be proposed that the underlying lesion is a chronic tendinitis or periostitis due in the majority of cases to prolonged tonic contraction of the extensor muscles and also due in a proportion to direct trauma. This theory is supported by the findings of Meherin and Cooper (1950).

Conclusion

From a comparison of the two groups it is clear that infiltration with hydrocortisone at the point of maximum tenderness is the treatment of choice for the condition known as tennis elbow. It is an improvement on other conservative treatments in several respects. The time spent in dealing with the patient is reduced from several hours to a matter of minutes. This results in a considerable saving in medical manpower and also to a saving in working man-hours. The duration of symptoms is reduced considerably so that the patient is able to do his work in comfort, thereby improving in dexterity and efficiency. Finally, a total cure or improvement rate of 97.4% has been obtained in this series after one or two infiltrations, so demonstrating that the general practitioner and the industrial medical officer in a smaller centre have at their disposal an effective treatment for what can be a very intractable condition.

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