

## TENNIS ELBOW

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The condition which is so inaptly known as tennis elbow is chiefly an affliction of middle age (Fig. 1). Many patients seek relief from this complaint, but few are found to be active participants in the game from which this syndrome has derived its name. The term "epicondylitis" which Continental writers have preferred is equally unsatisfactory, and it is

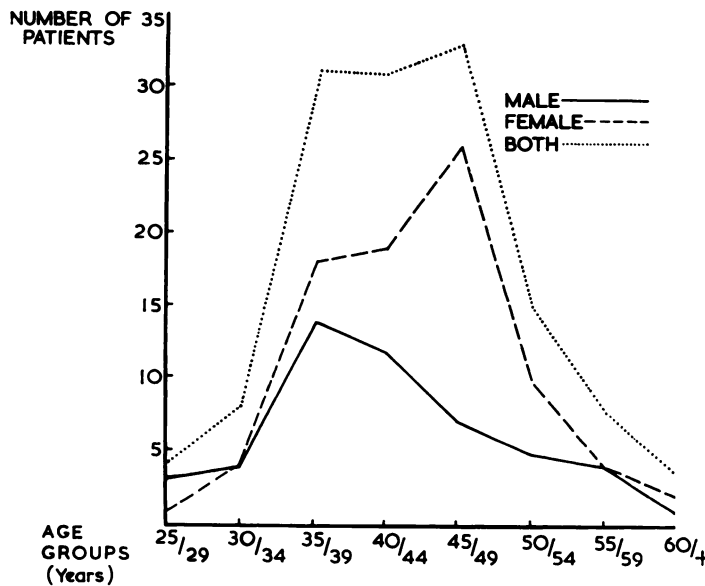


FIG. 1

Age incidence of tennis elbow in 131 patients (total number of elbows affected 137: women eighty-two; men forty-nine). The symptoms were bilateral in six patients.

unlikely that an acceptable name for this condition will be found until its true pathology is known.

Tennis elbow is widely regarded as a minor ailment which causes little more than an inconvenience to the patient. It is well known, moreover, to be a self-limiting condition which seldom persists for longer than twelve months under the age of sixty, and which, once cured, is unlikely to return (Cyriax 1936). Although this may generally be true, there are occasions when the disability is more serious. The workman who is prevented from earning his livelihood by pain over the outer aspect of his elbow regards the condition as an economic calamity.

He finds little comfort in the information that spontaneous cure is to be expected in time, and

demands more active measures to hasten his relief. Many methods of treatment have been suggested, but much has been done in the past to discredit these measures by inaccurate diagnosis. In present-day practice, however, the label of tennis elbow is no longer applied to all manner of vague discomforts in the upper limb, but is reserved only for those cases which satisfy well established diagnostic criteria.

### DIAGNOSIS

The syndrome of tennis elbow is characterised by pain over the outer aspect of the elbow and by aggravation of this pain on radial extension of the wrist. The essential features in diagnosis are: 1) tenderness on pressure over the region of the radio-humeral gap, and 2) acute discomfort during resisted extension of the wrist. In the absence of these findings the diagnosis of tennis elbow should not be made. Such actions as raising a cup, using a hammer or lifting a shovel typify the particular movement which initiates the pain, and the wrist extension test is but a convenient way of reproducing this movement. This test is best performed with the elbow in extension, but it may sometimes be found that the patient who suffers from tennis

elbow is unable to extend this joint fully (Mercer 1959), and an elastic resistance to the last few degrees of extension is encountered by the examiner comparable to that found with a locked semilunar cartilage in the knee.

#### PATHOLOGY

With such clearly defined clinical and diagnostic features the continued obscurity of the pathology in tennis elbow is surprising. This problem would doubtless have long been clarified had the surgeon been less reluctant to explore the elbow in a condition which scarcely warrants such interference with this unusually sensitive joint.

Since the condition was described by Runge in 1873 a bewildering list of suggestions in regard to causation and to treatment has appeared. Local inflammation, muscular or ligamentous strain, bursal irritation, nipping of synovial fringes, teno-periosteal tears, disturbances of local metabolism, degenerative changes in the orbicular ligament and cervical root irritation have each been held responsible for the symptoms. Further confusion has followed the attempts that have been made to classify this syndrome into different categories according to the site of greatest tenderness over the outer aspect of the elbow. The tender point may be found to lie along the epicondylar ridge, over or in front of the lateral epicondyle, in the region of the radio-humeral joint, or more distally in the extensor muscle mass. Such variation does not necessarily support the assumption that different types of lesion exist.

The most constant feature of the syndrome is the production of pain during extension of the wrist in radial deviation. This movement is performed by the extensor carpi radialis longus and brevis. Cyriax (1954) pointed out that, since the tenderness in tennis elbow is most frequently situated in the region of the lateral epicondyle, the fault is more likely to lie in the short radial extensor, which arises mainly from this epicondyle, than in the long extensor which arises more proximally along the lateral epicondylar ridge.

A tear between the common extensor origin and the underlying periosteum is still the most popular conception of the lesion in tennis elbow. Despite the accessibility of the epicondyle no indisputable evidence of such a tear in these tough structures has ever been forthcoming. A lesion in this situation should cause pain during the contraction of any, or all, of the muscles which derive from the common extensor origin. Since this does not occur, it would suggest that the origins peculiar to the extensor carpi radialis brevis are alone involved. This muscle is the only member of the superficial extensor group which arises from the lateral ligament which, in turn, blends with the capsule of the elbow and is inserted into the orbicular ligament. If the lesion were to lie in the lateral ligament, forced adduction of the elbow should be accompanied by the discomfort which is associated with the tennis elbow syndrome. This manoeuvre, however, seldom reproduces faithfully such discomfort, and may on occasion be followed by complete and permanent relief of symptoms.

The curative value of forced adduction of the elbow may be related to the traction which the tautened lateral ligament must exert upon its distal and relatively mobile anchorage, the orbicular ligament. This ligament is believed to play a significant role in tennis elbow. Bosworth (1955) and Meyer (1957) advised its resection for the relief of pain when conservative measures failed, and Bosworth stated that microscopic examination revealed evidence of hyaline degeneration and disorganisation of its structure. Compere (1956) reported that he had resected the orbicular ligament when operating for tennis elbow and had usually found a button-hole split in its substance. These observations, together with the finding that tennis elbow is commonly associated with middle age, support the belief that degenerative changes in the orbicular ligament constitute the underlying pathology in this condition. However this may be, contraction of the extensor carpi radialis brevis must still be singled out as the factor that produces pain in tennis elbow.

### CONSERVATIVE TREATMENT

The treatment of tennis elbow by splinting, physiotherapy or manipulation has long been practised, and many patients are relieved by these means. The local injection of hydrocortisone and more recently of prednisolone, oxygen or air (Hoyer 1957) has replaced many of the conservative methods of treatment. Hydrocortisone injection into the site of greatest tenderness, although somewhat erratic in its effects, is now a well established method of treatment. Occasionally full relief may follow this injection, but usually relief of symptoms is incomplete. Most patients are able to tolerate the residual discomfort without undue complaint. A few fail to benefit in any way, but a proportion of these will respond to a second injection either into the point of tenderness or directly into the joint itself. Hollander (1953) stated that in the treatment of tennis elbow the injection of hydrocortisone directly into the elbow joint is often desirable. The results of this technique have been studied during the past three years in a trial series of 114 patients treated by the introduction of 25 milligrams of hydrocortisone acetate directly into the radio-humeral joint irrespective of the site of greatest tenderness. After a full skin preparation the injection was given in the operation theatre. Of the patients treated in this way seventy-four (65.4 per cent) were relieved of their symptoms after one injection, and eleven of twenty-one patients were relieved after a second injection. A satisfactory response to one or two intra-articular injections was thus obtained in eighty-five of the 114 patients (75.2 per cent). This represents only a slight increase in the number of successful results as compared with the published figures for hydrocortisone injection into the site of tenderness, and cannot be held to justify the additional risks which injection into the joint must entail. It is clear, however, that most patients who suffer from tennis elbow can be sufficiently improved by a local hydrocortisone injection to make further treatment unnecessary, and operative intervention need be reserved only for the recalcitrant lesion which has defied conservative therapy.

### OPERATIVE TREATMENT

Many operations have been devised for the treatment of tennis elbow, of which excision of the tender area, ablation of the common extensor origin, Hohmann's (1926) operation, Bosworth's (1955) resection of the orbicular ligament and Kaplan's (1959) denervation of the radio-humeral joint are examples. Excellent results are to be expected from these procedures, but they all share the disadvantage of a direct attack upon the region of the elbow joint itself. Although operative measures are justified when conservative treatment fails, surgical intervention at the elbow is never to be undertaken lightly.

With these observations in mind, and in the belief that contraction of the extensor carpi radialis brevis was the factor principally involved, it was decided to investigate the effect of temporarily interrupting the action of this muscle. The function of an individual muscle may be interrupted in one of several ways. Its nerve of supply may be crushed or injected with alcohol, its tendon may be resected, transixed or sutured to a neighbouring tendon, or it may simply be divided. Of these, subcutaneous tenotomy of the easily identifiable tendon of the extensor carpi radialis brevis at the wrist appeared to be the most expedient.

This minor procedure was therefore carried out in a patient who had failed to respond to conservative therapy and who was complaining of considerable pain. Immediately after the tenotomy local tenderness at the elbow disappeared and wrist extension could be readily sustained. This subcutaneous tenotomy was repeated in five further patients with the same result. In two of these patients, however, some discomfort at the tenotomy site persisted for several weeks. Although the discomfort at no time assumed the disabling qualities of the symptoms at the elbow before operation, it was unsatisfactory. The tendon of the extensor carpi radialis brevis lies in a synovial sheath at its insertion and is closely related to its neighbouring tendons and to the wrist joint itself. It seemed, therefore, that local disturbance would be less likely to follow division of the tendon above the level of its synovial sheath. Open

lengthening of the tendon was then undertaken just distal to the musculo-tendinous junction. The same relief of symptoms followed this procedure and persistent tenderness at the site of operation was no longer troublesome.

In an attempt to simplify the interruption of the action of extensor carpi radialis brevis the tendon of this muscle was sutured to the overlying tendon of extensor carpi radialis longus, but the improvement which followed this procedure was clearly less positive than the relief of symptoms which accompanied actual lengthening of the tendon itself.

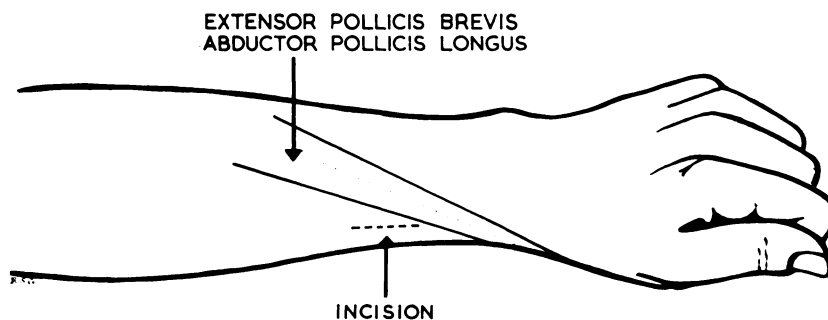


FIG. 2

Incision for Z-lengthening of the extensor carpi radialis brevis tendon above the level of its synovial sheath.

**Operative technique**—Open lengthening of the tendon of extensor carpi radialis brevis may be carried out under local anaesthesia, but general anaesthesia in conjunction with a pneumatic tourniquet is to be preferred. A small incision is made over the dorsi-lateral aspect of the forearm just proximal to the point at which the thumb extensors cross the radius obliquely (Fig. 2). The incision is deepened to show the flattened tendon of extensor carpi radialis longus, which is then drawn gently aside to expose the underlying tendon of extensor carpi radialis brevis. This tendon is also flattened and may consist of as many as five distinct subsections. If the incision is correctly placed no muscular fibres will be exposed, and the tendon can be cleanly divided by a Z-shaped tenotomy (Fig. 3). When division is complete and the cut ends have separated a catgut suture is inserted to hold the divided ends loosely together, and the wound is closed.

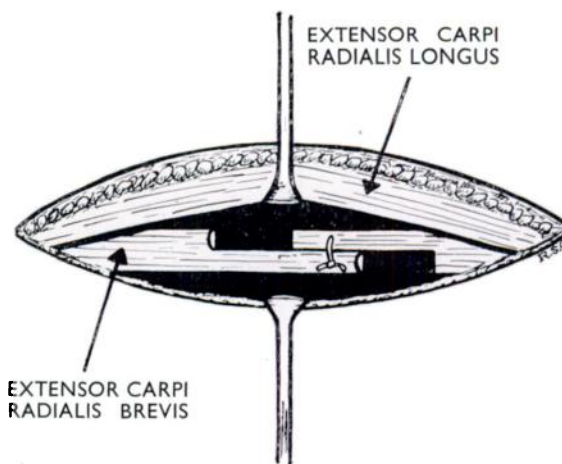


FIG. 3

Open lengthening of the extensor carpi radialis brevis by Z-shaped tenotomy.

No restrictions need be placed upon the patient's activities other than the avoidance of vigorous use of the arm during the first few days after operation. Early in the series one patient insisted upon returning to work immediately and the distal end of the divided tendon was later found curled up in a nodule at the wrist. A second patient used a wood chopper on the day of operation and the distal end of the tendon worked itself downwards in the same way. Since then the precaution has been taken of inserting a catgut holding suture, and this complication has not again been seen.

**Results**—The relief from pain which may be expected from lengthening of the extensor carpi radialis brevis tendon would be offset if weakness in the forearm or hand persisted. Such weakness in radial extension or in the power of the grip has never been a troublesome feature

TABLE I  
CLINICAL DETAILS IN FIFTY PATIENTS TREATED BY DIVISION OF THE EXTENSOR CARPI RADIALIS BREVIS TENDON

Case number	Sex	Age (years)	Occupation	Side affected	Duration of symptoms (months)	Date of operation
1	F	52	Housework	R	6	15 6 54
2	M	39	Carpenter	R	4	31 8 54
3	M	46	Crane driver	L	5	21 9 54
4	F	42	Weaver	R	6	21 9 54
5	M	49	Brick burner	R	2	21 9 54
6	M	56	Company director	R	4	12 10 54
7	M	49	Farmer	R	3	12 10 54
8	F	60	Housework	R	3	24 10 54
9	F	36	Housework	R	4	9 11 54
10	F	47	Teacher	R	3	30 11 54
11	M	41	Painter	L*	3	4 1 55
12	M	34	Butcher	L	3	18 1 55
13	M	47	Shoemaker	R	2	1/3/55
14	F	36	Bookkeeper	R	4	8 3 55
15	M	33	Representative	R	4	22 3 55
16	M	47	Labourer	R	9	22 3 55
17	M	53	Salesman	R	3	10 5 55
18	F	47	Housework	L	2	24/5/55
19	M	43	Fireman	L	3	31/5/55
20	F	62	Cook	R	3	7 6 55
21	M	49	Mechanic	L	5	23 8 55
22	M	44	Police officer	R	3	23 8 55
23	M	47	Labourer	R	4	20 9 55
24	M	36	Electrician	L	5	4 10 55
25	F	57	Housework	R	6	18 10 55
26	F	45	Weaver	R	9	25 10 55
27	F	46	Housework	R	4	25 10 55
28	M	45	Police officer	R*	3	2 12 55
29	M	50	Overlooker	L	5	12 7 56
30	F	45	Clerk	R	4	10 7 56
31	F	36	Domestic help	R	11	4 12 56
32	M	36	Moulder	R	5	8 1 57
33	F	48	Housework	R	4	5 3 57
34	F	49	Housework	R	9	2 4 57
35	M	59	Planer	R	3	21 5 57
36	M	42	Foundry worker	R	3	28 5 57
37	F	48	Housework	L	3	7 6 57
38	F	50	Chemist	R	3	16/7/57
39	M	45	Packer	R	6	23/7/57
40	F	49	Weaver	R	4	20 8 57
41	F	43	Typist	R	7	20 8 57
42	F	37	Shop assistant	R	5	25 9 57
43	F	45	Shop assistant	R	8	3 12 57
44	F	44	Housework	R	9	12/12/57
45	M	61	Local Government officer	R	4	12 12 57
46	M	46	Clerk	R	6	2 1 58
47	F	45	Housework	R	3	29 5 58
48	M	45	Labourer	R	3	19 8 58
49	M	42	Electrician	R	8	9 10 58
50	M	42	Motor engineer	R	4	4 11 58

\* Left hand dominant.

TABLE I—*continued*

CLINICAL DETAILS IN FIFTY PATIENTS TREATED BY DIVISION OF THE EXTENSOR CARPI RADIALIS BREVIS TENDON

Nature of operation	Follow-up period (years months)		Dynamometer grip test (lb.)		Spring balance lifting test (lb.)	
			Right	Left	Right	Left
Closed tenotomy	5	1	65	63	13	11
Closed tenotomy	4	11	117	110	17	14
Closed tenotomy	4	10	85	65	12½	10
Closed tenotomy	4	10	40	30	9	8½
Closed tenotomy	4	10	70	80	12	12
Closed tenotomy	4	9	95	90	12	10½
Z-lengthening	4	9	95	80	14	12½
Z-lengthening	4	9	32	35	7	7
Z-lengthening	4	8	55	56	8	8
Z-lengthening	4	8	45	30	4	2
Z-lengthening	4	7	85	85	11	15½
Z-lengthening	4	7	85	95	14½	16
Z-lengthening	4	7	95	80	14	12
Z-lengthening	4	7	62	52	6	6
Z-lengthening	4	7	70	65	14	11
Z-lengthening	4	7	55	60	6	10
Z-lengthening	4	2	55	55	10	9½
Z-lengthening	4	2	50	65	8	11
Z-lengthening	4	2	80	75	16	14
Z-lengthening	4	1	40	35	7½	7
Z-lengthening	3	11	68	60	12	8
Z-lengthening	3	11	80	65	10	7
Z-lengthening	3	10	90	60	10	7
Z-lengthening	3	9	55	55	7½	7
Z-lengthening	3	9	45	45	7	6
Z-lengthening	3	9	30	45	6	8
Z-lengthening	3	9	45	55	5½	8
Z-lengthening	3	7	65	70	6½	8½
Z-lengthening	3		75	70	8	7
Z-lengthening	3		65	65	8	7½
Z-lengthening	2	7	65	60	9	7½
Z-lengthening	2	6	75	75	9½	9½
Z-lengthening	2	4	50	40	6½	6
Z-lengthening	2	3	40	55	5	5½
Z-lengthening	2	2	55	60	7	6½
Z-lengthening	2	2	65	60	15	14
Z-lengthening	2	1	50	40	6½	6
Z-lengthening	2		50	45	8	8
Z-lengthening	2		80	80	10	11
Z-lengthening	1	11	45	45	6	5½
Z-lengthening	1	11	50	40	6	5½
Z-lengthening	1	10	55	50	8½	8
Z-lengthening	1	8	55	60	6	7
Z-lengthening	1	8	55	45	6	5
Z-lengthening	1	8	66	60	9	8
Z-lengthening	1	7	55	55	8½	9½
Z-lengthening	1	2	35	35	6½	6½
Z-lengthening		11	70	70	9½	8
Z-lengthening		9	60	55	7	6½
Z-lengthening		9	75	65	10	8½

of the recovery phase. As is not unusual after division of extensor tendons elsewhere, spontaneous healing has followed division of the extensor carpi radialis brevis as judged by palpation of its tendon at the wrist. Healing with some degree of lengthening must certainly occur, but this should be compensated for by adaptive muscle shortening. Theoretically permanent interference with muscle power is unlikely to be other than minimal, but if the advocacy of this procedure is to be justified fully it must be supported by a study of the late results of the operation in a sufficient number of patients observed over a reasonable length of time. For this purpose the first fifty patients treated by this operation were re-examined after nine months to five years. Each patient was subjected to dynamometer grip tests and to spring balance measurement of radial extension power (Table I). The tendon of the extensor carpi radialis brevis was examined at the wrist, and the patients were questioned about persistence of symptoms at the elbow or tenderness at the operation site.

Analysis of these results suggested that no patient failed to benefit in some way from the operation, and most obtained full and lasting relief. Residual complaints were of a minor character, and the dynamometer and spring balance tests showed no significant reduction in the power of wrist extension or grip. The length of time lost from work after this operation varied considerably and was largely dictated by the presence of the wound dressing. The clerical worker was able to resume work almost immediately and the heavy worker within a few weeks of the operation.

#### SUMMARY

1. Tennis elbow is largely an affliction of middle age, and it is believed that degenerative changes in the orbicular ligament may underlie its pathology.
2. It has been shown that most patients may be relieved by either extra-articular or intra-articular injection of hydrocortisone, and operative intervention is required only in a minority of cases.
3. Contraction of the extensor carpi radialis brevis is considered to be the principal pain-producing factor, and Z-lengthening of the tendon of this muscle has been found to relieve the symptoms when conservative measures have failed.
4. The late results in fifty patients have shown that this operation causes diminution neither of the power of wrist dorsiflexion nor in the efficiency of the grip. The operation may therefore be undertaken with every prospect of relieving the discomfort of tennis elbow without inviting alternative disability.

I wish to thank my registrars, Mr F. F. Silk and Mr D. G. Wray, who have conducted the trial series of intra-articular injections, and who have given much assistance with the follow-up review.

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