A Comparison of Two Treatment Regimens for Lateral Epicondylitis: A Randomized Trial of Clinical Interventions

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Eighteen subjects participated in a randomized controlled clinical trial to compare the effectiveness of two physical therapy treatments for tennis elbow. The subjects were divided into two groups: In the neural tension group (NTG), the head of the radius was mobilized and specific physical therapy mobilizations were used to address hypomobility of the radial nerve. The standard treatment group (STG) received ultrasound, transverse friction massage, and stretching and strengthening exercises for the extensors of the wrist. All subjects were treated twice weekly for 6 to 8 weeks. Follow-up data were obtained at 3 months post-treatment. Subjects who received radial head mobilization improved over time ($p < .05$), while those who did not receive radial head mobilization did not improve. Results of the NTG treatment were linked to the radial head treatment, and isolated effects of the NTG treatment could not be determined. There were no long-term positive results in the STG.

Tennis elbow, or lateral epicondylitis, has been the subject of considerable study, including retrospective reviews of surgical and nonoperative management, pathological findings at surgery, proposed etiologies, and detailed surgical anatomic findings (4, 7, 9). Etiology of tennis elbow is not completely understood and there is no consensus in the literature regarding either pathological diagnosis or treatment. There is, however, agreement about the presenting symptoms that occur with tennis elbow. Repeated movements of the forearm, wrist, and hand provoke symptoms of pain, predominantly over the lateral epicondyle and common extensor tendon origin. Pain can also radiate down the forearm and produce aching in the middle two fingers. Typically, pain and associated weakness are found when the extensor muscles of the forearm are tested isometrically (3).
Jobe and Ciccotti suggested that reducing pain and inflammation is the primary goal in the first phase of nonsurgical treatment (4). Nonoperative treatment includes nonsteroidal anti-inflammatory drugs (NSAIDS), corticosteroid injection (3, 4), bracing or strapping (4, 11), and physical therapy treatment. A number of patients have chronic symptoms and may have received steroid injections into the tendon of the common extensors, or the surrounding area. Physical therapy treatment for the most part has been designed to address inflammation and scarring of the common extensor tendon. Typically, treatments consist of transverse friction massage to the common extensor tendon (3), electrical stimulation for pain control, ultrasound to increase tissue elasticity, and stretching and strengthening exercises for the wrist and finger extensors (3). Anatomical evidence of inflammation was not observed at surgery in the studies of Roles et al. (7–9). Apart from the initial phase of this condition, perhaps there is no inflammation to control (13). This would support the consistent lack of success with the use of steroid injections in chronic cases (5).

The anatomic findings described by both Roles and Maudsley (9) and Morrison (7) at surgical exploration suggest that the course of the radial nerve and its branches may be adhered at specific mechanical interfaces (i.e., supinator, arcade of Frohse) as a result of tennis elbow or as an accompanying finding. Recently, treatments have been proposed to address the possible altered pathomechanics of the radial nerve in tennis elbow and the concept of adverse neural tension (2). These treatments are not commonly delivered, however, because there have been limited formal research or case studies to support their use.

Yaxley and Jull (13) investigated “adverse tension in the nervous system” in 20 subjects suffering from symptoms of tennis elbow. The authors used a neural tissue tension test, Upper Limb Tension Test IIb (ULTT IIb) (1, 2), which is purported to increase the tension of the radial nerve (analogous to the straight leg raise in the lower extremity). Their results indicated that neural tissue was less extensible in the symptomatic extremity and that glenohumeral abduction was decreased as measured by the ULTT IIb. This study, along with our own clinical observations, led us to investigate the adverse neural tension treatment method for subjects presenting with symptoms of lateral epicondylitis. The purpose of this randomized clinical trial was to compare the effectiveness of two physical therapy treatments for tennis elbow using recreational and occupational outcomes.

**Methods**

**Subjects**

Eighteen individuals were recruited for this study from our general clinic population and physicians in the community. Individuals ranged in age from 30 to 57 years, with a mean age of 46. Subjects were randomly assigned to one of two groups: the neural tension group (NTG) (4 women and 4 men, age 30–57 years,
mean age 46.4 years) or the standard treatment group (STG) (6 women and 4 men, age 34–53 years, mean of 45.5 years). Occupations included manual laborers, office workers, and homemakers. Recreational activities were varied and included bowling, weight lifting, gardening, tennis, racquetball, and wind surfing. Subjects all complained of elbow pain and dysfunction consistent with the symptoms of lateral epicondylitis (3).

The shoulder, elbow, wrist, first rib, cervical spine, and thoracic spine were examined as outlined by Maitland (6). A neurological examination was performed, which included testing reflex, sensation, and strength to rule out cervical or central nervous system pathology. Individuals were excluded from the study if they demonstrated cervical (radicular or somatic), shoulder, elbow, or wrist pathology other than lateral epicondylitis or if they had a history of systemic or nervous system disease.

All subjects participated in the following three testing sessions: at initial visit, upon discharge, and 3 months after discharge. Interrater reliability of the two clinical investigators for joint measurement (using a standard goniometer) and upper limb tension tests (2) was examined prior to the clinical trials and was found to be adequate (ICC formula 2,1 > .90) (10).

Tests

A forced choice, self-report questionnaire was used to assess level of recreational and occupational activities, level of competition, and chronicity of symptoms. The questionnaire is included in the appendix. A baseline hydraulic hand-held dynamometer (Fabrication Enterprises Inc., Irvington, NY) was used to measure grip strength, which was recorded with the individual seated, the arm unsupported at the side, and the elbow flexed to 90°. Two tests of maximal grip strength were taken and averaged for the measure.

Response to resisted isometric testing of the extensors of the third finger with the elbow joint in full extension (third finger extension test) was graded as painful or not painful (13). The subject was positioned in supine on a treatment table for this test. The ULTT IIb was conducted as described by Yaxley and Jull (12). The subject was positioned supine with stabilization belts placed at midthorax and pelvic levels to prevent trunk/spine motion. A sphygmomanometer cuff was used at a constant pressure of 20 mmHg to maintain shoulder depression during the upper limb tension test and subsequent treatments. A chin strap was placed from C2 around the chin to prevent any motion of the head during the neural tension tests and treatments. Shoulder abduction in degrees was measured with a goniometer and recorded when resistance was first perceived by the examiner and at the limit of motion (Figure 1).

Radial head mobility was assessed using two measures. In supine position, the investigator performed anterior and posterior radiohumeral glides with the elbow in maximum extension, and the involved arm was graded as hypomobile, normal, or hypermobile compared to the contralateral side using Maitland criteria for assess-
ment of passive accessory joint motion (6). Elbow extension range of motion (ROM) was compared to the uninvolved elbow and judged as limited or not limited.

**Treatment**

*Neural Tension Group.* Subjects in this group were treated using ULTT IIb positions which Butler suggested mobilize the radial nerve relative to the surrounding interface (e.g., supinator, arcade of Frohse). This is termed the *mechanical interface* (1). Graded wrist flexion and/or shoulder abduction techniques were used (2).

Anterior/posterior mobilizations of the radial head were also included when radial head mobility was judged to be hypomobile by anterior/posterior glide or restricted elbow extension. This was performed with the individual lying supine and the affected arm placed in elbow extension and full supination with approximately 50° of shoulder abduction. This arm position mimics a part of the Upper Limb Tension Test I (ULTT I). A home exercise program, which mimicked the ULTT IIb treatment, was designed to be used when the subject’s symptoms were not increased for longer than an hour following treatment. Initially, the subject performed 10 repetitions once a day. Subjects were instructed not to increase the exercise set more than twice a day.

*Standard Treatment Group.* Treatment was carried out on average twice weekly for 6 weeks. The subject sat in a chair with the arm supported on a table.
Continuous ultrasound was performed at thermal levels (1.0–1.5 w/cm² × 5 min) over the common extensor tendon using a 3 MHz head. This was followed by transverse friction massage to the involved extensor tendon site for three 1-min sessions per treatment. Stretching and strengthening of the wrist extensors were performed afterward. This included stretching with wrist flexion, maximal forearm pronation, and ulnar deviation for 5–10 repetitions, holding each stretch for 30 s. Dumbbells were provided as a graduated, recorded, strengthening program for a total of three sets of 15 repetitions. A home exercise program of stretching and strengthening exercises was included.

Data Analysis

A one-way ANOVA with one repeated measure (pretest, posttest, follow-up) was used to determine differences in measured variables by two different grouping variables (neural tension vs. standard and radial head treatment vs. no radial head treatment) for the following variables: recreational status, occupational status, ULTT IIb, and grip strength. Within-group ANOVAs with one repeated measure (pretest, posttest, follow-up) were performed to assess differences from pretest to posttest and follow-up within each group for recreational status, occupational status, ULTT IIb, and grip strength. Post hoc testing was performed when significant differences were identified by the ANOVA using a Tukey test. The third finger extension test was compared by group using a chi-square statistic.

Results

All subjects completed the 5-week course of treatment, the posttreatment, and the 3-month follow-up tests. There were no significant differences between groups (main effect) for any variable tested, although there were trends in the data that were clarified in the within-group analyses.

Recreational status was improved in the NTG at discharge and at the 3-month follow-up from pretest measures \(F = 4.2, p < .05\). Recreational status was improved in the STG at discharge \(F = 5.559, p < .05\) but not at follow-up. Occupational status was unchanged for both groups across all time periods. Grip strength was also unchanged. ULTT IIb was significantly different from pretest at discharge and at follow-up for the NTG \(F = 4.714, p < .05\) but not for the STG (Table 1).

Recreational status was significantly different from pretest at discharge \(F = 11.29, p < .05\) and follow-up \(F = 23.077, p < .01\) for those who received radial head mobilization but not for those who did not receive radial head mobilization. Occupational status was changed at discharge \(F = 6.25, p < .05\) but not at follow-up for those who received radial head mobilization. Grip strength was not different across trials for either group. ULTT IIb was significantly different from pretest at discharge \(F = 4.6, p < .05\) only for the group that received radial head mobilization, but this difference was eliminated at follow-up (Table 2).
### Table 1  Comparison of Measured Variables by Group: Neural Tension Versus Standard Treatment

<table>
<thead>
<tr>
<th></th>
<th>Neural tension</th>
<th>Standard</th>
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<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
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<td>Upper limb tension</td>
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<td>test IIb (°)</td>
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<td>Grip strength (lb)</td>
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</tbody>
</table>

*Significant difference from pretreatment \( p \leq .05 \).

### Table 2  Comparison of Measured Variables by Group: Radial Head Versus No Radial Head Treatment

<table>
<thead>
<tr>
<th></th>
<th>Radial head treatment</th>
<th>No radial head treatment</th>
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<tbody>
<tr>
<td></td>
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<td>Post</td>
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<td>Upper limb tension</td>
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<td>test IIb (°)</td>
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<td>Grip strength (lb)</td>
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<td></td>
<td>SD</td>
<td>10.89</td>
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</table>

*Significant finding \( p \leq .05 \).

### Discussion

There was no statistically significant difference between the NTG and STG at discharge or at follow-up for any of the measured variables. There was, however, a statistically significant and meaningful (1 grade change) improvement in recreational status for the NTG at discharge and at follow-up. It appeared initially that
this might have been the result of the neural tension treatment, but further testing accounting for the effect of radial head mobilizations suggested that the neural tension treatment may not have been the cause of the improvement. There was a significant difference in outcome, as measured by the recreational status measure, when radial head mobilization was used and radial head symptoms (hypomobility or restricted elbow extension) were present.

This study demonstrated that a combination of mobilization techniques and neural tension techniques was superior to the standard treatment for lateral epicondylitis. None of the individuals in the study had acute symptoms of lateral epicondylitis. It is not surprising, therefore, that treatment directed at inflammation and collagen remodeling was not effective in the long term. Recent reports of findings at the time of surgery remark on the absence of inflammation and the presence of scarring of contractile structures. This may be the etiology of the loss of joint motion found in the subjects in the present study. Roles et al. found that a branch of the radial nerve was adhered in the majority of surgical explorations (9). Clinicians who treat tennis elbow should consider these findings, especially in chronic cases.

Our initial hypothesis was that neural tension techniques could be more effective than traditional treatments. The present study may have been confounded by the addition of radial head treatment to the NTG treatment; however, an important finding emerged. Sixteen of the eighteen subjects had symptoms of radial head hypomobility that were subtle (mobility testing) or overt (restricted elbow extension). The restoration of full passive range of motion to the elbow joint, using mobilization, may have reduced the symptoms, or some interaction between the effect of the mobilization and the ULTT IIb mobilizations may have resulted in the beneficial effect.

The ULTT IIb measurements were improved in those who received radial head mobilization. Perhaps the ULTT IIb is a marker of successful treatment of recalcitrant tennis elbow, much like the straight leg raise in patients with lumbar nerve root irritation. Passive straight leg raise is often diminished in the patient with low back pain, and if treatment is directed to the spinal segments, reassessment frequently demonstrates improvement in the straight leg raise measurement.

Long-term positive benefits attributable to the neural tension treatments alone were not found. Support for isolated treatment directed at the radiohumeral joint, however, could be derived from this study. The ULTT IIb stretch may be necessary to maintain a degree of mobility in the upper limb in the long term. Mobilization to restore full passive end of range motion, coupled with the ULTT IIb and a home program of stretches, may result in a better long-term outcome. A 1-year follow-up of the subjects in the study should help clarify these issues.

Physical therapy treatments for orthopedic conditions often combine treatment techniques and modalities. Treatment of lateral ligament sprain of the ankle, for example, includes treatment directed at inflammation and fibrosis but also proprioceptive training and muscle strengthening. Tennis elbow treatment should
follow a similar path. Treatment of tennis elbow directed only at inflammation and scarring is not supported by the existing literature or the current study. Treatment consisting of a combination of transverse friction massage, ultrasound, and exercises continues to dominate tennis elbow management. Physical therapy and injection are the only nonoperative treatments available to subjects with tennis elbow and neither is particularly effective. Future research should further investigate the most effective combination of treatments.

References

### Appendix

<table>
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<tr>
<th>Age</th>
<th>Sex</th>
<th>Height</th>
<th>Weight</th>
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**Occupation**  
**How long at this occupation**

If less than 6 months, list previous occupation

**List job duties by predominance**

**List recreational activities you participate in**

**Frequency per week of participation**

**Level of competition**

**Chronicity of present injury (check one):**

- [ ] Acute (less than 1 month since injury)
- [ ] Subacute (1–6 months since injury)
- [ ] Chronic (greater than 6 months since injury)

**Preinjury leisure-time level**

- [ ] Almost completely inactive: reading, watching TV and movies, etc.
- [ ] Some physical activity at least 4 hours per week: riding a bicycle or walking to work, walking or skiing with a family member, light gardening.
- [ ] Regular activity: heavy gardening, running, calisthenics, tennis
- [ ] Regular hard physical training several times per week, such as for competition in running events, soccer, racing, European handball, etc.

**Preinjury occupational level**

- [ ] Predominantly sedentary, sitting: desk worker, sitting assembly line worker (light goods)
- [ ] Sitting or standing, some walking: cashier, general office worker, light tool and machinery worker, foreman
- [ ] Walking, some handling of material: mail carrier, food server, construction worker, heavy tool and machinery worker
- [ ] Heavy manual work: lumberjack, dock worker, stone mason, farm worker, ditch digger

To what degree does pain affect your ability to perform recreational activities? (circle one)

| Not at all | Minimal | Moderate | Severe |

To what degree does pain affect your ability to perform your job? (circle one)

| Not at all | Minimal | Moderate | Severe |