

# Conservative treatment of lateral epicondylitis: The impact of psychosocial factors on perceived treatment efficacy

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## ABSTRACT

**Background:** The relationship of pain, function, and treatment in lateral epicondylitis is not fully understood. Improved understanding of this interrelationship may be required to optimize treatment strategies, particularly with regard to bracing and activity modification. **Methods:** A cohort of 36 patients diagnosed by a fellowship-trained hand surgeon over a 25-month period that received treatment in the form of a cock-up wrist splint (CUWS) and recommendations of activity modification was identified. The patients' function was defined by the *QuickDash* Outcome measure and pain by the Numeric Pain Rating. Retrospective analysis of prospectively collected pre-treatment data were compared to those obtained following treatment using Wilcoxon signed-rank test. Changes in *QuickDash* Outcome measures and Numeric Pain Rating following treatment were compared between those individuals that stated the treatment helped and those that stated it did not. **Result:** Following treatment with a CUWS and activity modification, the median *QuickDash* score was 8 compared to 40 prior to treatment (95% CI: -32 ~ -20, p-value < 0.0001) indicating statistically significant functional improvement. All 36 of 36 (100%) patients stated that they were able to return to a normal activity level at the time of follow-up. Numeric Pain Rating values improved from 6 to 1 following treatment (95% CI: -6 ~ -4, p-value < 0.0001). The Kendall's Tau-b correlation coefficient between Numeric Pain Ratings and *QuickDash* Outcome measure was 0.296 (p-value = 0.018) and 0.473 (p-value = 0.001) before and after treatment, respectively, suggesting a weak to moderate correlation. Patients who stated that the treatment was effective experienced a median change in their *QuickDash* outcome score of -23 compared to -37 for those whom did not think it was an effective treatment; the estimated difference between the two groups was 14 (CI: 2, 30, p-value 0.019) indicating that patients who thought treatment was not effective actually experienced greater functional improvement. **Conclusions:** These results indicate that use of a CUWS and recommendations of activity modification is an effective strategy to help improve patient function and pain levels. However, low to moderate correlation between pain and disability both before and after treatment indicate that other factors such as coping skills and psychosocial influences may effect the disease and treatment course. Furthermore, patients may still make gains in function while questioning the effectiveness of their treatment, which may make assessment of therapeutic response difficult. Future research should be directed at identifying which factors other than pain may influence disability and devising strategies to address them.

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## INTRODUCTION

Lateral epicondylitis is the most common etiology of elbow pain with an annual incidence of 1 – 2% [1,2]. It typically affects individuals during the 5th and 6th decades of life. Repetitive forearm and wrist movements, especially related to occupational tasks, are associated with its onset and worsening severity [2-4]. It is also a significant source of direct and indirect healthcare costs [5].

Despite the recognition of lateral epicondylitis as a distinct disease entity for 140 years, an optimal treatment algorithm

continues to elude practitioners and considerable debate surrounds the effectiveness of the various conservative and surgical options [6]. The primary pain generator related to lateral epicondylitis is believed to be the origin of the extensor carpi radialis brevis (ECRB) [7]. The anatomic position of the ECRB's origin likely predisposes it to a dynamic process of compression against the extensor carpi radialis longus and underlying bone, which is dependent upon elbow and forearm positioning [8,9]. To this end, electromyographic studies have demonstrated increased activity of the ECRB in patients with lateral epicondylitis, which could result in increased tendon compression [10]. Histologic analysis

demonstrates non-inflammatory angiofibroblastic tendinosis with evidence of microtrauma and repetitive attempts at healing [11, 12]. Similar histopathologic findings of the extensor digitorum comminus and extensor digitorum longus have also been reported [12]. Thus, elbow and forearm bracing with the intent of resting the implicated musculotendinous structures to promote healing while providing immediate pain relief is a common strategy for management of patients with lateral epicondylitis.

The most common braces used are cock-up wrist splints (CUWS) and forearm counterforce straps. These bracing techniques have been compared with regard to pain resolution, grip strength, and function; however the relationship between pain and functional improvement in patients with lateral epicondylitis as it relates to treatment has not been investigated to our knowledge [13,14].

There is a growing body of evidence that suggests disability related to musculoskeletal conditions is not only associated with pain but also by patient coping strategies, as well as kinesophobia [15-17]. That is, patients may develop patterns of catastrophic thinking, feelings of helplessness related to the pain and fear of its worsening, which thereby affect disease-related disability. Patients may also experience kinesophobia, the pathologic fear of movement, related to notions of a serious underlying medical condition and ideas that movement may result in further injury [18]. Both kinesophobia and catastrophic thinking have previously demonstrated pertinence to disability related to musculoskeletal conditions of the upper extremity generally [15,16], but not lateral epicondylitis specifically.

The purpose of the study was to answer the following questions: 1) Does patient function and disability improve with treatment using a CUWS and activity modification? 2) Do pain levels improve with treatment using a CUWS and activity modification? 3) Is disability associated with pain in lateral epicondylitis? 4) Is patient perception of treatment effectiveness with a CUWS and activity modification associated with functional improvement?

## METHODS

After obtaining approval from our institutional review board, a retrospective review of prospectively collected data from a cohort of patients treated for lateral epicondylitis with a CUWS over a 25-month period was performed.

Individuals diagnosed with lateral epicondylitis by a fellowship-trained attending hand surgeon were initially identified by a query of our institution's database of International Classification of Disease, 9th Revision (ICD-9) codes for lateral epicondylitis, code 726.32. This search yielded thirty-eight individuals diagnosed and treated consecutively.

Patients' charts were reviewed and assessed for demographic information, medical history, physical examination, pertinent details regarding complaints of lateral elbow pain, and dispensed treatment. Diagnosis was made based upon history and physical examination with typical findings being point tenderness over the lateral epicondyle, tenderness along the mobile wad, and pain with resisted wrist and finger extension. Additionally, chart review yielded individuals' pain levels representing the average over the prior week by the Numeric Pain Rating and results of the QuickDASH Outcome Measure as completed at initial presentation per the senior author's standard patient visit protocol. Inclusion criteria consisted of age greater than 18, diagnosis of lateral epicondylitis without concurrent upper-extremity complaints or disabilities, and treatment with a CUWS that was supplied at the time of initial presentation and recommendations of activity modification. These include avoidance of heavy lifting and repetitive elbow, forearm and wrist movements. Exclusion criteria include patients under the age of eighteen, any other concomitant elbow pathology, prior surgery on the involved elbow, patients with a neurologic deficit involving the affected side, patients with incomplete data, and patients lost to follow up. All thirty-eight individuals met inclusion criteria. Patients were instructed to wear the brace as often as possible, particularly with repetitive activities of the upper extremity and at night.

Follow-up was performed by standardized telephone interview. (Table 1) Additionally, the QuickDash Outcome Measure and Numeric Pain Rating (as averaged over the prior week) were re-administered. Responses were compared to the clinical progress documented in follow-up visits, and no obvious discrepancies were found. All patients denied receiving treatment elsewhere. Two patients were unable to be contacted for follow-up and were excluded from analysis. The other thirty-six patients provided verbal consent to participate.

The primary outcome was QuickDash Outcome Measure scores, which is calculated from an 11-item questionnaire that measures physical function and symptoms for individuals with musculoskeletal disorders of the upper limb. Scores range from 0, representing no disability, to 100, which reflects complete disability. Two additional modules intended to measure disability in athletes and performing artists as well as workers with physically demanding jobs were completed when deemed appropriate based upon the questionnaire's standard instructions. The same modules completed at the initial visit for each patient were subsequently re-administered by telephone. Secondary outcomes were the Numerical Pain Rating score, as well as the ability and time required to return to normal activity. The Numerical Pain Rating score ranges from 0, indicating no pain, to 10, indicating the most severe pain experienced by the patient.

Table 1. Cohort Demographics

	N (%)
<b>AFFECTED EXTREMITY</b>	
RIGHT	20 (56.0%)
LEFT	17 (44.0%)
<b>DOMINANT EXTREMITY</b>	
RIGHT	28 (78.0%)
LEFT	8 (22.0%)
<b>GENDER</b>	
FEMALE	25 (69.0%)
MALE	11 (31.0%)
<b>RECEIVED PRIOR TREATMENT</b>	
CORTICOSTEROID INJECTION	3 (8.0%)
OCCUPATIONAL THERAPY	2 (6.0%)
<b>PAIN AT PRESENTATION</b>	
	36 (100.0%)
<b>WEAKNESS AT PRESENTATION</b>	
	9 (25.0%)
<b>REGULAR ATHLETIC / MUSICAL ACTIVITY</b>	
WEIGHT-LIFTING	21 (58.0%)
TENNIS	10 (22.0%)
GOLF	5 (14.0%)
GYMNASTICS	2 (6.0%)
GUITAR	1 (3.0%)
ROCK-CLIMBING	1 (3.0%)
VOLLEYBALL	1 (3.0%)
<b>EMPLOYED</b>	
MANUAL LABOR / HEAVY LIFTING	35 (97.0%)
SEDENTARY / DESK WORK	4 (11.0%)
WORKER'S COMPENSATION CLAIM	31 (86.0%)
	5 (14.0%)

Statistical analysis was performed using Wilcoxon signed-rank test and Wilcoxon rank sum test for one-sample and two-sample comparisons, respectively, to assess function before and after intervention with the CUWS. Correlation between the QuickDash score and the Numeric Pain Rating was described by Kendall's Tau-b correlation coefficient. Significance was defined as p-value  $\leq 0.05$ . Changes in

QuickDash scores following treatment were compared between patients that stated the intervention was effective and those that stated the treatment was not effective using Wilcoxon rank sum test.

**RESULTS**

Thirty-six patients could be contacted for follow-up after receiving treatment for lateral epicondylitis with a CUWS and activity modification (Table 2). The median age at presentation was 51 years (range: 28 ~ 82). All 36 of 36 (100%) patients complained of pain, and 9 of 36 (25.0%) additionally complained of elbow or wrist weakness. Eight of 36 (22.0%) patients underwent a course of occupational therapy following a period of CUWS use and activity modification. The median duration of pain prior to presentation was 8 weeks (range: 2 ~ 416). The median duration of time between initial presentation and telephone follow-up was 345 days (range: 175 ~ 966). All 36 of 36 (100%) patients stated they were able to return to "normal activity." The median time to return to normal activity was 24 weeks (range: 4 ~ 52).

The median QuickDash Outcome Measure score decreased significantly by a median of 26 points (95% CI: -32 ~ -20, p < 0.0001) following treatment indicating improvement in patients' physical function and symptoms (Table 3). Thirty-two of 36 (89.0%) individuals completed the QuickDash work module and had a significant decrease in their score with a median change of -23 points (95% CI: -31 ~ -13, p < 0.0001) following treatment. Likewise, there was a significant decrease in the post-treatment scores for the 21 of 36 (58.0%) patients completing the QuickDash sports/performance arts module with a median change of -29 points (-45 ~ -14, p < 0.001). Both results indicated statistically significant improvement.

The median Numeric Pain Rating at presentation was 6 (range: 1 ~ 10), which decreased to a median value of 1 (range: 1 ~ 4) at the time of follow-up; this median change of -4 (95% CI: -6 ~ -4, p < 0.0001) was significant (TABLE 2).

Table 2. Results of all QuickDash Modules and Numeric Pain Scores for the entire cohort at each stage of disease course

	Pre Median (N, Range)	Post Median (N, Range)	Post-Pre Estimated median (N, 95% CI)	P-value
Disability	40(36,7~93)	8 (36,0~64)	-26(36,-32~-20)	<0.0001
Work	31(32,0~75)	0 (32, 0~88)	-23(32,-31~-13)	<0.0001
Sport-Music	50(21,0~100)	12(21, 0~96)	-29(21,-45~-14)	<0.0001
Pain Level	6(36,1~10)	1(36, 1~4)	-4(36,-6~-4)	<0.0001

Correlation between the QuickDash Outcome Measure and the Numeric Pain Rating was 0.296 ( $p = 0.018$ ) before the intervention and 0.473 ( $p = 0.001$ ) after the intervention using Kendall's tau-b correlation coefficient. This suggested weak to moderate correlation between the QuickDash score and the pain score.

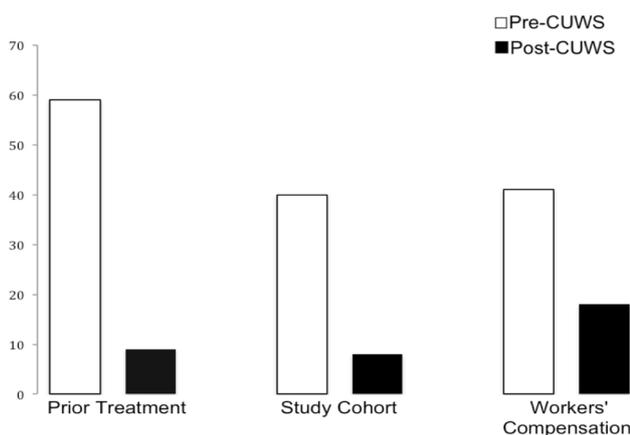
All 29 of 36 (81.0%) patients who reported that the intervention helped also stated that they wore the CUWS regularly until they returned to normal activity level. This group had a median change in their QuickDash outcome measure of -23 (range: -30 ~ -17), while the 7 of 36 (19.0%) patients who thought that the intervention did not help had a median change of -37 (range: -57 ~ -27). The difference of the changes between the two groups was estimated to be 14 (95% CI: 2,30). The Wilcoxon rank sum test was statistically significant ( $p=0.019$ ) which suggests that the group that reported that the intervention did not help had a greater decrease in their QuickDash score, indicating greater functional and symptomatic improvement. All 7 of 36 (19.0%) patients that stated the brace did not help also reported that they did not wear the CUWS regularly. All 29 of 29 (100%) patients that wore the CUWS regularly stated they would recommend the brace to others for the same condition.

Of the 5 of 36 (14.0%) patients seeking treatment for lateral epicondylitis as part of a Workers' Compensation claim, the median QuickDash score was 41 (range: 34 ~ 86) before treatment and 18 (range: 2 ~ 30) after treatment; however all 5 of 5 (100%) patients stated they still had some symptoms (FIGURE 1). The median pain rating was 7 (range: 6 ~ 10) at presentation and 3 (1 ~ 4) at follow-up (FIGURE 2). Four of these 5 (80.0%) patients reported that they wore the brace, 3 of 5 (60.0%) stated the brace helped, and 4 of 5 (80.0%) would recommend the brace to others. All stated they returned to normal activity at a median time of 32 weeks (range: 12 ~ 52). No statistical subgroup analysis was performed due to this small sample size.

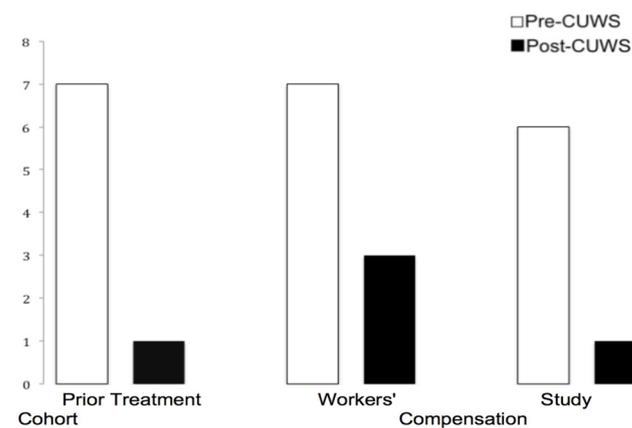
The 3 of 36 (8.0%) patients that had received treatment prior to presentation had a median QuickDash score of 59 (range: 43.2 ~ 65.9) at presentation and 9 (range: 4.5 ~ 63.6) at follow-up (FIGURE 1). The median numeric pain rating was 7 (range: 7 ~ 8) at presentation and 1 (range: 1 ~ 4) at follow-up (FIGURE 2). All 3 of 3 (100%) stated that they were able to return to normal activity at a median of 16 weeks (range: 12 ~ 40). No statistical subgroup analysis was performed due to the small sample size.

**Table 3.** Results of all QuickDash Modules and Numeric Pain Scores for the entire cohort before (pre) and after (post) treatment with the cock-up wrist splint.

	Pre Median (N, Range)	Post Median (N, Range)	Post-Pre Estimated median (N, 95% CI)	P-value
Disability	40(36, 7-93)	8 (36, 0-64)	-26 (36, -32—20)	<0.0001
Work	31(32,0-75)	0 (32, 0-88)	-23 (32,-31—13)	<0.0001
Sport- Music	50 (21, 0-100)	12(21,0-96)	-29 (21,-45—14)	<0.0001
Pain Level	6(36, 1-10)	1 (36, 1-4)	-4 (36, -6—4)	<0.0001



**Figure 1.** Changes in QuickDash Outcome measures are reported for individuals that received treatment prior to presentation, the entire study cohort, and those seeking treatment related to a workers' compensation claim



**Figure 2.** Changes in Numeric Pain Ratings are reported for individuals that received treatment prior to presentation, those seeking treatment related to a workers' compensation claim, and the entire study cohort.

## DISCUSSION

It is the senior author's experience that pain associated with lateral epicondylitis does not necessarily correlate with patient perceived disability. That is, patients may continue to complain of intense or worsening pain but demonstrate functional improvement or alternatively express improvement in pain but complain of worsening disability. Such a disparity could represent a gap in the understanding of disability associated with lateral epicondylitis. Similarly, patients' self-reported functional improvement may not correspond to their own assessment of treatment effectiveness. For example, patients may express doubt in the effectiveness of their treatment while concurrently reporting functional improvement. Thus, the extent to which a physical treatment for lateral epicondylitis, such as a CUWS, is disease-modifying or palliative is unclear. The purpose of this study was to investigate these relationships so as to help improve treatment algorithms and direct future research on this topic.

There are a variety of conservative and surgical treatment options available for management of lateral epicondylitis. Bracing and activity modification is a commonly prescribed intervention for this condition with the intent of providing immediate pain relief while "resting" the involved tendons to promote a robust healing response. Although previous studies have compared the effect of brace types on pain relief and functional outcomes in the past, none to our knowledge have investigated the relationship between disability and pain with regard to treatment [13,14]. However, there is a growing body of evidence that suggests that disability related to upper extremity musculoskeletal conditions in general and lateral epicondylitis in particular, is affected by more than pain [15-17]. Other factors contributing to disability may include catastrophic thinking, kinesophobia, as well as occupational and psychological stresses [15-17]. The purpose of this study was to elucidate the relationship between pain, disability, and treatment of lateral epicondylitis so as to help develop an improved, comprehensive approach to management and provide a basis for future research on this subject. This is particularly relevant as lateral epicondylitis is a source of significant disability, as well as direct and indirect healthcare costs [19].

It is the senior author's practice to prescribe a CUWS upon initial diagnosis of lateral epicondylitis regardless of symptom severity. The importance of activity modification is also conveyed with recommendations that include avoidance of heavy lifting and repetitive elbow, forearm and wrist movements. Patients are instructed to wear the brace as often as possible, particularly with repetitive activities of the upper extremity and at night. The intent of these relatively lax instructions is to promote a perception of this treatment algorithm as convenient and unobtrusive that will thereby encourage compliance but not impede normal

activity. Patients are also instructed that their condition historically improves with time even without intervention to provide reassurance [7,20]. A course of occupational therapy is offered once patients' symptoms improve to a level that will allow for meaningful participation. Corticosteroid or Platelet Rich Plasma injection and surgical interventions are not routinely offered.

This study has several limitations. First, it is a retrospective analysis; however, data was collected on a prospective basis. Thus, it is difficult to control for other factors that may have effected treatment, such as use of non-steroidal anti-inflammatories, which were not recommended but also not specifically advised against. Likewise, although the same instructions were provided for use of a CUWS, it would be impossible to fully control for wear patterns, and as such, patients were asked only if they wore the CUWS on a qualitative basis. Also, eight patients were referred to occupational therapy following a course of treatment with CUWS and activity modification. It would be impossible to assess the effect of this intervention in this small subgroup of our cohort. Second, although this cohort demonstrated significant clinical improvement, there was no control group, and it cannot be concluded that this treatment algorithm was responsible for the improvement, as time alone could have lead to improvement. Third, although the QuickDash Outcome Measure is validated and reliable for evaluating patients with musculoskeletal disorders of the upper limb and has been recommended by the American Academy of Orthopedic Surgeons' Outcomes research Committee, follow-up assessment was performed by telephone with the approval of the Institute for Work and Health; however, it is generally intended for completion in-person. Fourth, the final follow-up did not include objective assessment of range of motion or grip strength. However, patient self-assessment of the disease is likely most salient for evaluating therapeutic clinical response. Especially as patient perception and thought regarding the disease has consistently been shown to affect disability [15,17,21].

Use of a CUWS and activity modification is associated with significant improvement in function. There is a paucity of research that has utilized validated measurements of disability in assessing the effectiveness of splinting modalities for lateral epicondylitis. To our knowledge, none have implemented the QuickDASH instrument for this purpose. Garg et al. demonstrated improved clinical outcomes at 2 and 6 weeks following treatment with a CUWS as measured by the Mayo Elbow Performance and American Shoulder and Elbow Society Elbow Assessment instruments. Patients that wore a wrist splint experienced significantly greater pain relief than those patients wearing a forearm strap. However, these authors did not correlate pain levels to disability and did not evaluate the ability of patients to return to normal function [14]. Altan and colleagues demonstrated improvement in pain, sensitivity to pain stimulus, algometer score, and grip

strength after 6 weeks of wrist splint wear in patients with lateral epicondylitis [13]. In comparing this intervention to a forearm strap, the CUWS provided significantly greater pain relief. However, these authors did not utilize a validated assessment of patient disability and did not report on the ability of patients to return to a normal activity level. A retrospective review of workers seeking treatment for lateral epicondylitis demonstrated that those prescribed any type of splint had greater rates of limited duty, greater medical care requirements, higher charges, and longer treatment durations compared to those that did not wear a brace [22]. This study did not differentiate splint types, however, and is limited by the potential for bias due to the lack of control for baseline patient characteristics between those prescribed splints and those whom were not [22].

Functional improvement in this study was also represented by patients' abilities to return to normal activity. All patients in this cohort returned to "normal activity" at a median duration of 24 weeks following treatment. This reflects greater clinical improvement than has generally been reported in the past with bracing techniques [5,7,13,14]. The reason for this is unclear but could be related to the limited dichotomous nature of the question: "Were you able to perform most normal activities after treatment that were not able to before treatment?" to which patients were only allowed to answer "yes" or "no" to. Another reason could be due to patient recall bias. Objective measures of function, such as grip strength, could help mitigate this affect but are not necessarily more clinically relevant.

Following treatment with a CUWS and activity modification, pain levels were significantly less. This finding is consistent with previous studies. In a comparison of a wrist splint to counter-force braces, the only statistically significant difference was that those wearing a wrist splint experienced a greater reduction in pain as measured by the analog pain scale [14]. A similar comparison by Altan and colleagues demonstrated statistically significant improved pain ratings with rest and movement at 2 and 6 weeks following treatment with a wrist splint [13]. Sadeghi-Demneh evaluated the immediate effect of various orthoses on pain severity associated with lateral epicondylitis and found that a wrist splint offered statistically significant improvement in pain levels compared to placebo [23]. The reason for the immediate pain relief is hypothesized to be due to decreased activity of the involved musculotendinous units that alleviates dynamic compression at their origin. In support of this, Jansen et al. demonstrated decreased electrical activity of the wrist extensors while wearing the wrist splint [24]. This would be considered a palliative effect; however, it is unclear, whether the improvement in pain levels seen at longer treatment durations is palliative or disease modifying in nature. Many of the patients in our study, reported clinical improvement and had ceased to wear the brace while returning to normal activity, which is more consistent

with a disease-modifying affect. Correlation with objective diagnostic modalities such as histologic analysis or advanced imaging could elucidate a potential association, and further studies are required to define this relationship. However, the validity of MRI in the assessment of lateral epicondylitis has itself been questioned, and clinical assessment may be more valuable in this regard [25,26].

There was low to moderate correlation between Numeric Pain Rating and the QuickDash Outcome measure. This may indicate that disability from lateral epicondylitis is associated with factors other than pain. To our knowledge, there are no studies that have evaluated the relationship of pain to functional disability with regard to lateral epicondylitis. Das De evaluated the influence of various psychosocial factors on disability associated with several upper-extremity conditions as evaluated by the DASH outcome measure. They reported that catastrophic thinking correlated specifically to DASH scores and that catastrophizing and kinesiophobia accounted for the greatest proportion of disability variation in patients with upper-extremity musculoskeletal conditions.

These findings are similar to those of others, which have demonstrated that patient self-assessment of the upper-extremity health status related to lateral epicondylitis correlates with psychosocial factors [27]. Others have demonstrated that exogenous factors such as job demands may also play a role in the lateral epicondylitis disease course [21].

In this study, patients that believed the intervention of CUWS and activity modification was effective experienced statistically significant less functional improvement than those that believed it was ineffective. Altan and colleagues reported that patients treated with a wrist splint for lateral epicondylitis reported "good" response to treatment 28% of the time, and "medium" response to treatment 72% of the time, despite reporting improvement in pain, sensitivity, algometer score, and hand grip strength [13]. No patient reported an "excellent" response, which they defined as total pain relief. The disparity in patient perception of treatment effectiveness and functional outcome is unclear. One possible explanation is that our treatment algorithm, as opposed to providing a disease-modifying effect, encourages adaptation and optimism regarding the disease course of lateral epicondylitis. The former has demonstrated a role in improving outcomes in patients with other upper-extremity musculoskeletal conditions [16]. It is also possible that patients simply developed better coping strategies, such as mitigating the negative affects of catastrophic thinking and kinesiophobia, independent of the treatment course.

No subgroup analyses were performed in this study because the cohorts of individuals that had received prior treatment for lateral epicondylitis and those seeking treatment as part of a workers' compensation claim were small. However,

functional improvement and pain levels demonstrated similar trends to those of the entire cohort. As such, the senior author utilizes the same standardized, conservative approach to all patients, even for those that would typically be considered more difficult to treat.

Discussion of other bracing, nonoperative, and surgical management options is beyond the scope of this study. It should be noted, however, that there is a paucity of evidence in support of physical interventions for lateral epicondylitis in general [28-30]. One randomized controlled trial comparing physical therapy, elbow strap bracing, or both, reported successful outcomes in all groups without any significant difference amongst groups [5].

Meta-analyses on this same subject have been hampered by the heterogeneity of outcome measures as well as lack of long-term data resulting in a failure to fully support any conservative management options [17,31,32].

In summary, patients that were prescribed our standardized treatment regimen for lateral epicondylitis demonstrated significant improvement in functional outcome and pain control. The practitioner may consider such a treatment course for patients with this condition. The low to moderate correlation of Numeric Pain Ratings to QuickDash Outcome Scores in this cohort may represent the effect of psychosocial factors on disability related to musculoskeletal conditions. This was not specifically measured in this study and future research evaluating the effect of factors such as catastrophic thinking and kinesophobia using validated measures could help to elucidate this relationship. Such studies may also help to evaluate the underlying cause of our finding that patients' perception of treatment effectiveness does not correspond to functional improvement. Characterizing this relationship through future research may represent an opportunity to improve therapeutic strategies for lateral epicondylitis. That is, a multidisciplinary approach that addresses these factors and inquires about patients' thoughts on pain and ability to avoid certain provoking activities may be useful.

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