

What Is the Impact of Comorbidities on Self-rated Hand Function in Patients With Symptomatic Trapeziometacarpal Arthritis?

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Abstract

Background The thumb trapeziometacarpal joint is one of the most common sites of arthritic degeneration prompting specialty care. Surgical treatment algorithms are based on radiographic arthritic progression. However, the pain and disability attributable to trapeziometacarpal arthritis do not correlate with arthritic stage, and depression has independently predicted poorer self-rated hand function both at baseline and after treatment in patients' atraumatic hand conditions.

Questions/purposes (1) Does thumb trapeziometacarpal osteoarthritis impact both self-perceived general health and hand function? (2) Do depression and other comorbid conditions differentially impact patient-rated hand function based on the presence or absence of symptomatic

trapeziometacarpal arthritis? (3) How do disease-specific, patient demographics and comorbid conditions impact self-reported hand function in patients with trapeziometacarpal osteoarthritis?

Methods This cross-sectional study compared patients with symptomatic trapeziometacarpal osteoarthritis ($n = 47$) with matched control subjects without a symptomatic hand condition ($n = 47$). All participants self-reported medical (including depression) and musculoskeletal comorbidities and completed the SF-36 and the Michigan Hand Questionnaire (MHQ). Bivariate statistical analyses contrasted the patients with trapeziometacarpal osteoarthritis to control subjects. Linear regression modeling determined the impact of subject demographic data, comorbidity burden, and examination findings on total MHQ scores in patients with trapeziometacarpal arthritis.

Results Patients with scored trapeziometacarpal osteoarthritis indicated poorer perceived general health on the SF-36 categories of limitations resulting from physical health (52 ± 29 versus 71 ± 31 , mean difference 19 [95% confidence interval {CI}, 7–31], $p = 0.003$) and limitations resulting from emotional problems (50 ± 27 versus 67 ± 50 , mean difference 17 [95% CI, 3–33], $p = 0.022$) compared with control subjects. Self-reported depression was associated with worse hand function (total MHQ score) in patients with trapeziometacarpal arthritis (69 ± 20 versus 49 ± 22 : mean difference -20 [95% CI, -5 to -36], $p = 0.012$) but not in control patients (90 ± 13 versus 84 ± 20 : mean difference -5 [95% CI, -8 to 19], $p = 0.404$). In multivariate modeling, depression ($\beta -20$, [95% CI, -5 to -34], $p = 0.009$) and upper extremity comorbidities ($\beta -25$, [95% CI, -10 to -40], $p = 0.002$) were both associated with reduced total MHQ scores in patients with trapeziometacarpal osteoarthritis, and those factors accounted for 34% of the variance in the MHQ score.

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Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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Conclusions When interpreting patient-rated hand disability in patients presenting with symptomatic trapeziometacarpal osteoarthritis, scores should be interpreted after accounting for the presence of depression and upper extremity comorbidities.

Level of Evidence Level III, prognostic study.

Introduction

Trapeziometacarpal arthritis affects 7% of men and 15% of women with its prevalence increasing with advancing age to reach 94% of women and 85% of men older than 80 years of age [9, 24]. Surgical management of the trapeziometacarpal joint can reduce pain and improve function, yet residual disability may remain imperfect despite well-executed procedures [29]. Recently published series suggest that sources of pain outside of the thumb and depressive symptoms may contribute substantially to the disability and pain reported by patients with trapeziometacarpal arthritis [2, 12, 15]. A growing number of studies have examined the effects of psychological comorbidities, including depression, on patient-rated outcome measures for upper extremity musculoskeletal conditions. The prevalence of depression in orthopaedic patients exceeds the estimated 9% affected rate in the general population [3, 5, 7, 11, 18, 20, 28]. Depression negatively impacts patients' interpretation of pain and illness [13, 14, 25, 26, 30]. This provides a strong detrimental influence on patient-rated upper extremity function as assessed by the Disabilities of the Arm, Shoulder, and Hand score (DASH) and the Michigan Hand Questionnaire (MHQ) questionnaire [6, 15, 27].

Despite the well-documented prevalence of trapeziometacarpal arthritis and the sizeable body of literature comparing the various operative treatments for this joint, the magnitude of this condition's impact on general health is unknown. At the same time, the relevance of depression and other comorbidities on patient-rated hand function is becoming better appreciated. Although orthopaedic patients reported greater disability in the setting of depression, the impact of the orthopaedic condition on the effect of depression remains untested. Finally, reports that patient-reported pain and disability are unrelated to arthritic stage left us searching for other potential factors associated with poorer MHQ scores in patients with symptomatic trapeziometacarpal arthritis.

We therefore asked: (1) Does thumb trapeziometacarpal osteoarthritis impact both self-perceived general health and hand function? (2) Do depression and other comorbid conditions differentially impact patient-rated hand function based on the presence or absence of symptomatic

trapeziometacarpal arthritis? (3) How do disease-specific patient demographics and comorbid conditions impact self-reported hand function in patients with trapeziometacarpal osteoarthritis?

Patients and Methods

A cross-sectional study was conducted in the outpatient offices at two tertiary hand centers (Washington University, St Louis, MO, USA, and the University of Rochester, Rochester, NY, USA). Enrollment was completed over a 10-month period without longitudinal data collection between May 2011 and March 2012. The study was approved by the institutional review board at both institutions, and all enrolled patients provided informed consent, whereas control subjects provided verbal consent.

The study group comprised patients presenting to one of two fellowship-trained hand surgeons' (RC, JE) outpatient offices with symptomatic thumb carpometacarpal (CMC) arthritis. The diagnosis of thumb CMC arthritis was determined by the attending surgeons' assimilation of patient history, physical examination, and radiographic evaluation. Tenderness to palpation over the trapeziometacarpal joint and/or a positive grind test was required on physical examination to establish the diagnosis. Radiographic evaluation included either Betts or Roberts views and a lateral image of the involved thumb CMC joint. Patients with Eaton Stage II, III, or IV osteoarthritis (OA) were considered for inclusion in the study [8]. Patients were excluded if they were < 18 years of age, pregnant, lacked English proficiency, were unable to provide informed consent, had concomitant symptomatic hand pathology, or had prior thumb surgery. Control subjects were recruited from the population of adults accompanying patients to their appointments who were not currently receiving medical care for any hand or wrist complaint. Control participants completed the survey in a large waiting room for a multispecialty orthopaedic practice. These control subjects were not removed from family or friends while completing the surveys. Most control subjects were accompanying patients with orthopaedic conditions outside the hand.

Data collected included self-reported demographic information (presence or absence of 40 medical comorbidities [with free text "other"], two psychological comorbidities [depression, attention deficit hyperactivity disorder], and eight locations of musculoskeletal comorbidities) and patient-rated hand function (MHQ). Single-attempt maximal grip and key pinch strength were measured by either a trained researcher or independent hand therapist. Strength measures were obtained bilaterally to

allow for calculation of percentage of strength on the affected side versus unaffected side. These percentage strength measures were chosen for analysis to eliminate the confounding effects of patient age and sex on absolute values. Radiographic classification of trapeziometacarpal arthritis according to the Eaton staging system was performed independently by two attending hand surgeons (RC, JE) acknowledging limitations in interrater reliability ($\kappa = 0.53$) [4]. Control subjects completed all questionnaires but did not undergo physical or radiographic examination. Control subjects were therefore not screened for asymptomatic trapeziometacarpal arthritis, which may bias data toward minimizing differences between patients with arthritis and control subjects.

Statistical Analysis

Descriptive statistics were produced to characterize all participants. Student's t-test and chi-square testing were used for bivariate contrasts of continuous and categorical variables between patients with trapeziometacarpal arthritis and control subjects. Depression and upper and lower extremity comorbidities were analyzed as present versus absent while other medical comorbidities were summed. Statistical significance was defined at $p < 0.05$.

Among patients with trapeziometacarpal arthritis, correlation analyses determined the association of percentage grip strength, pinch strength, and number of medical comorbidities with overall MHQ score. In these patients, a linear regression model was constructed in a forward stepwise manner to determine predictors of overall MHQ score (self-reported hand function). Independent variables were eligible for inclusion in the regression model based on approaching statistical significance ($p \leq 0.100$) on bivariate testing and based on relevance to the study questions as permitted according to enrollment size. Bivariate analysis

of patients with trapeziometacarpal arthritis demonstrated that women had worse MHQ scores than men (60 ± 23 versus 80 ± 8 , $p = 0.006$). Patient age did not correlate with overall MHQ score ($r_p = 0.27$, $p = 0.078$). Percentage of contralateral grip and pinch demonstrated no correlation with MHQ score ($r_p = 0.04$, $p = 0.788$, $r_p = 0.11$, $p = 0.486$, respectively). Eaton stage of trapeziometacarpal arthritis was not associated with altered overall MHQ score ($r_s = -0.17$, $p = 0.35$). Having the dominant thumb affected did not impact the MHQ score (67 ± 24 versus 63 ± 20 , $p = 0.556$). Therefore, a multivariable model was constructed accounting for sex, depression, upper extremity comorbidity, and medical comorbidities based on its relevance to our study question.

An a priori sample size estimation was conducted before this investigation to detect an 0.8 effect size of difference on MHQ scores between patient groups [23]. For a $\beta = 0.2$ and $\alpha = 0.05$ we needed 14 pairs of patients matched one to one with control subjects. However, for regression modeling to accommodate at least five independent variables, we aimed to enroll 45 to 50 patients with trapeziometacarpal OA.

Forty-seven patients with trapeziometacarpal arthritis and 147 control subjects were enrolled and completed data collection. Forty-seven control subjects were chosen for data analysis after matching one to one with patients with trapeziometacarpal arthritis by sex and age (± 5 years). Demographic data were not different between the patients with trapeziometacarpal osteoarthritis and control subjects (Table 1).

Results

The presence of CMC arthritis was associated with poorer perceived health and worse hand function (Table 2). The patients with trapeziometacarpal OA scored more poorly

Table 1. Demographic comparison of patient groups

Demographic	Trapeziometacarpal arthritis (n = 47)	Control (n = 47)	p value
Age (years)	62 \pm 9	62 \pm 8	0.829
Female	35 (75%)	35 (75%)	1.000
White	45 (98%)	45 (98%)	1.000
Smoking	4 (9%)	2 (4%)	0.677
Depression	10 (21%)	5 (11%)	0.159
Average number of medical comorbidities	3 \pm 3	3 \pm 3	0.581
Upper extremity musculoskeletal comorbidity	8 (17%)	10 (21%)	0.672
Lower extremity musculoskeletal comorbidity	18 (38%)	18 (38%)	1.000
Average number of musculoskeletal comorbidities	2.2 \pm 1.8	1.4 \pm 1.7	0.027

Values are mean \pm SD or mean with percentage in parentheses.

Table 2. Scores on MHQ and SF-36 scales according to patient group

Parameter	Trapeziometacarpal arthritis (n = 47)	Control subjects (n = 47)	Mean difference (95% CI)	p value
SF-36				
Role limitation physical health	52 ± 29	71 ± 31	-19 (-7 to -31)	0.003
Role limitation emotional	50 ± 37	67 ± 36	-18 (-3 to -32)	0.022
Physical function	51 ± 23	60 ± 28	-9 (2 to -19)	0.093
Energy	64 ± 21	64 ± 18	0 (8 to -8)	0.979
Emotional well-being	68 ± 19	66 ± 18	2 (10 to -5)	0.528
Social function	72 ± 29	74 ± 28	-2 (10 to -13)	0.745
Pain	82 ± 29	81 ± 27	6 (12 to -11)	0.927
MHQ				
Overall Score	65 ± 22	89 ± 14	-24 (-16 to -32)	< 0.001
Function	58 ± 23	88 ± 16	-30 (-21 to -38)	< 0.001
ADL	54 ± 32	93 ± 13	-39 (-28 to -49)	< 0.001
Work (bilateral)	63 ± 28	91 ± 13	-28 (-18 to -38)	< 0.001
Aesthetics	78 ± 24	85 ± 22	-6 (3 to -16)	0.188
Satisfaction	43 ± 27	88 ± 19	-45 (-35 to -55)	< 0.001
Pain	53 ± 20	9 ± 13	45 (37-52)	< 0.001

Values are mean ± SD; MHQ = Michigan Hand Questionnaire; CI = confidence interval; ADL = activities of daily living.

on the SF-36 categories of limitations resulting from physical health (52 ± 29 versus 71 ± 31, mean difference -19 [95% confidence interval {CI}, -7 to -31], $p = 0.003$) and limitations resulting from emotional problems (50 ± 27 versus 67 ± 36, mean difference 17 [95% CI, 3-33], $p = 0.022$) compared with control subjects. Overall physical function, energy/fatigue, emotional well-being, social function, and pain were not different between patients and control subjects (Table 2). Trapeziometacarpal arthritis worsened the overall MHQ scores (65 ± 22 versus 89 ± 14, mean difference = -24 [95% CI, -16 to -32], $p < 0.001$). Compared with control subjects, patients with CMC arthritis had worse MHQ parameter of affected function (58 ± 23 versus 88 ± 16 in control subjects, mean difference = -30 [95% CI, -21 to -38], $p < 0.001$), affected activities of daily living (54 ± 32 versus 93 ± 13 in control subjects, mean difference = -39 [95% CI, -28 to -49], $p < 0.001$), ability to work with both hands (63 ± 28 versus 91 ± 16 in control subjects, mean difference = -28 [95% CI, -18 to -38], $p < 0.001$), and satisfaction (43 ± 27 versus 88 ± 19 in control subjects, mean difference = -45 [95% CI, -35 to -55], $p < 0.001$). However, no difference was detected in the scale for affected aesthetics (78 ± 24 versus 85 ± 22 in control subjects, mean difference = -6 [95% CI, 3 to -16], $p < 0.001$).

Comorbid disease differentially affected patient-rated hand function depending on the presence or absence of trapeziometacarpal arthritis (Table 3). In patients with trapeziometacarpal arthritis, depression was associated with worse overall MHQ scores (49 ± 22 versus 69 ± 20

mean difference -20 [95% CI, -5 to -36], $p = 0.012$). Similarly, those with other upper extremity comorbidities had worse total MHQ scores (44 ± 22 versus 70 ± 20, mean difference -26 [95% CI, -10 to -42], $p = 0.002$). The number of medical comorbidities, excluding depression, did not correlate with MHQ scores ($r_s = -0.13$, $p = 0.40$) in these patients. In control subjects without trapeziometacarpal arthritis, depression was not associated with worse MHQ scores (84 ± 20 versus 90 ± 13 mean difference -6 [95% CI, -8 to 19], $p = 0.4$). Presence of an upper extremity comorbidity in control patients was associated with worse overall MHQ score (83 ± 16 versus 93 ± 11 mean difference -10 [95% CI, -1 to -20], $p = 0.036$). Increasing number of medical comorbidities, excluding depression, was associated with poorer MHQ scores ($r_s = -0.35$, $p = 0.017$) in control participants.

After controlling for relevant confounding variables of sex and number of medical comorbidities (and having eliminated all disease-specific factors in bivariate testing), we found that the presence of upper extremity comorbidity (data) and depression (data) both were associated with reduced MHQ scores. Those two factors alone accounted for 35% of the variance in the MHQ score.

Discussion

Pain and self-reported hand function in patients with symptomatic trapeziometacarpal arthritis are entities that are not easily predicted. The pain experienced does not

Table 3. Association of comorbidity and overall MHQ score according to patient group

Parameter	Comorbidity present	Comorbidity absent	Mean difference (95% CI)	p value
Depression				
TM arthritis (n = 10)	49 ± 22	69 ± 20	-20 (-5 to -36)	0.012
Control (n = 5)	84 ± 20	90 ± 13	-5 (-8 to 19)	0.404
Upper extremity comorbidity				
TM arthritis (n = 8)	44 ± 22	70 ± 20	-26 (-10 to -42)	0.002
Control (n = 10)	83 ± 16	93 ± 11	-10 (-1 to -20)	0.036
Lower extremity comorbidity				
TM arthritis (n = 18)	66 ± 18	65 ± 25	1 (-14 to 14)	0.947
Control (n = 18)	83 ± 16	93 ± 11	-10 (-1 to -19)	0.028

MHQ = Michigan Hand Questionnaire; CI = confidence interval; TM = trapeziometacarpal.

correlate with radiographic arthritic stage and depressive symptoms has been associated with worse patient-rated hand function [12, 15]. This study was conducted to quantify the association of comorbid disease, patient demographics, and arthritic characteristics on patient-rated hand function in patients with symptomatic trapeziometacarpal arthritis compared with asymptomatic control participants. Although asking slightly different questions and using a hand-specific patient rating of function, our data confirm marked associations of depression and the presence of a comorbid upper extremity condition with worse patient-rated hand function for isolated trapeziometacarpal arthritis.

There are several limitations to this cross-sectional study. First, comorbidity burden was assessed by patient self-report. Attempts to corroborate survey answers through medical record review were not performed. Depression was also assessed by self-reported history without attempts to delineate current depressive symptoms or treatment history. However, given the relatively non-sensitive nature of the information gathered, we do not expect patient self-reporting data to differ substantially from the medical record. Second, over 95% of our study population was white, which precluded meaningful investigation into the impact of race. Third, without longitudinal data collection, we cannot comment on the effect that depression treatment would have on patient-rated hand function and do not know exactly how depression will impact perceived hand function after treatment of the trapeziometacarpal arthritis. However, based on a prior study by London et al. [15], we suspect that depressed patients will respond to treatment of their trapeziometacarpal arthritis to a similar degree as nondepressed patients and thus the final outcome will still indicate greater perceived impairment compared with unaffected patients. Fourth, imperfect interrater agreement determining the Eaton arthritic stage may have resulted in misclassification, which may have biased our data toward a type II error when

determining if arthritic stage impacted total MHQ score. However, the lack of association between arthritic stage and patient-rated function in our study was replicated by Hwang and Ring [12]. Finally, we did not weight medical comorbidities to apply differential importance to the comorbidities according to severity or overall impact on health.

We found that patients with thumb CMC arthritis have limitations resulting from both physical health and emotional problems compared with age- and gender-matched control subjects. The patients with thumb CMC arthritis had deficits in measures of function, ability to work, ability to perform activities of daily living, and satisfaction. This finding is similar to the results of studies evaluating the impact of osteoarthritis of the hip, knee, and ankle on patient-rated function [21, 22]. Salaffi et al. demonstrated that osteoarthritis in the lower extremity was associated with poorer overall health on the SF-36 in both physical and mental summary scores [21]. Our data differed in that trapeziometacarpal arthritis produced a more limited impact on the general health subscales of the SF-36. Saltzman et al. found that ankle OA produced worse perceived general health with an effect that was, like our study, potentiated by other musculoskeletal comorbidities [22].

The negative association of depression on patient-rated hand function realized in this study adds to a growing body of literature demonstrating the relation between musculoskeletal conditions and depression. Ayers et al. [1] found that patients undergoing total joint arthroplasty who had lower mental component scores on the SF-36 and higher Beck Depression Inventory scores used more catastrophizing coping techniques and had poorer pain control. Recently, Noiseux et al. [19] showed a correlation between preoperative depression and moderate to severe pain with ROM after TKA at 6-month followup. Furthermore, patients with higher scores for catastrophic thinking, anxiety, posttraumatic stress disorder, and depression on

several questionnaires are more likely to be taking opioid pain medications 1 to 2 months after musculoskeletal trauma than patients with lower scores [10]. Depression has also been associated with lower baseline and posttreatment MHQ scores in a general population of patients receiving treatment for atraumatic hand conditions [15]. Collectively, these prior trials suggest that orthopaedic patients with depression report disproportionate pain and functional limitation. This should be factored into analyses and outcome reporting because the influence of depression clearly impacts outcomes even when judged by patient-rated measures thought to be specific to the hand.

Concurrent upper extremity comorbidity was associated with lower MHQ scores in both patients with trapeziometacarpal arthritis and in control subjects. This finding is consistent with data from London et al. who identified that depressive symptoms were associated with poorer MHQ scores in patients with atraumatic hand conditions [15]. The magnitude of the difference in MHQ score associated with depression was similar in our study (20 points) and London et al.'s study (17 points). The data suggest that the MHQ, a measure designed to be specific for hand function, is susceptible to influence by shoulder and elbow pathology. The association of other musculoskeletal comorbidity impacting patient-rated function of another extremity region confirmed data by Saltzman et al. in their study of ankle arthritis [22]. In the control group, the presence of a lower extremity comorbidity also worsened MHQ scores. We hypothesize that several questions on the MHQ such as carrying a grocery bag and tying shoelaces may be affected by lower extremity dysfunction but produce an impact that is only apparent in the absence of any hand-specific impairment. The finding that depression only worsened self-reported hand function in patients with arthritis and not in control subjects was not expected. We interpret this finding to suggest that the effect of depression is related to heightening the pain or perceived impairment of a specific hand condition as opposed to depression itself leading to hand pain and limited hand function.

In patients with trapeziometacarpal arthritis, comorbid depression and upper extremity comorbidities were more strongly associated with patient-rated hand function than any demographic factor, objective measure of thumb function, or other medical comorbidity. Although Lozano-Calderon et al. studied the DASH questionnaire, they also identified that depressive symptoms and pain catastrophizing accounted for the 51% of the variability in patient-rated disability associated with trapeziometacarpal arthritis [17]. Therefore, the strength of the influence that upper extremity comorbidities and depression has on patient-rated hand function appears robust. Furthermore, when considering the magnitude of change associated with each of these conditions, the impact exceeded the estimated

minimal clinically important difference on the MHQ [16]. This suggests that the perceived impaired function and heightened pain are clinically relevant and not just statistically significant.

Impaired patient-rated hand function associated with trapeziometacarpal OA is potentiated in the setting of depression and upper extremity comorbidities. The impact of depression was unique because other medical comorbidities did not alter MHQ scores. The association of depression with lower patient-reported hand function is impressive given that neither objective disease-related measures such as grip strength and thumb metacarpal-phalangeal joint hyperextension nor the radiographic severity of the arthritis were associated with lower MHQ scores. As a result of this study, we recommend questioning patients with trapeziometacarpal arthritis about a history of depression and other upper extremity conditions. In orthopaedic patients, depression may be a preexisting comorbidity or develop as a result of ongoing pain or physical impairment. In this study we queried a history of depression among a list of diagnosed medical conditions, which we anticipated would largely capture preexisting depression as opposed to situational depressive symptoms in patients presenting for treatment of trapeziometacarpal arthritis. However, we believe that whether independent of or a result of an orthopaedic condition, depression is likely to impact patient-reported pain and musculoskeletal disability. Future research to examine the impact of treating comorbid depression in patients with trapeziometacarpal arthritis will determine if the negative impact of depressive symptoms on patient-rated upper extremity disability is reversible.

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