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# THE ROLE OF PAIN, UPPER LIMB FUNCTIONING AND RADIOLOGICAL CHANGES IN PATIENTS WITH THUMB CARPOMETACARPAL OSTEOARTHRITIS: A CROSS-SECTIONAL STUDY

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**ABSTRACT** – ***Objective:*** The aim of this study was to evaluate the characteristics of pain and its impact on upper limb functioning in patients with trapeziometacarpal osteoarthritis (TMC OA) and their relationship with site-specific radiological findings.

***Patients and Methods:*** We performed a retrospective observational study including patients affected by TMC OA, according to the European League Against Rheumatism (EULAR) recommendations and graded with Eaton-Glickel classification. We excluded men and women under 50 years, patients with other hand disorders, and hand injuries in the last 24 months and previous hand surgery. Strength, pain, and disability of the upper limb were assessed in all patients with handheld Jamar dynamometer, Numeric Rating Scale (NRS) and disability by the Quick DASH (Disabilities of the Arm, Shoulder and Hand) scale, respectively. We divided our cohort in two groups according to Eaton-Glickel classification. First group included stage 1 and 2, whereas the second group included 3 and 4 stage.

***Results:*** Our results demonstrated that patients with TMC OA have a significant reduction of strength and function of upper limb, and moderate-severe pain. However, the comparison according to all the outcome measures did not demonstrate significant difference between groups.

***Conclusions:*** Our findings demonstrated that the severity of radiological stage assessed with Eaton-Glickel classification is not correlated with the magnitude of symptoms, especially pain and upper limb function.

**KEYWORDS:** Carpometacarpal Joint, Osteoarthritis, Thumb osteoarthritis, Trapeziometacarpal osteoarthritis, Eaton-Glickel Classification.

## INTRODUCTION

Trapeziometacarpal osteoarthritis (TMC OA) is a degenerative and disabling disease, with a prevalence of 15% in subjects older than 30 years and 25% in post-menopausal women[1]. The impairment of the trapeziometacarpal (TMC) joint reduces by 50% the functional capacity of the whole upper limb, since this joint plays a key role in the execution of almost all activities of grasping and handling[2]. Several studies evaluated the effectiveness of conservative and surgical approaches for reducing pain and increasing upper limb function in subjects with basal thumb osteoarthritis[3-5]. A comprehensive approach to TMC OA requires the assessment of pain, joint stiffness, handgrip strength, and specific clinical signs such as the traction-shift test and the grind test[6,7].

Radiological assessment in hand osteoarthritis is based on Eaton-Glickel radiographic classification which categorizes disease severity in four stages, from slight joint modification to deterioration and narrowing, with sclerosis and cysts, similarly to Kellgren-Lawrence classification in knee OA[8].

Magnetic Resonance Imaging (MRI) seems to have better sensitivity for detecting synovitis, osteophytes, cartilage space loss, and erosions [9]. Moreover, MRI evaluation has an important role in identifying bone marrow lesions, frequently found in these patients since this condition could have a significant impact on the clinical scenario (pain and limitation in functioning) and prognosis [10].

However, x-rays alone might be insufficient to predict functional status and treatment response because of lack of correlation between clinical (pain, functional limitations) and radiological findings.

Therefore, it is crucial to investigate the impact of pain type and intensity on hand function and disability in patients with this condition at different radiographic stages.

The aim of this study is to analyze the characteristics of pain and its impact on upper limb functioning in patients with TMC OA, according to Eaton-Glickel classification.

## PATIENTS AND METHODS

We performed a retrospective cross-sectional study enrolling patients referring to outpatient rehabilitation service, affected by TMC OA diagnosed according to the European League Against Rheumatism (EULAR) recommendations,[11] and staged by Eaton-Glickel classification. The exclusion criteria were men and women under 50 years, the presence of other hand disorders, such as carpal tunnel syndrome, tendonitis, rheumatoid arthritis, hand injuries in the last 24 months and previous hand surgery. The main outcomes assessed were handgrip strength using the handheld Jamar dynamometer, pain by the Numeric Rating Scale (NRS) and disability by the Quick DASH (Disabilities of the Arm, Shoulder and Hand) scale.

The measurement of handgrip strength was performed according to the recommendations of the American Society of Hand Therapists (ASHT), using the Jamar hydraulic handheld dynamometer: in a three-trials assessment, the patient should be seated with the arms adduct in the chest and neutrally rotated, elbow flexed to 90°, forearm and wrist in a neutral position. From this position, the patient was asked to perform three times a maximal isometric contraction of the dominant hand, with one-minute rest periods between contractions. At the end of the isometric contractions, it was measured the arithmetic mean of the three trials, which indicates the patients' handgrip strength measured in kilograms (kg)[12].

Pain assessment was performed with the NRS 0-10 and the Brief Pain Inventory (BPI). NRS 0-10 is a numerical and unidimensional assessment method in which the patient reports the intensity of pain in the last week on a 11-points scale (from 0 to 10), where 0 corresponds to 'absence of pain' and 10 to 'maximum perceived pain'. BPI is a self-administered pain measure consisting of the patient reported intensity of the pain and its level of interference in the activity of daily living[13]. Pain severity is measured as worst pain, least pain, average pain, and current pain; pain interference evaluation includes relations with others, enjoyment of life, mood and sleep, and the affective sub-dimension (walking, general activity, working and sleep). The upper limb disability evaluation was carried out using the Quick DASH scale[14]. The Quick DASH scale is a questionnaire including 11 items, designed to assess the capacity to carry out both domestic and recreational activities in patients with musculoskeletal problems in the upper limb. The patient is asked to answer each question, referring to its functional during the last week. To calculate the final score, patients have to answer at least 10 of the 11 questions: each question is evaluated on a scale from 1 to 5, with a summary score out of 100, in order of increasing disability.

The population was divided into two groups according to the Eaton-Glickel classification. The first group included patients with 1 or 2 Eaton-Glickel stage (slight joint widening or narrowing, minimal subchondral sclerosis, joint debris < 2 mm), whereas the second group included patients with 3 or 4 Eaton-Glickel stage (marked narrowing/obliteration of joint space, dorsal subluxation, joint debris > 2 mm with or without sclerosis and cystic changes).

## STATISTICAL ANALYSIS

Statistical analysis was performed using IBM SPSS statistics V21.0 software (IBM SPSS, Armonk, NY, USA). Continuous variables are presented as means ± standard deviations, categorical data as absolute values and percentages. Mann-Whitney test was performed to calculate the differences between groups. The correlation among the outcome measures (BPI severity and interference, handgrip strength, Quick DASH) were calculated by linear correlation coefficient ($\rho$ Pearson correlation); a value of $p<0.05$ was accepted as statistically significant.

## RESULTS

The demographic and clinical data of the study population are reported in Table 1. The mean age and the mean body mass index (BMI) of the whole population study were 68.6 years ± 8.51 and 27.9 ± 5.09, respectively. The severity of pain by NRS score was 4.5 ± 1.91 whereas by BPI severity index and interference index were 4.49 ± 1.92 and 4.51 ± 2.52, respectively. Upper limb function measured by mean Quick DASH score was 50.99 ± 24.17 and the mean handgrip strength was 10.67 ± 5.49. Subjects in the first group with lower Eaton-Glickel stage (n=43) showed a mean BPI severity index of 4.63 ± 1.73, a BPI interference index of 4.52 ± 2.50, handgrip strength value of 10.56 ± 5.49 Kg, and a Quick DASH mean score of 52.91 ± 24.47. Subjects in the second group (n=18) with higher Eaton-Glickel score showed a mean BPI severity index of 3.92 ± 2.06, a BPI interference index of 4.02 ± 2.62, handgrip strength 9.80 ± 5.65 Kg, and a Quick DASH mean of 41.16 ± 22.29 (Table 2).

**Table 1. Demographic and Clinical characteristics of the study population.**

| Variables | N |
|---|---|
| **Age (years)** | 68.6 ± 8.51 |
| **BMI (kg/m²)** | 27.9 ± 5.09 |
| **Handgrip Strength (kg)** | 10.67 ± 5.49 |
| **NRS (0-10)** | 4.5 ± 1.91 |
| **Quick-DASH score** | 50.99 ± 24.17 |
| **BPI Severity Index** | 4.49 ± 1.92 |
| **BPI Interference Index** | 4.51 ± 2.52 |

Abbreviation: BMI = Body Mass Index. NRS = Numeric Rating Scale, BPI = Brief Pain Inventory. Values are expressed as means (standard deviations, SD) for continuous data.

**Table 2. Demographic characteristics of patient with low (1-2) and high (3-4) stages according to Eaton-Glickel classification.**

| Variables | Group 1 (n=43) | Group 2 (n=18) | *p*-value |
|---|---|---|---|
| **Age (years)** | 65.89 ± 9.02 | 67.53 ± 6.59 | 0.062 |
| **BMI (kg/m²)** | 27.65 ± 5.39 | 25.41 ± 4.29 | 0.339 |
| **Handgrip Strength (kg)** | 10.56 ± 5.49 | 9.80 ± 5.65 | 0.800 |
| **Quick-DASH score** | 52.91 ± 24.47 | 41.16 ± 22.29 | 0.092 |
| **BPI Severity Index** | 4.63 ± 1.73 | 3.92 ± 2.06 | 0.424 |
| **BPI Interference Index** | 4.52 ± 2.50 | 4.02 ± 2.62 | 0.564 |

Values are expressed as means (standard deviations, SD) for continuous data. Abbreviation: BMI = Body Mass Index. BPI = Brief Pain Inventory. Mann-Whitney test by was performed for the statistical analysis.

The comparisons of the two groups according to BPI severity index, BPI interference index and Quick Dash score were not statistically significant. The linear correlation analysis showed that the mean BPI severity index (r=0.519, $p<0.001$) and interference index (r=0.454, $p<0.001$) were significantly correlated with the Quick DASH score. Moreover, handgrip strength was significantly correlated with Quick DASH score (r= –0.326, $p<0.01$) (Table 3).

**Table 3. Linear correlation coefficient between function, pain and strength.**

| Variables | Quick Dash | *p*-value |
|---|---|---|
| BPI severity index | ρ 0.519 | <0.0001* |
| BPI interference index | ρ 0.454 | <0.0001* |
| Handgrip strength | ρ 0.326 | <0.01* |

ρ Pearson correlation was performed for the statistical analysis. *Significant *p*-values.

## DISCUSSION

The TMC OA is a degenerative process that leads to hand deformity, reduction of grip strength and functional limitation of the upper limb. At the same time, moderate-severe pain, can significantly contribute to reducing the overall functional capacity of the upper limb in TMC OA patients.

In our population, we find poor handgrip strength in all patients (mean=10.67 Kg) along with a significant TMC OA-related disability (mean Quick Dash score 50.99). The differences between the two groups, identified by different radiological stages, were not statistically significant for all outcomes investigated, although the strength and upper limb function were lower in the group with a higher Eaton-Glickel stage. These data confirm the role of the TMC OA in compromising patients' functioning independently of radiological alteration.

It is commonly believed that patients with higher pain intensity show a worse anatomical condition according to radiological assessment. On the other side, our data demonstrate that the comparison between groups according to Eaton-Glickel score does not highlight a significant difference in terms of pain, with even higher severity and interference of pain for patients with better radiological findings. Taken together, our results suggest that the radiological severity of TMC OA does not significantly affect the magnitude of symptoms and functional limitation.

In literature, the correlation between clinical and radiographic evaluation in patients affected by OA is still debated. Bedson and Croft15 provided evidence that worse radiographic knee OA seems related to a higher probability of showing accompanying symptoms. On the other side, even a slight knee joint space narrowing is correlated with pain occurrence, although with poor sensitivity (38.3%)[16]. Hannan et al[17] reported the incidence of pain in about 50% of knee OA patients with stage 2-4 Kellgren-Lawrence, suggesting that the diagnosis of OA is not always associated with pain. For the thumb OA few studies investigated the correlation between radiological stages and pain. Recent research demonstrates a poor correlation between clinical symptoms and radiographic findings, such as erosion and narrowing of the joint space[18]. On the contrary, the same study evidences a significant correlation between synovial inflammation of the TMC joint, evaluated as power Doppler signal at ultrasound, and pain. This finding proposes synovial inflammation rather than structural cartilaginous and bone degeneration of the joint as the main cause of pain in patients with TMC OA. On the other hand, Kroon et al[19] recently claimed the key role of radiographic osteophytes for the thumb base pain. Since there are conflicting data in literature, further research is required to provide evidence of the pathophysiologic mechanisms of determining the early onset of symptoms.

Our findings show a significant moderate correlation (r=0.519) between Quick-Dash and BPI severity index, suggesting a relationship between pain and overall upper limb function. On the other hand, lower handgrip strength is poorly correlated with hand function (r=-0.326). These results, compared with the previous analysis, highlight that the lower functioning levels of upper limbs in patients with TMC OA might be due to pain severity independently of radiological classification.

We suggest that clinical and functional assessment, in terms of strength and pain of TMC joint might have a key role in clinical and therapeutical management, more than rely mainly on x-ray evaluation. We also suggest that as the first approach to TMC OA, in patients with mild pain, it might be useful to perform an ultrasound assessment, to better define the role of synovial inflammation.

The main limitation of this study was the small sample size, although we believe that our cohort was representative of the clinical conditions underlying TMC OA. Moreover, we have not excluded the presence of sarcopenia in our patients and this could have influenced the grip strength. Finally, as we found a correlation between our outcomes, we cannot define the cause-effect relationship between the functional limitation and pain severity.

## CONCLUSIONS

Our retrospective observational study confirms that patients affected by TMC OA have moderate pain, poor grip strength, and functional limitations. Our findings demonstrate that the severity of the radiological stage assessed with the Eaton-Glickel classification is not correlated with the magnitude of symptoms, especially pain and upper limb function. On the other hand, we figure out a significant correlation between pain, grip strength and upper limb disability, suggesting the relevance of a comprehensive clinical and functional assessment that includes validated outcome measures in patients affected by TMC OA.

### Conflict of interest:

The authors declare that they have no conflict of interest.

### Ethics Committee Approval:

We performed a retrospective study. Therefore, we collected data from medical records of patients.

### Author Contributions:

"Conceptualization, M.P., G.I., and A.M..; methodology, M.P., S.L.; writing—original draft preparation, M.P., L.G, A.M., F.T.,; writing—review and editing, M.P., A.M, G.I.; All authors have read and agreed to the published version of the manuscript.

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