THE EFFECT OF TRAPEZIOMETACARPAL JOINT OSTEOARTHRITIS ON PAIN, MUSCLE STRENGTH AND OVERALL DISABILITY OF THE UPPER LIMB

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The impairment of the trapeziometacarpal joint (TMCJ) 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. Trapeziometacarpal joint osteoarthritis (TMCJ OA) is a degenerative and disabling disease, with a growing prevalence in subjects over 30 years of age. The endpoint of this study was to evaluate the effect of TMCJ OA on handgrip strength, pain and overall functionality of the upper limb. In this cross-sectional study carried out in our outpatient rehabilitation service, we included 27 patients with TMCJ OA. Men and women under 50 years of age, subjects with hand disorders such as carpal tunnel syndrome, tendonitis, rheumatoid arthritis, and hand injuries were excluded from evaluation. All subjects were assessed with a comprehensive approach including measurement of handgrip strength, pain, and hand disability, using the Quick DASH scale (Disabilities of the Arm, Shoulder and Hand) and the brief Michigan Hand Outcomes Questionnaire (MHQ). In the study population, the mean age was 69 years, the mean Body Mass Index (BMI) was 27.8±4 SD. Our sample was divided into 3 age groups: 55-66 years; 66-75 years; >75 years. The mean NRS score was 7. The evaluation of the muscle strength of the upper limb, revealed a reduction in handgrip strength in all age groups, particularly in women over 75 years. Functional assessment showed that mean Quick DASH score and brief-MHQ score were 53.9±19 SD and 31.8±4.3 SD, respectively. The multiple linear regression analysis demonstrated that the Quick DASH score was significantly correlated with the NRS score (r 0.48, p = 0.01) and with the handgrip strength (r -0.45, p = 0.01). Instead, the brief MHQ score was not correlated with either NRS score (r 0.35, p = 0.07), or with the handgrip strength (r -0.35, p = 0.07). Our study confirms the clinical finding that patients with TMCJ OA have a significant hand function limitation, which is closely related to both the lack of muscle strength and pain. The use of validated assessment tests and scales, such as handgrip strength and Quick DASH scale, might be the right approach to better characterize subjects with TMCJ OA.

Several studies have evaluated the effects of conservative and surgical approaches for reducing pain and increasing upper limb function in subjects with trapeziometacarpal joint osteoarthritis (TMCJ OA) (1,2). Quite a lot of specific outcome measures are considered relevant to the best way of measuring treatment outcomes for TMCJ OA (3). The impairment of the trapeziometacarpal joint (TMCJ) 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 (4). TMCJ OA is a degenerative and disabling disease,

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with a prevalence of 15% in subjects over 30 years of age and 25% in post-menopausal women (5). This condition is effectively treated, in terms of pain reduction and improvement of mobility with intra-articular injection of hyaluronic acid (6). The endpoint of this study was to evaluate the effect of TMCJ OA osteoarthritis on handgrip strength, pain and overall function of the upper limb.

MATERIALS AND METHODS

We performed a cross-sectional study in the outpatient rehabilitation service, in the period between March 2013 and September 2013.

In this study we included 27 patients with TMCJ OA, diagnosed according to both the European League Against Rheumatism (EULAR) recommendations (7) and Eaton-Glickel classification (8).

A comprehensive approach to TMCJ OA requires the assessment of pain, joint stiffness, handgrip strength, and specific clinical signs such as the traction-shift test and the grind test (9, 10).

Degenerative changes involving the TMCJ can cause deformity in flexion and adduction of the thumb, hyperextension of the first metacarpophalangeal joint (MCPJ), limitations in performing activities in daily living (ADL).

The exclusion criteria were: men and women under 50 years of age, the presence of other hand disorders, such as carpal tunnel syndrome, tendonitis, rheumatoid arthritis, and hand injuries or hand surgery. For each patient we measured handgrip strength using the handheld dynamometer (Jamar©, Sammons Preston Rolyan, Bolingbrook, IL, USA) and evaluated pain by the Numeric Rating Scale (NRS) and disability by the Quick DASH scale (The disabilities of the Arm, Shoulder and Hand) and the brief Michigan Health Questionnaire (MHQ).

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 (11): in a three-trial assessment, the patient should be seated with the arm adduct in the chest and neutrally rotated, elbow flexed to 90°, forearm and wrist in neutral position. From this position, the patient is asked to perform three times a maximal isometric contraction of the dominant hand. After each contraction the patient should observe a one minute rest period between sets. At the end of the isometric contractions, the arithmetic mean of the 3 assessments was measured, which indicates the patient's handgrip strength in kilograms (kg).

Pain assessment was performed using the NRS, a numerical and unidimensional assessment methods, in which the patient reports the intensity of pain in the last week, on an 11-points scale (from 0 to 10), where 0 corresponds to 'absence of pain' and 10 to 'maximum perceived pain'.

The upper limb disability evaluation was carried out using the Quick DASH scale and the brief MHQ. The Quick DASH scale (12) 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 function during the previous week. In order 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 other rating scale used to assess hand functioning in our population was the brief MHQ (13), including 12 items about the ability of subjects to perform activities of daily living and employment, the pain, the hand aesthetic appearance and the degree of satisfaction of the patient for hand appearance and hand function. Each item is evaluated on a scale from 1 to 5, with 1 being poor and 5 optimum function. For some items it is necessary to reverse the scoring as follows:1= 5, 2=4, 4=2, 5=1. The results of 12 items were totalled and normalized to obtain a global score on a scale from 0 to 100, where 0 corresponds to the worst function and 100 to the ideal hand function.

Statistical analysis

Statistical analysis was performed using the STATA 11.0 software. The parametric variables are presented as means ± standard deviations. The correlation coefficients among the outcome measures (handgrip strength, Quick DASH, and brief MHQ) were calculated by linear regression analysis; 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 I. The mean age and the mean body mass index (BMI) were 69.1 years (min 50; max 97) and 27.8±4 SD, respectively. The population was divided into 3 age groups: 55-65 years; 66-75 years; >75 years (Table II). The median NRS score was 7 (min 2, max 10), corresponding to the mean pain intensity for the first two age groups. Subjects over 75 years of age showed a mean NRS value of 8. The upper extremity muscle strength

testing revealed a reduction in handgrip strength in all age groups, particularly in patients over 75 years. In the first group (55-65 years), the mean handgrip strength was 11.7±5.7 kg SD, in the second group (65-75 years) 9.2±5.8 kg SD, and in the last group (> 75 years) was 6.9±2.8 kg SD.

The mean Quick DASH score and the brief MHQ score were 53.9±19 SD and 31.8±4.3 SD, respectively. In our population, 12 (44.4%) women had severe pain (NRS score ≥7) and showed a mean Quick DASH score of 56.2. 55.6% women had moderate pain (NRS score 4 to 6) and they had a Quick DASH score of 52.3. The multiple linear regression analysis showed that the mean Quick DASH score was significantly correlated with the mean NRS score (r 0.48, p = 0.01) and with the mean handgrip strength (r -0.45, p = 0.01). On the other hand, the mean brief MHQ score was not significantly correlated with either the mean NRS score (r 0.35, p = 0.07), or with the mean handgrip strength (r -0.35, p = 0.07). The highest mean Quick DASH score, corresponding to worse upper limb functioning, was 57.9±14.7 SD for the age group above 75 years, while the age group between 55 and 65 years had the best mean Quick DASH score (47.6). The subjects in the age group of 65-75 years showed a mean Quick DASH score of 56.3±12.3 SD. The Quick DASH scores showed a significant correlation with the NRS scores (r 0.48, p = 0.01). Conversely, the brief MHQ scores were not significantly correlated with the NRS scores (r 0.35, p = 0.07). The mean Quick DASH scores showed a significant correlation with the mean handgrip strength (r -0.45, p = 0.01), otherwise the correlation between the mean brief MHQ scores and the mean handgrip strength did not show statistical significance (r -0.35, p = 0.07).

DISCUSSION

TMCJ OA is a degenerative process that compromises hand shape and function, leading to pain, deformity, reduction of handgrip strength and limitation of manual tasks. Indeed, these anatomical and functional changes are also a result of aging, such as loss of muscle strength. Moreover, in our study cohort the mean handgrip strength (9.4 kg) was significantly lower than that reported in a population of peers without TMCJ OA (22.2 kg) (14).

Table I. *Demographic and clinical data in our population.*

Variables	N
Mean age (years)	69.1 (min. 50; max 77)
Mean BMI (kg/m²)*	27.8 ± 4 SD
Mean Handgrip Strength (kg)	9.4 ± 5.3 SD
Median NRS (0-10)**	7 (min.2, max.10)
Mean Quick-DASH score	53.92 ± 19 SD
Mean brief MHQ score	31.8 ± 4.3 SD

** BMI = Body Mass Index. ** NRS = Numeric Rating Scale*

Table II. *Study population data according to age.*

Variables	55- 65 years (9 patients)	66-75 years (11 patients)	>75 years (7 patients)
Mean BMI (kg/m²)*	27 ± 5.5 SD	28.1 ± 3.8 SD	27.6 ± 1.1 SD
Mean Handgrip Strength (kg)	11.7 ± 5.7 SD	9.2 ± 5.8 SD	6.9 ± 2.8 SD
Median NRS (0-10)**	7 (min.2, max.10)	7 (min.5, max. 9)	8 (min.4, max.10)
Mean Quick-DASH score	47.6 ± 26.6 SD	56.3 ± 12.3 SD	57.92 ± 14.7 SD
Mean brief MHQ score	32 ± 4.4 SD	35.9 ± 4.6 SD	34.6 ± 2.8 SD

** BMI = Body Mass Index. ** NRS = Numeric Rating Scale*

TMCJ OA is an aggravating factor for the functional limitations of the upper limb. Indeed, moderate-severe pain, constantly present in patients suffering from TMCJ OA, might justify per se the reduced overall functional capacity of the upper limb. In our population, 44.4% of the women had severe pain (NRS score ≥7) and showed a mean Quick DASH score of 56.23, suggesting a significant impairment of the upper limb. Women with moderate pain (NRS 4 to 6) showed a Quick DASH score of 52.34, suggesting a moderate level of disability. Therefore, our findings confirm that the level of functional performance is closely correlated with the perception of hand pain in patients with TMCJ OA. Moreover, both thumb basal joint osteoarthritis and pain, have a significant negative impact on muscle strength and hand performance. Indeed, our results regarding handgrip strength confirm literature data, which demonstrated a significant handgrip strength reduction in subjects with TMCJ OA (15). At the same time, we found a significant correlation between the Quick DASH scores and the handgrip strength, as well as among the Quick DASH scores and the median NRS. Therefore, in our patients, pain and reduction in handgrip strength had a negative impact on hand functioning. However, the limitation of this study was the small sample size, although our cohort was representative for the clinical conditions underlying TMCJ OA.

CONCLUSIONS

Our observational study confirms that the patients affected by TMCJ OA have persistent local moderate to severe pain, reduction of muscle strength, and significant functional limitation, the latter of which closely related to both the previous factors. A comprehensive approach to the subject with TMCJ OA, and thus the rehabilitation planning, must include the appropriate assessment of pain, strength, and hand performance. The combined use of handgrip strength test, Quick DASH scale and NRS represents, in our opinion, a valuable approach to better characterize the clinical and functional conditions of patients with TMCJ OA.

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