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Prevalence and Incidence of Hand Osteoarthritis and Upper Limb Complaints in Patients with Knee Osteoarthritis. Correlations among Functionality, Grip Strength, Changes in Body Mass Index and Symptoms among Patients in an Educational Osteoarthritis Program

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Abstract

Objective: To evaluate the prevalence of hand osteoarthritis (hOA) in a population with knee osteoarthritis (KOA) at baseline and one year following the administration of a multi-professional OA educational program correlating symptoms and changes in BMI with function questionnaires of the upper limbs and direct grip strength measurements. Design: Epidemiological study of the prevalence of hand OA in patients with knee osteoarthritis. The Stanford Health Assessment Questionnaire instruments (HAQ); Disabilities of the Arm, Shoulder and Hand* (DASH); grip strength; and finger pinch were utilized, and the upper limbs symptoms were verified at baseline and one year following the educational program. Results: The prevalence of hOA was 23.7% at baseline and 47.4% at one year (incidence of 31.8% per year). The HAQ indicated that patients who did not alter or increased their BMI experienced worsened global strength, whereas patients who reduced BMI improved global strength ($p = 0.041$). Patients with higher initial BMIs experienced less improvement in the HAQ ($r = -0.148$, $p = 0.041$). The DASH results improved, but the right and left tripod grip worsened in all patients, irrespective of BMI change ($p < 0.05$) or symptoms at baseline and reassessment ($p < 0.05$). Pinch strength (right and left tripod and left pulp-pulp) was higher in

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patients without symptoms at baseline (p = 0.048, p = 0.045 and 0.033, respectively). Conclusions: The prevalence of hand OA increased for patients with OA undergoing an educational program irrespective of improved upper function and regardless of BMI change. Patients who decreased their BMI improved their global strength.

Keywords

Hand Deformities, Acquired, Hand Strength, Osteoarthritis, Knee, Prevalence, Incidence, Health Education

1. Introduction

Despite being a common problem, hand osteoarthritis (OA) is less studied than knee and hip OA [1]. From 71 - 100 years of age, the prevalence of symptomatic OA reaches 26% in females and 13% males. As a result, these patients lose strength in the hands and have difficulties with daily manual activities [2]. The main joints involved are the proximal and distal interphalangeals and the first carpometacarpal [3].

Inflammatory, metabolic and mechanical aspects involved in the pathogenesis of musculoskeletal diseases are directly associated with obesity [4]-[6]. Obese patients have an increased risk of developing hand OA due to inflammatory and metabolic factors, regardless of joint load [7]-[9].

The current treatment for hand OA primarily aims at improving pain and function and preventing deformities. Currently, non-pharmacological conservative therapies include the use of orthotics, exercise, heat application, and patient education on joint protection combined with the provision of adaptive equipment to improve grip strength and function [10].

This study investigates the prevalence of hand OA in a patient population with knee osteoarthritis (KOA) at baseline and one year after the administration of a multi-professional OA educational program and conservative OA treatment. Correlations were identified between symptoms, BMI changes, health and function questionnaires of the upper limbs, and direct measures of grip strength.

2. Methods

Design: This study was an epidemiological study of the prevalence of hand OA in two stages (baseline and 1 year) following educational intervention and clinical therapy in patients with knee osteoarthritis. It was approved by the Ethics Committee for the Analysis of Research Projects (CAPPesq) under protocol number 0622/11.

Clinical Trials registration number: NCT01572051.

2.1. Participants

Participants were patients with knee osteoarthritis (KOA) under usual clinical care at the osteometabolic group since 2010. By November 2011, 306 patients were under usual care for KOA and were invitedin 2012 to participate in a multi-professional educational program for the treatment of OA (Orthopedics Institute, Hospital das Clinicas, University of São Paulo) [11].

The patients met the following criteria: outpatient aged 45 years or older with KOA according to the American College of Rheumatology clinical and radiological definition [12]; no rheumatoid arthritis or any other rheumatologic disease other than OA; received usual care for OA during the past six months; knee pain rated above 30 mm on a numerical scale and necessitating drug treatment; no neurological problems; able to understand, agree and sign the informed consent and the questionnaires (irrespective of their level of education); and agree and be evaluated by the occupational therapy team. The exclusion criteria included missing evaluations; performing hand surgery during the evaluation period; or engaging in another clinical trial.

2.2. Intervention

Participants were evaluated for their upper limb abilities. At baseline in February 2012, the Stanford Health Assessment Questionnaire instruments (HAQ) [13] and the Disabilities of the Arm, Shoulder and Hand (DASH)

[14] [15] were utilized. The patients were evaluated for grip strength with a Jamar dynamometer. Key pinch strength, tripod pinch and pulp-pulp pinch were evaluated using a B & L Pinch-gauge. The force was established by averaging three attempts. The tests were performed bilaterally. The presence of deviations or deformities of the hands were evaluated. Those patients with indications for hand, wrist and/or finger orthotics received prescriptions for the devices. All participating patients were measured (height and weight), and BMI was calculated.

Between March and May (2012), the patients received educational material (booklet and DVD) and/or attended two days of classes with 7 different professional teams (orthopedic surgeons, psychology, physical therapy, occupational therapy, physical fitness, nutritionist and social workers) regarding OA, its causes and modalities of treatment [11]. The importance of diet, exercise and medication was emphasized. Regarding occupational therapy, the patients were instructed on joint protection methods during activities of daily living and the importance of alternating activities with different levels of energy expenditure. This was performed in a 50 minute class and a one hour workshop with a simulated house (kitchen, living room, bathroom, bedroom and tools room (this one for the men) (**Figures 1-5**) in the first day of lecture. In the second day of lecture, patients were enrolled in one-hour workshop to alternate activities of different levels of energy expenditure in their weekly routine.

After 12 months, the patients were again subjected to the HAQ and DASH questionnaires, and the handgrip and pinch strength measurements were repeated using the same instruments and BMI calculations.

Figure 1. Keep your back straight, lengthens the handle of the broom and shovel.

Figure 2. Twist towels hooking on tap and rolling it up using both hands. Avoid rubbing the clothes, prefer to use washing machine.

Figure 3. Thickeners of different diameters are used to reduce the strength necessary to clamp or gripping during manipulation of tools used in daily activities (broomstick, comb, brush, pen, toothbrush), thereby reducing joint overloading of the fingers and thumb base.

Figure 4. How to sleep sideways.

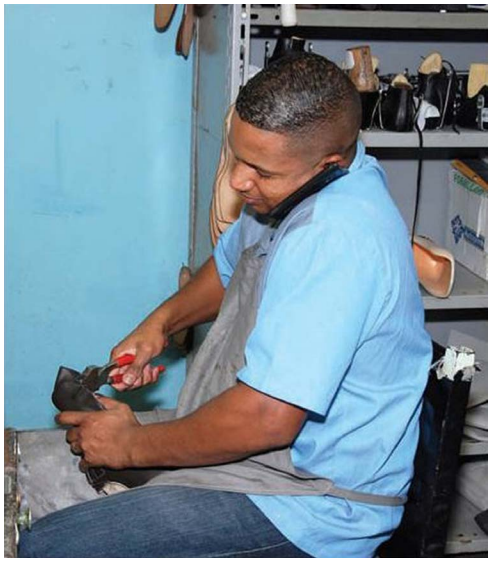

Figure 5. Do one task at a time.

2.3. Simple Size

This was a sub-project of a thematic study evaluating the effects of multi-professional education for KOA clinical treatment. The sample size included all patients that agreed to participate and were actually evaluated by the occupational therapy group. It is part of a pilot study [11].

2.4. Statistics

The HAQ, DASH and strength measurements were calculated. Pearson's correlations were calculated between the changes in BMI and changes in scales and force measurements. Data from patients that missed the second (one-year reassessment) evaluation were not analyzed.

Two groups of patients were created, patients with no change or increased BMI and patients that reduced BMI. The HAQ and DASH values and force measurements at each time point were calculated for both groups using summary measures (means, standard deviations and 95% confidence intervals). These values were compared between groups and between time points with an analysis of variance (ANOVA) with repeated measures (two factors) followed by Bonferroni multiple comparisons when necessary.

ANOVA with repeated measures (two factors) for scales and force measurements between time points and according to the presence of symptoms at baseline and one year were conducted separately.

The tests were performed at the 5% significance level.

3. Results

The occupational therapy group evaluated 195 (at baseline) of the initial 228 patients (85.53%) that accepted to participate, and 192 patients (98.5% of the patients included) were evaluated at one year. One patient died, and two patients abandoned the study.

Of the 195 patients evaluated by occupational therapy at baseline, 45 (23.7%, 11 men and 34 women) had some involvement of the hands. We observed symptoms and characteristics of first carpometacarpal joint arthritis, deviations and nodes, pain in the fingers and wrist, trigger finger, carpal tunnel syndrome, joint stiffness and swan neck deformity. Some of these patients had more than one symptom. At re-assessment, 15 patients had no hand symptoms, and 30 patients continued to present symptoms. At one year, 91 patients (47.4%) complained of hand symptoms (61 patients were previously asymptomatic at baseline).

When comparing these patients regarding the presence of symptoms at baseline and one year (*i.e.*, symptoms at baseline and one year; symptoms at baseline but not at one year; no symptoms at baseline but symptoms at one year; no symptoms at baseline and at one year), there were no differences in age (average of 62, 64, 63 and 63, respectively); BMI (average baseline BMI of 33, 34, 32 and 34 and one-year BMI of 32, 34, 32 and 34, respectively); changes in BMI; or changes in HAQ. The DASH results improved most in those patients that remained symptomatic (from 39 to 33). Those that remained asymptomatic improved the least (from 28 to 27) but had the best results. Patients only initially symptomatic improved from 40 to 38 (worst results). Patients who became symptomatic improved from 35 to 32.

Table 1 presents the results of the HAQ, DASH and grip and pinch strength at baseline and after 12 months.

The actual decrease in BMI was very small. Only 15 patients decreased more than 2 points in their BMI. However, the HAQ results from patients who did not change or increased their BMI increased, whereas patients who reduced their BMI improved, *i.e.*, decreased ($p = 0.041$). The DASH improved and the force on the right and left tripod pinch worsened in all patients regardless of the variation in BMI ($p = 0.012$, $p = 0.001$ and $p = 0.032$, respectively). The other force measurements indicated no significant changes throughout the study or with respect to groups that decreased BMI or not ($p > 0.05$).

There were no significant correlations between the changes in BMI and changes in HAQ or DASH scales ($p = 0.314$ and $p = 0.168$, respectively) or with the variations of force measures ($p > 0.05$). The HAQ changes were inversely correlated with the baseline BMI (*i.e.*, higher initial BMI was related to less improvement in the HAQ). The correlation was weak ($r = -0.148$, $p = 0.041$).

The DASH results (**Table 2**) improved irrespective of the symptoms at baseline ($p = 0.015$ and $p = 0.004$). The right and left tripod pinch and left pulp-pulp pinch had higher mean values in patients without symptoms at baseline ($p = 0.048$, $p = 0.045$ and 0.033, respectively).

The force measurements on the left hand, except grip, had lower mean values in patients with symptoms at one year ($p < 0.05$), **Table 2**.

Table 1. Description of scales and measures of force according to the time of assessment and changes in BMI (decreased, increased or unchanged).

Variable	Moment	BMI Variation															
		Unchanged or Increase								Reduction							
				CI (95%)								CI (95%)					
		Mean	SD	Lower	Upper	Median	Minimum	Maximum	N	Mean	SD	Lower	Upper	Median	Minimum	Maximum	N
HAQ	Baseline	0.76	0.46	0.64	0.87	0.70	0.05	2.20	62	0.86	0.49	0.77	0.94	0.85	0.00	2.60	128
	12 Months	0.94	1.40	0.59	1.29	0.68	0.00	11.00	62	0.77	0.45	0.69	0.85	0.73	0.00	2.40	128
DASH	Baseline	32.84	20.18	27.73	37.94	31.25	0.00	86.66	60	34.01	20.70	30.32	37.70	32.75	0.00	89.81	121
	12 Months	30.46	21.81	24.94	35.97	26.63	0.00	86.60	60	30.95	19.49	27.48	34.42	30.55	0.00	75.83	121
Right Palmar Grip	Baseline	21.70	10.08	19.10	24.29	20.00	3.30	52.60	58	22.96	10.09	21.18	24.74	22.32	3.60	67.30	124
	12 Months	21.25	9.48	18.81	23.69	20.00	2.16	46.66	58	22.57	8.98	20.99	24.15	21.33	5.30	46.50	124
Right Pulp to Pulp Pinch	Baseline	4.14	1.87	3.67	4.62	4.00	0.20	9.10	60	4.18	1.85	3.85	4.50	3.80	0.30	12.00	125
	12 Months	4.05	1.94	3.56	4.54	4.00	0.00	9.00	60	4.17	1.67	3.88	4.46	4.00	1.00	12.00	125
Right Key Pinch	Baseline	6.46	2.57	5.81	7.11	6.48	1.00	14.00	60	6.48	2.54	6.03	6.93	6.30	1.00	15.00	125
	12 Months	6.37	2.51	5.73	7.01	6.08	1.00	13.00	60	6.43	2.45	6.00	6.86	6.30	1.00	15.00	125
Right Tripods Pinch	Baseline	5.18	2.20	4.63	5.74	4.82	0.50	12.00	60	5.31	2.18	4.93	5.69	5.00	0.60	12.00	125
	12 Months	4.84	2.23	4.28	5.40	4.50	1.00	10.00	60	5.02	2.01	4.67	5.37	4.66	0.00	12.00	125
Left Palmar Grip	Baseline	22.18	9.39	19.76	24.60	20.48	4.00	52.00	58	22.88	10.49	21.03	24.73	22.00	6.00	77.00	123
	12 Months	21.52	8.95	19.22	23.82	20.17	6.00	48.00	58	22.33	9.46	20.66	24.00	20.66	3.00	61.00	123
Left Pulp to Pulp Pinch	Baseline	4.01	1.68	3.58	4.43	4.00	0.60	8.60	60	3.88	1.68	3.59	4.18	3.50	1.00	8.60	124
	12 Months	3.85	1.67	3.43	4.27	3.83	0.16	9.50	60	3.79	1.50	3.53	4.06	3.50	1.00	9.00	124
Left Key Pinch	Baseline	6.06	2.26	5.48	6.63	6.00	0.50	12.60	59	6.00	2.32	5.59	6.41	5.60	1.20	13.30	124
	12 Months	5.97	2.31	5.38	6.56	5.66	1.00	14.00	59	6.01	2.32	5.60	6.42	5.63	2.00	14.00	124
Left Tripod Pinch	Baseline	5.11	2.07	4.59	5.64	4.83	0.10	12.00	60	4.87	1.89	4.53	5.20	4.60	1.00	10.60	123
	12 Months	4.84	1.94	4.35	5.33	4.66	0.50	9.83	60	4.75	1.73	4.44	5.05	4.50	1.66	10.60	123

Changes in strength and functional results (DASH) occurred irrespective of symptoms.

4. Discussion

The present study demonstrated that the prevalence and incidence of hOA is high in a population of patients already diagnosed with KOA, which supports the idea that OA is a systemic disease not just localized. Moreover, this study demonstrated initial prevalence rates of 23.7%. Following 12 months, the prevalence was 47.4%. These rates were higher than reported for older patients, where the prevalence of OA is higher [16].

The hypothesis that decreased BMI generates improved function and joint pain was proven correct when analyzing the HAQ overall strength score. Patients that decreased BMI improved function, whereas patients who

Table 2. Description of scales and measures of force according to lack or presence of hand symptoms at baseline and one year according to the lack or presence of hand symptoms at one year and their respective results at baseline.

Variable	Moment	Baseline Symptoms										1 Year Symptoms									
		No					Yes					No					Yes				
		Mean	SD	CI (95%) Lower	CI (95%) Upper	N	Mean	SD	CI (95%) Lower	CI (95%) Upper	N	Mean	SD	IC (95%) Lower	IC (95%) Upper	N	Mean	SD	CI (95%) Lower	CI (95%) Upper	N
HAQ	Baseline	0.78	0.48	0.70	0.85	150	0.97	0.44	0.84	1.10	45	0.80	0.48	0.71	0.89	103	0.85	0.48	0.75	0.94	92
	12 Months	0.81	0.97	0.65	0.97	147	0.87	0.49	0.73	1.02	45	0.75	0.43	0.66	0.83	101	0.91	1.19	0.67	1.15	91
DASH	Baseline	31.01	19.74	27.86	34.17	150	39.84	20.56	33.77	45.92	44	30.20	20.01	26.36	34.05	104	36.27	20.07	32.12	40.41	90
	12 Months	29.10	19.94	25.81	32.40	141	36.55	20.13	30.46	42.64	42	28.78	19.18	24.95	32.54	98	33.19	21.14	28.70	37.69	85
Right Palmar Grip	Baseline	22.72	9.61	21.15	24.29	144	21.63	11.07	18.35	24.90	44	22.83	9.91	20.85	24.81	96	22.08	10.04	20.02	24.13	92
	12 Months	22.83	9.25	21.30	24.36	140	20.16	8.60	17.65	22.68	45	22.73	9.94	20.72	24.74	94	21.61	8.26	19.92	23.31	91
Right Pulp to Pulp Pinch	Baseline	4.30	1.87	3.99	4.60	145	3.63	1.65	3.14	4.11	45	4.32	1.93	3.94	4.70	98	3.94	1.72	3.59	4.30	92
	12 Months	4.22	1.86	3.91	4.53	141	3.80	1.36	3.40	4.20	45	4.38	1.92	3.99	4.77	95	3.85	1.54	3.53	4.17	91
Right Key Pinch	Baseline	6.48	2.48	6.08	6.88	145	6.24	2.72	5.44	7.04	45	6.54	2.59	6.03	7.05	98	6.29	2.48	5.78	6.80	92
	12 Months	6.52	2.47	6.11	6.93	141	6.06	2.39	5.36	6.76	45	6.67	2.57	6.15	7.19	95	6.14	2.30	5.67	6.61	91
Right Tripod Pinch	Baseline	5.38	2.17	5.02	5.76	145	4.84	2.14	4.21	5.46	45	5.41	2.21	4.97	5.85	98	5.08	2.12	4.64	5.51	92
	12 Months	5.16	2.15	4.81	5.51	141	4.34	1.69	3.85	4.83	45	5.26	2.18	4.82	5.70	95	4.64	1.91	4.25	5.03	91
Left Palmar Grip	Baseline	22.74	9.30	21.22	24.26	144	22.00	12.04	18.44	25.56	44	22.97	9.75	21.02	24.92	96	22.16	10.25	20.07	24.25	92
	12 Months	22.34	8.95	20.85	23.83	139	21.57	10.37	18.54	24.60	45	22.62	9.58	20.67	24.57	93	21.67	9.07	19.82	23.52	91
Left Pulp to Pulp Pinch	Baseline	4.04	1.64	3.77	4.31	144	3.45	1.68	2.96	3.94	45	4.16	1.68	3.82	4.49	97	3.63	1.61	3.30	3.95	92
	12 Months	3.93	1.63	3.66	4.20	139	3.44	1.25	3.07	3.80	45	4.11	1.65	3.78	4.45	93	3.50	1.40	3.21	3.79	91
Left Key Pinch	Baseline	6.09	2.20	5.73	6.45	143	5.70	2.55	4.95	6.44	45	6.30	2.23	5.86	6.75	97	5.67	2.31	5.20	6.14	91
	12 Months	6.16	2.25	5.79	6.53	139	5.47	2.44	4.76	6.18	45	6.35	2.31	5.88	6.82	93	5.62	2.26	5.16	6.08	91
Left Tripod Pinch	Baseline	5.09	1.90	4.78	5.40	143	4.43	1.97	3.86	5.01	45	5.17	1.85	4.80	5.54	96	4.68	1.99	4.28	5.09	92
	12 Months	4.91	1.82	4.61	5.21	138	4.37	1.70	3.87	4.86	45	5.07	1.82	4.70	5.44	92	4.48	1.74	4.13	4.84	91

did not decrease their BMI worsened (**Table 1**). Of the patients who improved, those with higher baseline BMIs improved less.

The DASH score, which assesses the ability of the upper limbs, demonstrated improvements in all patient populations, regardless of BMI or symptoms. Similarly, the right and left tripod pinch forces also changed in all patients but with decreased strength (**Table 1** and **Table 2**). Interestingly, patients without symptoms had stronger hands.

Although patients improved on subjective scores (improved function globally via treatment and education regarding the disease), they generally lost strength in their hands, and the prevalence of hand complaints increased. Subjective improvements combined with worsening objective data creates doubt regarding the reliability of the answers obtained from patients or regarding the quality of the program. The program may need to include more specific hand exercises to avoid pinch weakening. Teaching hand exercises by occupational therapists is the best cost-benefit treatment for hOA [17].

Our study has limitations. Our patients were diagnosed with hOA only by anamnesis, physical examination, and without the use of radiographs. This study was also an epidemiological study that evaluated only the prevalence and incidence of hOA. The use of orthotics was not controlled. One third of the patients were initially symptomatic and had no symptoms at one year. This result was probably due to the treatment because there was

no significant difference in BMI, changes in BMI, and exercise (data not shown) from the 15 patients that improved and the 30 patients that remained with pain. Our patients were obese with a low educational level and most of them were laborers but this was not studied at this point. The duration of obesity was not registered. However, the study did indicate a higher than expected prevalence of patients with hand OA when seeking treatment for KOA [18].

In summary, the incidence of the disease increased during the study irrespective of drugs or educational program. Changes in strength and functional results (DASH) occurred irrespective of the symptoms and BMI changes. The program should be adapted to improve hand strength.

5. Conclusion

The prevalence of hand OA increased during an educational program for patients with OA irrespective of improved upper limb function or BMI changes. Patients with decreased BMIs (following one year) demonstrated improved global strength.

Ethical Approval

This study was conducted under the principles of the Helsinki Declaration and was approved by the Ethics Committee for the Analysis of Research Projects (CAPPesq) under protocol number 0622/11. Clinical Trials registration number: NCT01572051.

Contributors

VCK performed data analysis and manuscript writing. DSS, RMS, LCA, NLRB contributed to the study design, data collection, and manuscript editing. MUR contributed to the study design, data collection, analysis and manuscript writing/editing.

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Conflicts of Interest

There are no conflicts of interest.

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