ORIGINAL ARTICLE

Performance of quality of life and functional capacity in women with knee osteoarthritis treated with viscosupplementation and strength training

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ABSTRACT

The viscosupplementation and strength training are interventions accepted in the treatment of knee osteoarthritis. **Objective:** The study describes the effect of two interventions in quality of life and functional capacity. **Method:** Thirty women diagnosed with bilateral knee osteoarthritis of grade II and III by radiological criteria of Kellgren & Lawrence, were randomized into three groups with ten patients each: VSTF group submitted to viscosupplementation and strength training, TF group submitted only to strength training and VS group submitted only to viscossuplementation. Moments of the study were defined as pre-procedure (PRE), after 48 hours of VS (POS-VS) after 12 weeks of training (POS T) and after eight weeks of detraining (POS D). Quality of life was assessed by the SF-36 BRAZIL, functional capacity by Lequesne index. Intraarticular infiltrations were carried out with a single dose of 6 ml / 48 mg with 6,000,000 kDa Hylan GF-20 and strength training sessions were held for twelve weeks. **Results:** Strength training and viscosupplementation were effective in the treatment of knee osteoarthritis. Both interventions promoted improvements in quality of life and in functional capacity ($p < 0.001$), with advantage to the groups that trained force. **Conclusion:** Strength training is a possible replacement of viscosupplementation in the treatment of osteoarthritis of women's knees. However, the beneficial effect of viscosupplementation in pain reduction suggests better efficiency in the strength training execution which may be an advantage of the association of both.

Keywords: Osteoarthritis, Knee, Viscosupplementation, Resistance Training, Quality of Life

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BACKGROUND

Over the years, different became the factors that intervene in the transmission and spreading of diseases. Such changes happen in developed and in developing countries and end up changing health promotion and disease prevention models, especially when it concerns the elderly population, making chronic and degenerative diseases, like the Osteoarthritis (OA), take a major role in health models, theories and debates.[1]

Osteoarthritis is currently considered to be a clinical syndrome resulting from the unbalance between the formation and destruction of cartilage, which involves multiple systemic, genetic, inflammatory, and mechanical factors with the active participation of the synovia and the cartilage of the subchondral bone resulting in the so-called joint insufficiency.[2-20] which may cause alterations in Quality of Life (QL) and in Functional Capacity (FC) in patients suffering from it, especially those patients with knee osteoarthritis (KOA).[21] Pain deprives patients from going upstairs and downstairs, kneeling, strolling, and associated with morning stiffness are the main complaints affecting life style and psychosocial characteristics of the patients.[21,22] Although many studies focus on pain and on physical incapacity, there has been an increasing interest in measuring the effect of such diseases on QL, mainly KOA.[1,21,22]

It is known that the greatest therapeutic challenge considering chronic and degenerative diseases is behavior change in face of the deficiency; chronic pain, incapacity, problem solving, and the way patients deal with KOA impact negatively their QL.[12,21-23] Muscular strength reduction is considered a risk factor for patients with KOA,[24] increased in patients who underwent a meniscectomy[25] also negatively influencing QL, FC and daily activities.[24,25]

It is fundamental that both FC and QL be measured, mainly because it is a commonly wrong perception among most patients that the symptoms are a natural consequence of aging, they consider themselves healthy people despite painful joints, unfortunately, such misconception is also shared by physicians, nurses, physiotherapists, and care-takers.[22]

Among large joints, the knee joint is the most affected, resulting in a functional deficit of 10% of individuals above 55 years old and in 25% of the severe cases of the disease[20] reducing QL and FC.[26-28] Along with that, during senescence, the impact occasioned by the debility caused by OA, just taking into consideration KOA, is similar to those observed in cardiovascular changes.[14]

There are many pharmacologic and non-pharmacologic proposals for the treatment of KOA. As a pharmacologic proposal, the intra-articular therapy with HYLAN GF-20 (HGF-20) or viscosupplementation (VIS) is recommended as clinical management in KOA cases,[29] both in acute and chronic phases[30-32] presenting better results when underwent in the initial stages of the disease.[33-35] The procedure consists in improving the joint rheologic condition and the viscoelasticity of the synovial fluid.[36-38]

As a non-pharmacologic proposal, aerobic and anaerobic exercise programs are recommended when dealing with senescence and degenerative diseases, like OA,[39-41] and recognized as a first-choice consevative intervention in KOA treatment, the most beneficial being strength training (ST)[42,43] for the improvement brought in physical function,[44] its analgesic effect,[29] and for contributing to improve the action of anti-inflammatory cytokines.[45] Exercise is to be recommended by physicians only.[46]

In the last two decades, studies have demonstrated a positive relation between regular physical exercise practice and the increase of longevity, associated with the improvement of quality of life and functional capacity.[1,12,21-28] ST in women with KOA controls hypotrophy and moderates the progression of the joint disease.[1,42-44,47-50] However, one cannot find studies evaluating the impacts of VIS and ST in conjunction, in the FC and in the QL of patients with KOA. In this study, it was measured the influence of viscosupplementation and strength training, in the quality of life and in the functional capacity of women with osteoarthritis of the knees level II and III.[51,52]

OBJETIVE

The study describes the effect of two interventions in quality of life and functional capacity.

METHODS

Study Design

A double-blind, randomized clinical trial.

Subjects

Participants were evaluated at Laboratório de Pesquisas Neuromusculares do Instituto Nacional de Traumato Ortopedia (PNEURO / INTO). Subjects were 30 sedentary women or that had spent at least a minimal period of six months without any kind of exercising; and assisted at the outpatient medical clinic of degenerative joint diseases at Serviço de Reumatologia do Hospital Universitário Clementino Fraga Filho da Universidade Federal do Rio de Janeiro (HUCFF/UFRJ) with clinic and radiological diagnosis of KOA level II and III;[51,52] pain complaint equal to or higher than 6 according to the Visual Analog Scale – VAS; and Body Mass Index - BMI below 39. Patients excluded were: the non-collaborative; under age of 40; the illiterate or those who answered less than 85% of the questions for difficulties due to understanding them; with comorbidities that would interfere in the development or in the execution of the physical exercise program, or that might experience cardiovascular risk; with sequel to fracture and/or with great angular articular deformity, articular blockage, ankylosis eligible for surgical procedures; or that had already undergone any kind of surgical interventional knee treatment; that presented clinical history of sensitivity to any kind of chicken protein. Dropouts were considered those patients who missed more than one evaluation, while those missing one evaluation were considered partial dropouts.

The study was approved by the CEP of HUCFF/UFRJ, under the protocol nº 41376814.3.0000.5257 in 06/04/2015. Every participant filled in and signed an Informed Consent Form.

PROCEDURES

Group Formation

Initially, subjects were randomized into three groups: group 1 = underwent viscosupplementation and strength training (VSST); group 2= underwent only strength training (ST); group 3= underwent only viscosupplementation (VS). The collaborators in the study - the isokinetic evaluator, the supervisor of rating scales, and the physical educator -were blinded to such randomizations.

Strength Training

ST sessions happened at Centro de Treinamento de Força do Centro Ortopédico Reumatológico e Fisiátrico (CTF-CORF). Training load was prescribed according to the result reached in a 10-RM test undertaken until voluntary concentric muscular failure was reached, with a three-minute interval between series.[53,54] The participants were individually instructed about the techniques involved in the execution of each exercise. None of the subjects completed the 10-RM test; consequently, minimum load of equipments was used, leg extension and leg curl, initially to every participant, 5 Kg (PRE), worked out slowly and in a controlled manner,

three seconds to the concentric phase and three seconds to the eccentric phase of the movement. ST was undertaken for twelve weeks with supervised and monitored sessions by the same Physical Education professional obeying the following periodization: two series of ten repetitions, three times a week using the initial load of 5 Kg summing up a volume of 300 Kg a week.[53] Loads were reevaluated every four weeks and weight training volume adjusted individually taking into consideration the load achieved by each patient (53), up to the completion of twelve weeks of training (POS T). After such period of time, training was interrupted for eight weeks (POST D). The assessments took place in the study phases defined as pre-procedure (PRE); 48hours after the VIS (POS-VS); after 12 twelve weeks of training (POS T); and after eight weeks of detraining (POS D).

Isokinetic Evaluation

The studies of isokenetic dynamometry of the three groups happened at PNEURO/INTO in order to determine the maximum extension and flexion torques of the knee, in phases PRE, POS-VS, POS T, and POS D. To evaluate muscle strength an isokinetic dynamometer - CSMI, model HUMAC NORM – was used. Subjects sat with the lateral femoral condyle aligned with the axis of rotation of the machine and the ankle attached to the stem component, knee attachment was strapped on using velcro. To determine maximum voluntary strength, isokinetic concentric-concentric knee flexion and extension tests within the velocity protocol of 60º/s in five repetitions were used. The highest instant torque found was considered the peak torque and used for the analysis.[55] Before testing procedure, all patients performed warm-up exercise in a cycloergometer (5 min., 60 watts).

Viscossuplementation

Intra-articular knee injections using HGF-20 or VIS were used in all patients. The VSST and VS groups were viscosupplemented after first isokinetic evaluation while ST was viscosupplemented after the conclusion of the study. The viscosupplementation injections were assisted by ultrasound. The VIS was a single dose of 6ml /48 mg with 6.000.000 kDa of HGF-20 in each knee.[56] After infiltrations, patients were instructed to rest for a period of 48 hours.[57]

Instruments and Scales

Generic and specific instruments have been used for the assessment of quality of life, functional capacity, pain intensity, cardiovascular risk, and physical aptitude test. The instruments were respectively: BRASIL SF36; Lequesne Index for knee osteoarthritis; Visual Analog Scale - VAS; Coronary Index Test - RISKO and Physical Activity Readiness Questionnarie - PAR-Q,[58-62] in PRE, POS T and POS D phases, applied by only one examiner. Pain was assessed during PRE, POS-VS, POS T, and POS D phases, applied by only one examiner.

Statistical Analysis

The data gathered was statistically analyzed by the SPSS - Statistical Package for the Social Sciences, version 20.0. Analysis of Variance was processed by One-way ANOVA and Two-way ANOVA for repeated differences within group and within moments. It was considered of relevance a rate superior to 5% ($p < 0,05$).

RESULTS

Out of 96 patients eligible for the clinical trial, 46 patients did not meet the criteria; 20 patients were not willing to participate. Among the 30 participants included in the clinical trial, 20 had osteoarthritis level II and 10 osteoarthritis level III. There were two partial dropouts during detraining (POS D), one patient belonging to VSST and another in ST for being infected with the ZIKA virus.

The demographic data of subjects presented the highest age and BMI averages in the VS group, and equivalent levels of KOA severity (50%); while the second lowest age and BMI averages were, both found in ST group with 80% of least severe cases of KOA (n=8). The VSST group had the lowest age average among the three groups; a higher BMI average in relation to ST, but lower than the VS group; and 70% of least severe cases of KOA (n=7) (Table 1).

None of the tests undertaken by patients to evaluate physical aptitude and cardiovascular risk, PAR-Q and RISKO respectively,[60-61] excluded participants from physical training. All results were within normal range in every subject tested.

Both ST and VIS proved to be efficient interventions for the treatment of KOA, independently of the radiologic disease severity. There was reduction in pain; improvement in both quality of life and in functional capacity in the three groups when comparing values of the PRE period to the POS T without reversal of the results when compared to POS D (Table 2).

DISCUSSION

Muscle strength reduction of the lower limbs has a major impact in everyday activities in patients with KOA.[1,63] It is known that among men and women it is associated with the level of pain and the radiological severity of KOA.[64] The results found in this study show benefits of the interventions in the three groups of the trial, the isokinetic response in PRE-moment is quite reduced when compared to the moments POS-VS, POS T and POS D (Table 2) which demonstrates an improvement both in the acute and in the long-term response (Table 2).

In the groups that underwent viscosupplementation there was a significant improvement in the acute isokinetic response, in both flexor and extensor muscle groups, with differences in peak torque at POS-VS moment when compared to PRE-moment (Table 2). Analyzing PÓS T and PÓS D moments, it is noticeable that even without training the results suggest a relation with isokinetic load and the improvement in quality of life and in functional capacity (Table 2), which has already been demonstrated by Miltner et al.[65] and by Diracoglu et al.[66]

The groups that underwent strength training show significant differences in the flexion and extension peak torques in relation to PRE-moment ($p < 0,05$), with equivalence in extension isokinetic response between VSST and ST groups in POS T moment and a better result, in the same moment, in the flexion isokinetic response in group VSST, with equivalent gain maintenance by both groups in POS D moment, both in extensor and flexor torques (Table 2).

Table 1. Demographic and clinical characteristics of participants in different intervention study groups

	Viscosupplementation + Training (n=10)	Training (n=10)	Viscosupplementation (n=10)	p-value
Age (years)	61,90 ± 7,23	64,00 ± 8,82	67,80 ± 9,31	NA
Height (cm)	160,70 ± 6,55	159,60 ± 6,90	157,00 ± 3,94	NA
Body Weight (kg)	78,42 ± 11,93	74,72 ± 13,7	82,43 ± 10,23	NA
BMI (kg/m2)	30,41 ± 4,68	29,58 ± 4,00	33,45 ± 4,12	NA
Osteoarthritis L II	7	8	5	NA
Osteoarthritis L III	3	2	5	NA

NA = not applicable

Table 2. Outcome

	PRE	POS VS	POS T	POS D	P-value
Extension Isokinetic Response (average ± DP) Peak Torque (Nm. kg-1)					
VSST+ VS	0,92 ± 0,33	0,96 ± 0,33	NA	NA	0,367*
VSST	1,08 ± 0,38	NA	1,17 ± 0,44	1,14 ± 0,40	p < 0,05**
SP	1,05 ± 0,24	NA	1,16 ± 0,23	1,14 ± 0,15	p < 0,05**
VS**	0,76 ± 0,16	NA	0,77 ± 0,12	0,73 ± 0,14	NA
Flexion Isokinetic Response (average ± DP) Peak Torque (Nm. kg-1)					
VSST/VS	0,60 ± 0,23	0,66 ± 0,23	NA	NA	0,125*
VSST	0,71 ± 0,28	NA	0,81 ± 0,29	0,79 ± 0,26	p < 0,05**
ST	0,69 ± 0,13	NA	0,73 ± 0,19	0,78 ± 0,15	p < 0,05**
VS**	0,50 ± 0,11	NA	0,57 ± 0,14	0,53 ± 0,16	NA
VAS (average ± DP)					
VSST + VS	7,45 ± 1,19	3,80 ± 0,83	NA	NA	< 0,001
VSST	7,1 ± 0,88	NA	1,8 ± 0,79	1,9 ± 0,88	< 0,001
ST	6,5 ± 0,71	NA	2,0 ± 1,25	2,4 ± 1,43	< 0,001
VS	7,8 ± 1,40	NA	1,5 ± 1,18	1,60 ± 1,26	< 0,001
BRASIL SF-36 (average ± DP) SCORE					
VSST	99,9 ± 21,2	NA	122,6 ± 9,3	124,3 ± 9,3	< 0,001
ST	95,4 ± 18,9	NA	117,7 ± 12,3	121,2 ± 15,5	< 0,001
VS	98,2 ± 24,9	NA	126,0 ± 14,3	127,9 ± 13,9	< 0,001
HEALTH					
VSST	60,2 ± 22,5	NA	77,6 ± 18,1	77,9 ± 18,6	< 0,001
ST	62,8 ± 17,6	NA	75,0 ± 13,0	76,0 ± 14,3	< 0,001
VS	62,6 ± 20,2	NA	83,6 ± 15,7	85,8 ± 13,2	< 0,001
FUNCTIONAL CAPACITY					
VSST	49,1 ± 39,7	NA	78,0 ± 20,7	83,0 ± 17,7	< 0,001
ST	46,5 ± 29,2	NA	77,5 ± 13,6	81,0 ± 15,1	< 0,001
VS	48,5 ± 23,0	NA	77,0 ± 19,5	85,5 ± 11,9	< 0,001
PHYSICAL LIMITATION					
VSST	40,0 ± 47,4	NA	97,5 ± 7,9	97,5 ± 7,9	< 0,001
ST	40,0 ± 35,7	NA	100,0 ± 0,0	100,0 ± 0,0	< 0,001
VS	55,0 ± 43,8	NA	97,5 ± 7,9	100,0 ± 0,0	< 0,001
EMOTIONAL LIMITATION					
VSST	53,3 ± 50,2	NA	100,0 ± 0,0	100,0 ± 0,0	< 0,001
ST	43,3 ± 41,7	NA	96,7 ± 10,6	96,7 ± 10,6	< 0,001
VS	66,7 ± 41,6	NA	92,5 ± 23,7	100,0 ± 0,0	< 0,001
SOCIAL ASPECT					
VSST	49,6 ± 39,7	NA	88,8 ± 10,9	90,0 ± 9,9	< 0,001
ST	57,9 ± 25,2	NA	83,8 ± 16,7	86,3 ± 17,1	< 0,001
VS	75,8 ± 32,5	NA	95,3 ± 6,2	95,0 ± 6,5	< 0,001
PAIN					
VSST	45,9 ± 20,9	NA	73,9 ± 15,5	80,9 ± 14,7	< 0,001
ST	35,7 ± 15,5	NA	73,8 ± 9,9	74,0 ± 9,2	< 0,001
VS	50,7 ± 23,4	NA	84,4 ± 9,9	85,8 ± 13,4	< 0,001
VITALITY					
VSST	63,5 ± 23,5	NA	82,5 ± 15,1	82,5 ± 15,9	< 0,001
ST	54,0 ± 22,5	NA	70,5 ± 16,4	68,5 ± 14,9	< 0,001
VS	52,0 ± 28,2	NA	82,0 ± 16,4	76,5 ± 19,7	< 0,001
MENTAL HEALTH					
VSST	70,0 ± 19,0	NA	78,0 ± 17,0	80,4 ± 13,3	< 0,001
ST	62,4 ± 20,1	NA	70,0 ± 19,1	70,4 ± 18,1	< 0,001
VS	62,8 ± 26,4	NA	82,2 ± 17,8	82,0 ± 23,0	< 0,001
LESQUESNE (average ± DP)					
VSST	9,65 ± 2,5	NA	5,9 ± 1,3	1,75 ± 1,9	< 0,001
ST	9,15 ± 2,1	NA	2,25 ± 2,3	1,39 ± 1,3	< 0,001
VS	11,1 ± 3,4	NA	2,45 ± 1,5	2,2 ± 1,4	< 0,001

NA – Not Applicable, ** Significantly Different Over VS, * Without Significant Difference.

Concerning the intervention effects in the pain reported by patients, it is observed that the acute response of viscosupplementation, between PRE and POS-VS moments, assessed by VAS presents meaningful difference ($p < 0,001$) proving that viscosupplementation is very efficient in immediate pain reduction. In the same way, the long-term response was also satisfactory since its analgesic effect was significantly different from POST and POSD moments ($p < 0,001$) in viscosuplemented groups (Table 2) corroborating with the results found in a great number of prior studies that evaluated the pain reported by patients who underwent viscosupplementation.[21,29,31-38,67-71]

On the other hand, strength training improved the pain relief referred by patients in trained groups ($p < 0,001$), with discrete advantage to VSST group over ST group; with maintenance of obtained benefits, but inferior to the maintenance observed in groups that underwent viscosupplementation (Table 2). Such advantage might be explained, by the reduction in pain severity directly promoted by viscosupplementation thus providing better joint mechanic efficiency, better reologic effect, and consequently suggesting a better response in training considering that in the 4th week there was a percentage equivalence in the evolution of training load between both groups, while in the 8th week of training, the VSST group presented a higher evolutionary percentage than the ST group (Table 3). This result, suggests an earliest closure of motor engram, that according to Moritani et al.[71] normally happens after five weeks of training.

Few studies assessed the effect of such interventions in quality of life and in functional capacity, among these few, it is worth highlighting the study by Rat et al.[21] in patients with KOA level II and III treated with HGF-20 and evaluated in three moments: pre , after 3 months and after 6 months of intervention showing improvements assessed within moments in the quality of life by SF36, in pain severity by VAS, and in functional capacity by Lequesne index, but without considering interactions with other interventions.

Our results also show benefits in quality of life, with considerable difference in the scores assessed by SF-36, higher than ten in global scores and in other domain scores, in comparison from PRE to POS T and POS D ($p < 0,001$) in the three groups, in all interventions, with an advantage to the groups that underwent viscosupplementation

Table 3. Training Volume (Kg / average ± DP) and Gain (%)

GROUPS	MUSCULAR GROUP	PRE	4th S	%	8th S	%	12th S	%
VSST	EXTENSION	5 ± 0,0	6,7 ± 2,37	34	9,5 ± 2,29	90	12,2 ± 2,18	144
	FLEXION	5 ± 0,0	5,7 ± 1,20	14	7,7 ± 1,41	54	9,2 ± 1,68	84
ST	EXTENSION	5 ± 0,0	7 ± 2,58	80	9 ± 3,94	80	13 ± 4,37	160
	FLEXION	5 ± 0,0	6 ± 1,74	44	7,2 ± 2,18	44	9,5 ± 1,97	90

(Table 2). The social aspect domain shows that VS group was significantly different from VSST and ST groups ($p < 0,05$) and among PRE, POS T and POS D moments ($p < 0,001$), however it was not identified the reason for such difference and we attributed it to the initial value shown by the VS group because when it was summed to the other moments it resulted in a higher value than those in the other groups (Table 2).

The domain pain shows a difference between ST and VS groups ($p < 0,001$) and among PRE moment in comparison to POS T and POS D ($p < 0,001$), therefore the same result in the VAS assessment, which was previously discussed (Table 2). These results are also compatible to Vincent et al.[72] studies, that evaluated pain and functional capacity in patients with KOA level II that underwent viscosupplementation concluding that it reduces pain intensity, but showing a discrete impact on the functional tests results; this finding may be explained by the lack of strength training. In this study, the domain functional capacity in the VSST group presents a better score in POS T moment while the VS group in POS D moment (Table 2), possibly exposing the direct detraining influence in functional capacity, still, the group without training did not refer or was not able to notice differences in the improvement obtained after viscosupplementation in their everyday activities.

These findings were also reproduced by Lequesne functional index for KOA, showing a sensible reduction in the sample average in the three groups in the comparison of the moments being significantly different from POS T and POS D moments ($p < 0,001$), with advantage to the groups that underwent strength training (Table 2).

In the present study, the efficiency of both interventions was confirmed in isolation or in association. Both strength training and viscosupplementation are efficient in KOA treatment, independently of its severity level. There was a reduction in pain severity, improvement in quality of life, in functional capacity, and in the isokinetic response, in every moment and with lasting effect. On the other hand, the hypothesis that the association of interventions would be more efficient than the use of one of them alone was not confirmed. However, it was shown that strength training, for its known beneficial effect in the joint mechanic[24-28,42-44,47-50] and anti inflammatory action[45] was, in isolation or in association, superior to viscosupplementation isolated suggesting a positive effect in the isokinetic response, reducing pain severity, and improving quality of life and functional capacity.

CONCLUSION

In conclusion, it is suggested strength training as a possible alternative to viscosupplementation in the treatment of KOA in women, since it is a lower cost alternative to viscosupplementation and for showing benefits in pain management, quality of life, functional capacity, and in the isokinetic response. However, the beneficial effect of viscosupplementation in pain reduction suggests better efficiency in the strength training execution which may be an advantage of the association of both. Later studies may demonstrate the possibility of generalization of such recommendations.

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