Research Article

Glucosamine and Chondroitin Sulphate Supplementation along with Diet Therapy Provides Better Symptomatic Relief in Osteoarthritic Patients as compared to Diet Therapy Alone

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ABSTRACT

A lot of studies have been carried out on glucosamine and chondroitin sulphate supplementation and diet therapy separately on patients suffering from osteoarthritis. However no trial has been carried out in India to study the combined effect. The objective of the study was to assess the effect of diet therapy alone and in combination with glucosamine & chondroitin sulphate supplementation on the symptoms of patients with knee osteoarthritis in terms of anthropometric measurements, clinical scores and reduction of intensity of symptoms. An open, randomized intervention study was conducted on 117 patients suffering from knee osteoarthritis. They were randomly divided into two groups. One group i.e. Diet and Supplementation group (DS) received Glucosamine (1500 mg) and Chondroitin Sulphate (1200 mg) in combination per day in two equally divided doses along with a weight loss diet and the other group i.e. Diet only (DO) group received a weight loss diet for a period of one year. Height, weight, Body Mass Index, WOMAC score, Lequesne's score, Visual analogue scale score, macronutrient and micronutrient intakes were measured at baseline, 6 months and 1 year for both the groups. Asimilar significant decrease in the weight and BMI values in both the groups was observed post intervention but the decrease occurred faster in the first 6 months as compared to the next 6 months ($p<0.05$). A higher significant decrease for almost all the clinical scores was observed in the DS group as compared to the DO group which could be due to the combined effect of diet therapy and glucosamine and chondroitin sulphate supplementation ($p<0.05$). The results indicate that an approximate reduction of 1.4 kg led to a decrease of 1 point in the Visual Analogue Scale which is used to measure the current perception of pain. In both the groups a significant decrease in the mean energy, carbohydrate and fat intakes along with a significant increase in the mean protein, total dietary fiber, calcium, phosphorus, iron and Vitamin C intakes was observed post intervention. A combination of a weight loss diet and glucosamine and chondroitin sulphate supplementation has a better effect in providing symptomatic relief as compared to diet therapy alone in patients suffering from osteoarthritis, however significant decrease in the clinical scores were also seen in the DO groups post intervention and hence the effectiveness of a weight loss diet alone for symptomatic treatment of osteoarthritic patients cannot be ignored.

Keywords: Chondroitin sulphate, Diet therapy, Glucosamine, Knee Osteoarthritis, Lequesne's score, Visual Analogue Score, WOMAC score.

INTRODUCTION

Osteoarthritis is the most common joint disorder with symptoms in the hands, knees, hips, back, and neck.[1] It is a painful and debilitating disease of the synovial joints, affecting an estimated 12-15% of the population 25-74 years of age. The prevalence of this disease increases significantly with age, with radiographic evidence observed in over 70% of the population over age 65.[2-3] The prevalence of knee pain or symptomatic knee osteoarthritis is high among older people in the Asian region in rural and urban areas. The prevalence is comparable to that found in other regions of the world.[4] Osteoarthritis is distinctively characterized by progressive degenerative changes in the morphology, composition, and mechanical properties of the articular cartilage, subchondral bone, synovium, and other joint tissues.[2] According to the Centers for Disease Control and Prevention (CDC, 2010), osteoarthritis (OA) is a disease characterized by degeneration of cartilage and its underlying bone within a joint as well as bony overgrowth. Osteoarthritis can affect any joint, but it is most common in the hip and knee. The wearing away of cartilage occurring in OA causes bones to rub together. This impact causes pain, swelling, and joint stiffness, which can lead to a debilitating state in affected adults. [5-6]

The pharmacological treatments aim to correct symptomatic complaints as well as structural problems in OA. According to Nandhakumar et al. 2009[7], among these pharmacological treatments and despite serious adverse effects associated with their long-term use, non steroidal anti-inflammatory drugs remain among the most widely prescribed drugs for OA, mainly for relief of pain. However, they are also known to cause serious side effects, especially in the older population. Unfortunately, it is this older population who is more likely to suffer from OA of the knee.[6-7]

Considering the side effects of non steroidal anti-inflammatory drugs, alternative therapies and methods are required for the symptomatic relief of osteo arthritic patients. One of these methods is the use of glucosamine

and chondroitin sulphate, glucosamine is a hexosamine sugar and a basic building block for the biosynthesis of the glycosaminoglycans and proteoglycans that are important constituents of the articular cartilage. Chondroitin is a glycosaminoglycan that is found in the proteoglycans of articular cartilage. Both are animal products having antiarthritic and anti-inflammatory activities.[8-12] Being safe, these compounds have great utility in the treatment of OA even if they show moderate efficacy.[8-12]

A study carried out by Richy F et al, 2003[13] on the structural and symptomatic efficacy of glucosamine and chondroitin in knee osteoarthritis demonstrated a highly significant efficacy of glucosamine on all outcomes, including joint space narrowing and WOMAC wherein Chondroitin was found to be effective on Lequesne's Index, visual analogue scale pain, mobility, and responding status. Safety was found to be excellent for both compounds. In a study carried out by Sudha Vidya sagar et al., 2004 [12] glucosamine, chondroitin sulfate and methyl sulfonyl methane combination was found to be definitely useful in decreasing pain, improving functional ability and joint mobility in patients with osteoarthritis.

Obesity is one of the most important risk factors for osteoarthritis in knee. It is an important risk factor for development of knee OA.[14] Not only are overweight people at high risk of developing knee osteoarthritis, but increasingly, longitudinal studies suggest that overweight persons with knee osteoarthritis are at high risk of disease progression[15-17] and that women with unilateral disease who are overweight may be at a much higher risk of developing bilateral knee osteoarthritis than their non-overweight counterparts.[16,17]

Weight loss in osteoarthritic patients has been found to be useful in reducing the intensity of symptoms and providing relief. In a study carried out by Stephen P.et. al a weight reduction of 1 kg was associated with reductions of 40.6 N and 38.7N in compressive and resultant forces, respectively. In addition, a reduction in body weight of 1 kg was associated with a 1.4% reduction in knee abduction movement. The same study showed that each pound of weight loss resulted in a 4 fold reduction in the load exerted on the knee per step during daily activities.[18] Accumulated over thousands of steps per day; a reduction of this magnitude would appear to be clinically meaningful. In another study on patients with knee OA, a weight reduction of 10% improved function by 28%. A low energy diet might be of advantage because of the rapidity of weight loss and a more significant loss of body fat.[19]

A number of trials have been carried out on glucosamine and chondroitin sulfate supplementation and administration of weight loss diet therapy separately but no trial till date has been carried out in India which demonstrates its combined effect. The current use of non-steroidal anti- inflammatory drugs for the treatment of osteoarthritis to provide symptomatic relief is associated with a lot of side effects in the long run and hence the present study aims at studying the combined effect of two safe methods on the symptoms of patients suffering from knee osteoarthritis.

MATERIALS AND METHODS

Subjects

The target population included patients diagnosed with primary knee osteoarthritis aged 50 and above referred to orthopedic clinics in Mumbai, Maharashtra. Males and females were recruited from two hospitals and one clinic in Mumbai. Standard inclusion and exclusion criteria were set for the study based on American College of Rheumatology (ACR) criteria of clinical, physical and radiographic findings.[20]

The patients were screened based on the inclusion criteria and were randomly assigned to one of the two groups i.e. either DS or DO. 117 patients were recruited at baseline, 61 in DS and 56 in DO group. At the end of the study a total of 89 patients were left, 49 in DS and 40 in DO group. At the time of recruitment the patients were provided an informed consent form wherein the procedure and purpose of the study was explained in the language best understood by them. A consent form was also signed by each patient which stated that they had participated voluntarily. The study was approved by the Ethics Committee of Lokmanya Tilak Municipal Medical College & LokmanyaTilak Municipal General Hospital, Sion (IEC 19/11).

The major reason for drop out was found to be no relief from pain, followed by relief from pain so no need to continue with the supplementation. 3.57% of dropouts reported side- effects such as constipation, acidity and loss of appetite respectively (Table 1).

Design

An open, randomized intervention study was carried out to study the effect of diet therapy alone and in combination with glucosamine and chondroitin sulphate supplementation on the symptoms of patients with knee osteoarthritis in terms of anthropometric measurements, clinical parameters and reduction of intensity of symptoms. The patients from DS group received a weight loss diet which consisted of a balanced energy controlled diet supplying approximately 1200-1400 kcal /d. The contribution of macronutrients to the total energy intake was as follows- Carbohydrate- 50%-55%, Protein- 15-25%, Fat- < 30%.The fibre intake was also increased by increasing the consumption of fruits and vegetables in the diet.

The menu plan was modified for each patient based on his individual preferences, food intake patterns i.e. (vegetarian and non vegetarian) and energy requirement. Though the calorie intake differed the composition of the diet was kept more or less the same. Compliance to the diet was monitored every month and in order to prevent monotony certain modifications were made. Along with the diet therapy they also received Glucosamine (1500

mg) and Chondroitin Sulphate (1200 mg) per day in two equally divided doses. On the other hand the DO group received a diet therapy similar to DS group. Weight, Body Mass Index , KL score, WOMAC score, Lequesne's score, Visual analogue scale score, macronutrient and micronutrient intakes were measured at baseline, 6 months and 1 year for both the groups. At baseline, information regarding demographic characteristics, Medical history, Family medical history and present medical condition was recorded for each patient.

The distribution of the patients (Figure 1) was as follows

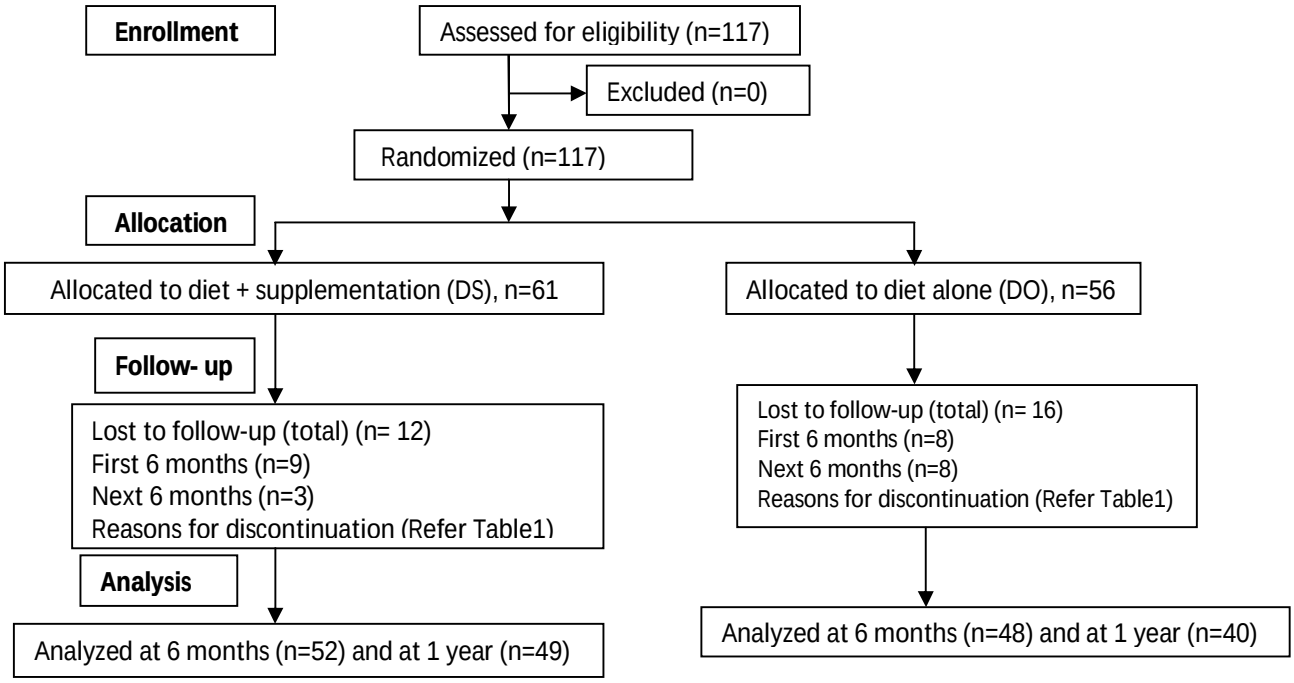

Figure 1: Distribution of patients

Table 1: Reasons cited for drop out

Reasons	DS GROUP No. of dropouts	DO GROUP No. of dropouts	Total no. of dropouts (%)
No relief from pain	1	7	8 (28.57%)
Fear of Diabetes	1		1 (3.57%)
Relief from pain so no need to continue with the supplementation	5		5 (17.85%)
Acidity and loss of appetite	1		1 (3.57%)
Constipation	1		1 (3.57%)
Gone out of town	1	3	4 (14.28%)
Surgery and other medical treatment	1	2	3 (10.71%)
Unknown	1	1	2 (7.14%)
Satisfied with the weight loss so did not wish to continue further		3	3 (10.71%)
	12	**16**	**28**

Dietary intake

A **24 hour dietary** recall was administered at baseline, 6 months and 1 year to estimate the daily nutrient intakes. Nutrient intakes in terms of macronutrients i.e. Carbohydrate, Protein and Fat and micronutrients i.e. Calcium, Phosphorus, Carotene, Iron, Vitamin C, Total dietary fibre, Insoluble and soluble dietary fiber were calculated accordingly. The recipes were standardized and calculated using Nutritive value of Indian foods[21].

Anthropometric measures

Height and weight were measured at baseline, 6 months and one year.[22] Height was measured to the nearest centimeter using a measuring tape. Body weight was measured in kilograms with one decimal by a digital weighing scale. Based on the weight and height measurements, Body Mass Index (BMI) values were calculated. Based on the WHO classification[23] the subjects were classified as underweight, normal, overweight, pre obese, obese and severely obese.

Clinical Scores[22]

The clinical outcome of the intervention was measured in terms of WOMAC score, Lequesne's score[24] and Visual Analogue scale.[25] WOMAC Score[26] included parameters such as pain, stiffness and physical function. Lequesne's score included parameters such as pain, maximum distance walked and Activities of Daily Living. The Visual Analogue scale consisted of a 10 point scale which assessed the patient's current perception of pain. All the three scores were used to assess the patients at baseline, 6 months and 1 year.

Statistical methods

SPSS 20.0 was used for data analysis. The comparison of mean±SD values for pre and post intervention for anthropometric measurements, clinical scores and nutrient intakes within the groups was done using paired t- test. The comparison of mean changes observed in clinical scores and anthropometric measurements for both the groups for assessing the efficacy was done using paired t-test. A p value ≤ 0.05 was considered to be significant.

Table 2: Mean ±SD height, weight, BMI and clinical score values at baseline and 6 months for both the groups[1]

Parameters	DS GROUP			DO GROUP			DS:DO
	Baseline[4]	6 months[5]	$p^2 \leq 0.05$	Baseline	6 months	$p \leq 0.05$	$p \leq 0.05$
Age (yrs)	59.98±8.81[3]			60.70±8.31			0.65
Sex (M:F)	11:50			16:40			
Height (cm)	161.90±5.13			160.61±6.25			0.22
Weight (kg)	71.63±10.68	67.50±8.98	0.00	71.39±10.03	67.04±9.19	0.00	0.65
BMI(kg/m^2)	27.36±3.71	25.76±3.00	0.00	27.68±3.03	26.06±2.79	0.00	0.88
WOMAC Pain	13.98±1.85	9.10±1.67	0.00	13.54±2.20	10.69±1.98	0.00	0.00
WOMAC Stiffness	5.29±1.12	2.60±0.56	0.00	4.94±1.08	3.00±0.82	0.00	0.00
WOMAC Physical function	45.60±8.29	32.62±4.79	0.00	44.71±7.24	36.48±6.69	0.00	0.00
Lequesne's Pain or stiffness	6.75±1.28	3.75±0.96	0.00	6.35±1.37	4.63±1.26	0.00	0.00
Lequesne's Maximum distance walked	2.98±1.52	1.87±0.99	0.00	3.23±1.74	2.48±1.33	0.00	0.00
Lequesne's Acivities of daily living	4.54±1.32	2.62±0.88	0.00	4.96±1.30	3.71±1.09	0.00	0.00
Lequesne's Total Index score	14.33±2.65	8.27±1.76	0.00	14.44±2.63	10.83±2.21	0.00	0.00
VAS Score	7.98±0.89	3.27±0.56	0.00	7.94±1.06	5.35±1.00	0.00	0.00

[1]DS group (Diet + Supplement) received diet therapy and glucosamine and chondroitin sulphate supplementation and DO (Diet Only) group received diet therapy alone; [2]Level of significance P≤0.05 at 95% confidence interval; [3]Mean ±SD (all such values); [4]At Baseline DS group (n=61) and DO group (n=56); [5]At 6 months DS group (n=52) and DO group (n=48)

RESULTS AND DISCUSSION

Effect of intervention on clinical scores and nutrient intakes at 6 months

The baseline characteristics of patients are presented in Table 2. At baseline there was found to be no significant differences in the age , height, weight, BMI ,WOMAC Scores, Lequesne's Index and Visual Analogue Scale values between DS and DO group. The DS group along withthe diet therapy also received Glucosamine (1500 mg) and Chondroitin Sulphate (1200 mg) per day in two equally divided doses. On the other hand the DO group only received a diet therapy similar to DS group. WOMAC Score, Lequesne's Index and VAS Score were used to assess the clinical outcome of the study. A significant decrease ($p \leq 0.05$) in the mean weight and BMI values was observed in DS and DO group which could be due to the dietary intervention which consisted of an energy restricted balanced diet.

There were found to be no significant differences($p \leq 0.05$) in the changes observed in the mean weight and BMI values at 6 months which shows that the change observed in terms of weight and BMI was similar in both the groups. With respect to the clinical scores there was found to be a significant decrease ($p \leq 0.05$) for all the clinical scores for both the groups at 6 months. There was also found to be a significant difference($p \leq 0.05$) between the DS and DO group in the mean decrease which was seen at 6 months where DS group showed a higher decrease as compared to the DO group which could be due to the combined effect of diet therapy with glucosamine and chondroitin sulphate supplementation. The mean nutrient intakes at baseline and 6 months are

shown in Table 3. A 24 hour diet recall was used to assess the dietary intakes. A significant decrease was observed in the mean energy, carbohydrate and fat intakes whereas a significant increase was observed for mean carotene, total dietary fibre, calcium, phosphorus, iron and vitamin C in both the groups at 6 months. These changes which have been observed could be due to the diet therapy administered which aimed at inclusion of foods rich in complex carbohydrates , protein rich foods such as dairy products and pulses, fruits and vegetables rich in Vitamin C and carotene.

Table 3: Mean ± SD nutrient intakes at baseline and 6 months for both the groups

Parameters	DS GROUP			DO GROUP		
	[3]Baseline	[4]6 months	[1]p≤0.05	Baseline	6 months	p≤0.05
Energy (kcal)	1811.02±310.61[2]	1464.40±41.35	0.00	1698.23±223.61	1455.56±90.35	0.00
Carbohydrate (gms)	238.10±59.47	218.50±17.73	0.02	238.10±43.08	210.52±21.60	0.00
Protein(g)	42.56±10.95	56.98±3.46	0.00	43.08±9.12	54.81±4.51	0.00
Fat (gms)	54.40±14.43	39.60±5.79	0.00	56.94±13.92	38.96±5.11	0.00
Carotene (mcg)	1484.92±2053.89	5277.04±872.15	0.00	574.00±816.03	5546.43±1973.41	0.00
***TDF (gms)**	31.33±9.92	46.06±2.81	0.00	27.77±8.16	44.50±4.05	0.00
****IDF (gms)**	23.56±7.82	36.08±2.31	0.00	21.35±6.17	35.15±4.15	0.00
*****SDF (gms)**	8.92±5.20	10.23±1.18	0.06	6.71±1.96	9.38±1.00	0.00
Calcium (mg)	577.94±332.44	1733.75±294.92	0.00	439.85±182.34	1425.67±401.81	0.00
Phosphorus (mg)	784.73±544.58	1065.83±503.99	0.00	815.02±216.45	1098.92±170.41	0.00
Iron (mg)	13.15±5.34	18.19±1.81	0.00	12.31±3.81	18.75±1.60	0.00
Vitamin C (mg)	62.44±29.36	113.27±12.92	0.00	50.56±20.17	121.10±14.38	0.00

[1]Level of significance p≤0.05; [2]Mean nutrient intakes (Mean ±SD) for all such values; [3]At Baseline DS group (n=61) and DO group (n=56); [4]At 6 months DS group (n=52) and DO group (n=48); *Total Dietary fiber, **Insoluble dietary fiber, ***Soluble dietary fiber.

Table 4: Mean±SD height, weight, BMI and clinical score values at baseline and 1 year and mean changes observed at 1 year for both the groups

Parameters	DS GROUP			DO GROUP			DS:DO
	Baseline[4]	1 yr[5]	[2]p≤0.05	Baseline	1 yr	p≤0.05	[3]p<0.05
Weight (kg)	71.63±10.68	64.63±8.07	0.00	71.39±10.03	65.12±9.43	0.000	
Mean change	-6.57±2.36[1]			-6.60±2.29			0.95
BMI(kg/m^2)	27.36±3.71	24.75±2.66	0.00	27.68±3.03	25.27±2.74	0.000	
Mean change	-2.46±1.02			-2.47±0.87			0.97
WOMAC Pain	14.00±1.84	6.20±1.04	0.00	13.68±2.11	9.30±1.65	0.000	
Mean change	-7.79±1.67			-4.37±1.44			0.00
WOMAC Stiffness	5.29±1.13	1.33±0.51	0.00	4.98±1.09	2.18±0.67	0.000	
Mean change	-3.95±1.15			-2.80±1.01			0.00
WOMAC Physical function	45.57±8.36	25.43±4.82	0.00	45.33±6.93	33.33±5.43	0.000	
Mean change	-20.14±7.29			-12.00±5.57			0.00
Lequesne's Pain	6.80±1.29	2.10±0.79	0.00	6.30±1.43	3.60±0.74	0.000	
Mean change	-4.69±1.35			-0.75±0.63			0.00
Lequesne's Maximum distance walked	2.96±1.55	1.76±0.87	0.00	3.28±1.69	2.38±1.25	0.000	
Mean change	-1.20±0.91			-1.25±0.72			0.08
Lequesne's Acivities of daily living	4.57±1.35	1.67±0.51	0.00	4.90±1.35	2.78±0.83	0.000	
Mean change	-2.89±1.37			-2.12±0.99			0.00
Lequesne's Index score	14.39±2.72	5.53±1.47	0.00	14.43±2.65	8.73±1.67	0.000	
Mean change	-8.85±2.55			-5.70±1.89			0.00
VAS Score	8.00±0.91	1.90±0.51	0.00	8.05±0.98	3.60±0.81	0.000	
Mean change	-6.10±1.02			-4.45±1.13			0.00

[1]Changes observed in the values form baseline to 1 year expressed as Mean +SD; [2]At baseline DS group (n=61) and DO group (n=56); [3]At 1 year DS group (n=49) and DO group (n=40)

Table 5: Mean ± SD nutrient intakes at baseline and 1 year for both the groups

Parameters	DS GROUP			DO GROUP		
	Baseline[3]	1 year[4]	[1]p≤0.05	Baseline	1 year	p≤0.05
Energy (kcal)	1806.02±313.66[2]	1428.10±52.38	0.00	1707.53±229.38	1437.05±56.32	0.00
Carbohydrate (gms)	233.94±57.70	207.98±18.07	0.00	237.28±45.12	205.63±18.20	0.00
Protein (g)	42.98±10.98	57.90±3.26	0.00	43.00±9.39	55.70±3.36	0.00
Fat (gms)	54.14±14.72	38.14±5.842	0.00	57.85±14.33	38.10±4.70	0.00
Carotene (mcg)	1441.24±2004.17	5370.04±1895.73	0.00	599.53±890.03	5977.63±1463.57	0.00
TDF (gms)	30.35±9.103	46.90±2.20	0.00	27.38±8.49	45.43±3.01	0.00
IDF (gms)	22.80±7.29	36.63±2.16	0.00	21.10±6.42	35.83±2.55	0.00
SDF (gms)	8.78±5.24	10.39±1.23	0.02	6.63±2.00	9.33±1.81	0.00
Calcium (mg)	585.92±339.49	1735.24±284.72	0.00	444.75±191.93	1512.20±329.57	0.00
Phosphorus (mg)	780.04±559.59	1115.39±530.15	0.00	816.75±226.06	1131.75±149.47	0.00
Iron (mg)	12.88±5.25	17.86±1.69	0.00	12.23±4.08	18.95±1.98	0.00
Vitamin C (mg)	59.12±26.85	115.33±12.11	0.00	50.78±21.66	122.50±13.97	0.00

[1]Level of significance p≤0.05; [2]Mean nutrient intakes (Mean ±SD) for all such values; [3]At Baseline DS group (n=61) and DO group (n=56); [4]At 1 year DS group (n=49) and DO group (n=40)

Table 4 shows the mean clinical scores at baseline and 1 year and it also depicts the mean changes observed at 1 year from the start of intervention. There was found to be a further significant decrease in mean weight and BMI values in DS and DO group due to the dietary intervention .The decrease in weight in both the group was faster in the first six months as compared to the next six months. With respect to changes in weight and BMI there was found to be no significant difference between the groups which could be due to the similarity in the administration of diet therapy. T- test for equality of means showed that there was found to be a significant difference in the decrease in the WOMAC score at 6 months and 1 year between the two groups .The decrease in WOMAC Score was found to be significantly higher in the DS group in terms of pain, stiffness and physical function. With respect to Lequesne's total Index Score there was found to be a significant difference in both the groups at 1 year with DS group showing a higher decrease of 8.85 points v/s DO group which showed a decrease of 5.70 points. The difference in the decrease for the maximum distance walked was found to be non significant for both the groups. The same trend was also observed in the VAS Score for both the groups, the DS group showed a higher decrease of 6.1 points v/s 4.45 points for DO group.

The mean nutrient intakes at baseline and one year are presented in Table 5. At the end of 1 year there was found to be a significant decrease in the mean energy, carbohydrate and fat intakes and significant increase in the mean Carotene, Total dietary fibre, Insoluble dietary fibre, calcium, phosphorus, iron and Vitamin C intakes.

There was found to be a decrease in the % of patients consuming painkillers on a daily basis in both the groups. Similar trends were observed for both the groups (Figures 2 & 3). At baseline 42.62% of people consumed painkillers on a daily basis whereas at the end of the trial not a single patient consumed it on a daily basis in the DS group. The % of patients consuming painkillers on a daily basis in the DO group was 23.21% and at the end of the trial the % dropped down to 12.50% which shows that even without the supplementation a reduction in the weight can lead to a decrease in the pain experienced by the patients. Thus the intervention was found to be effective in terms of providing symptomatic relief from pain to patients for both the groups thereby reducing the side effects caused by consumption of painkillers on a long term basis.

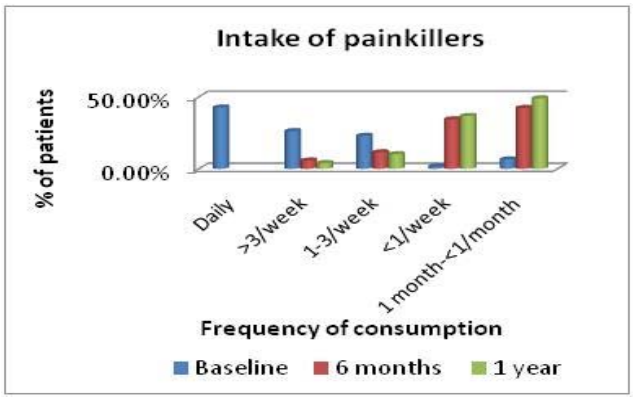

Figure 2: Frequency of consumption of painkillers in DS group

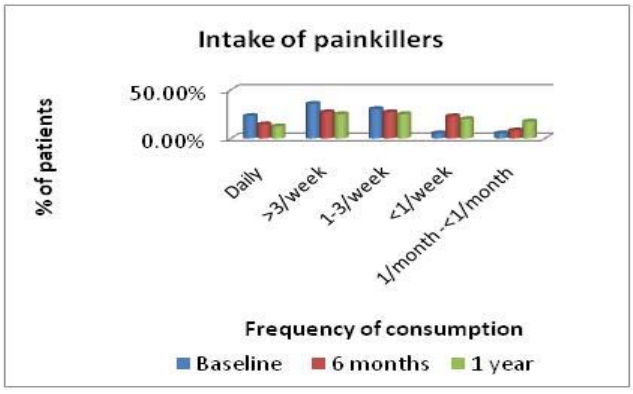

Figure 3: Frequency of consumption of painkillers in DO group

The important findings of this study are that a combination of weight loss treatment and glucosamine and chondroitin sulphate supplementation provides better pain relief as compared to weight loss treatment alone in patients with knee osteoarthritis. Weight could act through two different intermediaries to cause osteoarthritis. First, and most logically, being overweight, because it increases the load across a joint which could increase stress on cartilage and induce breakdown that then leads to osteoarthritis.[27] Another reason could be that overweight people have higher bone mineral densities which could itself be a risk factor for osteoarthritis.[27-28]

The weight loss diet given to these patients aimed at modifying the patient's current macronutrient intake which could aid weight loss. Inclusion of complex carbohydrates and good quality protein helped in achieving weight loss in these patients. Since the diet also focused on improving the fiber intake due to a higher intake of fruits and vegetables it helped in improving the overall food consumption pattern of these patients which in turn had a positive effect on the nutritional status of these patients due to monthly diet counseling sessions which were conducted for these patients.

In both the groups a decrease was observed in the frequency of consumption of painkillers which proves that even a slight reduction in the weight can provide pain relief which is safe as compared to the relief provided by painkillers which is accompanied by side effects in the long run. NSAIDs (Non Steroidal anti inflammatory drugs) can cause digestive problems, stomach upsets, indigestion, or damage to the stomach lining so in most cases they'll be prescribed along with a drug called a proton pump inhibitor (PPI), which will help to protect your stomach. NSAIDs also carry an increased risk of heart attack or stroke.[29]

The present study aimed at measuring the changes which were observed in the clinical scores in both the groups post intervention. WOMAC Score, Lequense's Score and Visual Analogue Score significantly decreased in both the groups at 6 months and 1 year post intervention. It was also found that even an average reduction of 1.24 kg led to a reduction of 1 point with respect to the Visual Analogue Score which is in agreement with a study done by Stephen P. Messier et. Al 2005 which showed that an average weight loss of 5% over 18 months in over weight and obese adults with knee OA results in an 18%improvement in function and when dietary changes are combined with exercise, function improves by 24% and is accompanied by a significant improvement in mobility. Similar changes were observed in a study carried out by Selvan T et. Al 2012[30] which showed that a combination of Glucosamine sulphate and NSAID's caused a reduction in the WOMAC and VAS scores. However Sawitzke et al., 2010[31] found beneficial but non significant differences in WOMAC pain and function in 662 patients who received glucosamine for a period of 2 years.

In the present study a significant decrease was observed in the Lequesne's Total Index Score in the DS (-8.85±2.55) and DO (-5.70±1.89) group. In the present study majority of the patients had a common myth that glucosamine and chondroitin sulphate supplementation leads to weight gain but due to the weight loss treatment provided the patients did not gain weight thereby reducing the risk of any further complications which could also be a reason for good compliance. In the current study though a lot of significant improvement was seen for the symptoms, the KL grade was found to be the same at 6 months and one year for both the groups which shows that the intervention had a positive effect on the symptoms but was not effective in reducing the joint space and this finding was similar to findings observed in a trial carried out by Sudha Vidya Sagar et al , 2004 (n=32) which also showed significant improvement in pain and Lequesne's index at four, eight and twelve weeks ($p < 0.05$) and gradual improvement in joint mobility over twelve weeks but no improvement in radiological changes in twelve weeks study period[12].Glucosamine and chondroitin sulphate is said to exert its effect by having an anti arthritic and anti inflammatory activity[32-33] but may be the duration of the present study was not sufficient enough to show positive effects on joint space narrowing. The compliance of the drug was found to be good which shows that the supplement was well tolerated by the patients. In the present study improvement in clinical signs such as reduction in swelling and crepitus started occurring after 3 months. An overall reduction was also seen in these patients in terms of patients taking other forms of treatment such as physiotherapy, heat pad treatment and ultrasound techniques. A lot of studies which have been carried out to study the effect of glucosamine and chondroitin sulphate supplementation on OA patients so far have shown both positive and negative results. Simultaneously during the current study one separate group was also studied wherein only glucosamine with chondroitin sulphate supplementation was given which showed positive results.[22]

No trial has been carried out in India to study the combined effect of diet therapy and supplementation and hence the current study aimed at studying the changes observed. The limitation of the current study was that hematological and biochemical parameters were not analyzed due to lack of funds. Since radiological findings were used to study the change in the joint structure they may not be apt enough to study minute changes occurring in the joint space in one year's time. No severe adverse effects were reported during the trial.17.85% of patients dropped out because of pain relief experienced before the end of the trial and therefore they did not wish to continue with the supplementation. Since this study was done without a control group a placebo effect showing improvement in symptoms cannot be ruled out. Further research is required with a larger sample size and a longer duration to study the effect of combination of glucosamine and chondroitin sulphate and diet therapy for patients with knee osteoarthritis on a long term basis.

CONCLUSION

A combination of weight loss treatment and glucosamine and chondroitin sulphate supplementation provides better symptomatic relief as compared to weight loss treatment alone in patients with knee osteoarthritis. Even a modest weight loss of 1 kg provides relief in pain and stiffness experienced by patients with knee osteoarthritis thereby reducing the consumption of painkillers .Since there were no adverse effects the tolerability of glucosamine and chondroitin sulphate supplementation was found to be good which can also be demonstrated by the compliance rate of the patients.

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