Educational Administration: Theory and Practice
2024, 30(3), 2959-2965
ISSN: 2148-2403
https://kuey.net/

Research Article

Effect Of Hamstring Strengthening With Conventional Occupational Therapy Program On Pain And Functionality In Individuals With Bilateral Knee Osteoarthritis

Garima Chauhan[1*], Dr. Soumita Das[2], Prof. (Dr.) R.K Sharma[3]

[1*]Master of Occupational Therapy (Orthopaedics) student, Santosh College of Occupational Therapy,
[2]Assistant Professor, Santosh College of Occupational Therapy, Ghaziabad,
[3]Dean, Paramedical and Principal, Santosh College of Occupational Therapy

Citation: Garima Chauhan, et.al (2024), Effect Of Hamstring Strengthening With Conventional Occupational Therapy Program On Pain And Functionality In Individuals With Bilateral Knee Osteoarthritis , *Educational Administration: Theory and Practice*, 30(3) 2959-2965 Doi: 10.53555/kuey.v30i3.8836

ARTICLE INFO

ABSTRACT

Background: Knee osteoarthritis (KOA) is characterized by structural changes to the articular cartilage and subchondral bone, as well as Hoffa's fat pad, synovia, ligaments, and muscles, leading to the viewpoint that OA is considered as a disease affecting the entire joint. Knee osteoarthritis (KOA) is regarded as the most prevalent cause of functional limitations and escalating pain in the knee joint, which has a significant negative impact on a person's ability to lead an active life. To reduce inappropriate joint loading and enhance joint stability, it is essential to strengthen the quadriceps, hamstrings and ankle rotators.

Study design: Experimental control research Study

Aim: To assess the effect of hamstring strengthening with conventional occupational therapy program on pain and functionality in individuals with bilateral knee osteoarthritis.

Objective: To evaluate the effect of hamstring strengthening with conventional occupational therapy program on pain and functionality using Visual analogue scale (VAS) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) in individuals with bilateral knee osteoarthritis.

Participants: A total of 60 participants according to inclusion and exclusion criteria were included in the study.

Method: A total 60 participant selected between 40 - 60 years of age. Participants were randomly assigned in one of 2 groups, experimental group and control group. In experimental group hamstrings strengthening exercises with conventional occupational therapy (quadriceps strengthening + ankle rotators strengthening) was given to the participants. In control group conventional occupational therapy program (quadriceps strengthening + ankle rotators strengthening) was given to the participants. The intervention was given for 4 weeks, 5 sessions per week for 45 min. The outcomes of the intervention were assessed using VAS and WOMAC outcome measure.

Result: The control group exhibited a decrease in mean VAS scores from 4.6 to 3.03, and WOMAC scores from 49.3 to 38.47. In contrast, the experimental group demonstrated a more pronounced effect, with mean VAS scores reducing from 4.6 to 2.3 and WOMAC scores decreasing from 55.43 to 39.03. The standard errors post-intervention was lower in the experimental group than in the control group, indicating greater precision in mean estimates. Furthermore, the lower standard deviation and variance in the experimental group suggest a more consistent and reliable reduction in both pain and functional limitations compared to the control group.

Conclusion: In conclusion, the findings from the paired t-tests clearly indicated that the combination of hamstring strengthening exercises with conventional occupational therapy significantly enhances outcomes for individuals suffering from bilateral knee osteoarthritis. These results advocate for broader implementation of combined therapeutic strategies to address both pain and functionality in patients with knee osteoarthritis.

Keywords: Osteoarthritis, VAS, WOMAC, Hamstring strengthening

INTRODUCTION:

Osteoarthritis (OA) is the most common form of arthritis. Osteoarthritis (OA) can also be referred to as degenerative joint disease, hypertrophic arthritis, and degenerative arthritis. OA is a chronic condition that is commonly known as "wear and tear" arthritis because of the breakdown of cartilage in the joints [1]. Osteoarthritis the most prevalent progressive musculoskeletal condition that can affect joints, but it primarily affects the hips and knees as the major weight- bearing joints. Knee osteoarthritis (KOA) is characterized by structural changes to the articular cartilage and subchondral bone, as well as Hoffa's fat pad, synovia, ligaments, and muscles, leading to the viewpoint that OA is considered as a disease affecting the entire joint.[2]

Knee osteoarthritis (KOA) is regarded as the most prevalent cause of functional limitations and escalating pain in the knee joint, which has a significant negative impact on a person's ability to lead an active life.[3] According to research, between 10 and 30 percent of patients with OA are seen to develop symptoms like pain, which is the primary reason why they are unable to undertake any sport or leisure activity and, as a result, are disabled.[3] Pain is a common clinical sign, especially after heavy lifting and continuous exertion, whereas stiffness is seen after inactivity [4]. Knee swelling, locking, and instability are common problematic signs. The limitations, which are primarily pain-related are typically walking, climbing stairs, performing domestic tasks, and sitting up straight are among the physical and psychological symptoms of this condition, both of which can lower quality of life [5].

A complex interaction of constitutional and mechanical elements, such as joint health, hereditary susceptibility, local inflammation, mechanical stresses, and cellular and biochemical processes, leads to OA [5]. Osteoarthritis (OA) is one of the frequently occurring diseases that affects elderly individuals and, as a result, causes a significant level of disability.[5]

The incidence of knee OA appears to be rising along with the average age of the global population.[3] The overall prevalence of primary knee OA in big cities was 33.2%, 19.3% in small cities, 18.3% in towns, and 29.2% in villages. As compared to rural areas, urban areas have a significantly higher prevalence of symptomatic primary OA knee [6].

There's evidence that the pathophysiology of knee osteoarthritis includes muscular dysfunction. Important muscular dysfunction may result from either quadriceps weakness or weakening of the hamstrings relative to the quadriceps since the lower limb musculature serves as the knee joint's natural bracing [7]. Patients with knee OA also demonstrated reduced calf muscle strength [8]. This has been observed that there is more emphasize given on the quadriceps strengthening than the hamstring. The hamstring also provides the structural and functional stability to the knee joint and that is why hamstring strengthening is very important [9].

In order to reduce inappropriate joint loading and enhance joint stability, it is essential to strengthen the quadriceps, hamstrings and ankle rotators.[3] Presently, complete cure for KOA is not there. However, the present state of this disease can be significantly improved by the prescription of exercise. Knee joint isometric training has always been a vital exercise in promoting the regeneration of deteriorated cartilage, reducing pain, and assisting patients in enhancing their functional capacity which leads to a better quality of life [3].

There is a paucity of research assessing the effect of hamstring strengthening in addition to conventional Occupational therapy program (Quadriceps strengthening and ankle rotators strengthening) on pain and functionality in subject with knee osteoarthritis to provide the better quality of intervention and holistic care strategies.

METHODOLOGY:

This study was reviewed, discussed and approved by the Santosh Occupational Therapy institutional ethical committee. 60 participants were selected from Ratanlal hospital and Divine hospital as per inclusion and exclusion criteria. Prior to participate in the study, participants were explained about the study. The written consents were obtained from the participants. The participants were assigned to control and experimental group by random sampling method.

As per inclusion criteria, individuals with bilateral knee osteoarthritis with pain duration more than 3 years, age range between 40-60 yrs, both male and female and who had oosteoarthritis level 2 or 3 on Kellgren-Lawrence Scale and Pain intensity less than 6 on VAS, were included in the study. As per exclusion criteria, individuals with any deformity of the knee, hip, and back, who were diagnosed with any neurological condition, and who were having diabetes mellitus and hypothyroidism and individuals with patellofemoral joint involvement were excluded.

In experimental group hamstrings strengthening exercises with conventional occupational therapy (quadriceps strengthening + ankle rotators strengthening) was given to the participants. In control group conventional occupational therapy program (quadriceps strengthening + ankle rotators strengthening) was given to the participants. Participants of both groups received intervention for 4 weeks, 5 sessions per week for 45 min. The outcomes of the intervention were assessed using VAS and WOMAC outcome measure.

Intervention Program includes

Quadriceps strengthening exercises - ten straight legs raise, ten isometric contractions of the quadriceps muscle, holding them for 15 s along with 90° knee flexion and 180° knee extension with a rest phase of 5 s.[3]
Ankle rotators strengtheningg exercises- includes calf raises—basic 10 reps for 3 sets, calf raises-external rotation 10 reps for 3 sets, plantar flexion with resistance band (green) for 10 repetitions in set of 3 with 15 s hold period and adequate rest pause for 5s. [3]

Hamstrings strengthening exercises includes Hamstrings Clenches 10 times, buttock Kicks 10-20 times for 3 sets and kick Backs 10-20 times for 2 set.[10]

Outcome measures:
1. Visual Analogue Scale: VAS is frequently used as an assessment of pain severity around the world. VAS has been demonstrated to be a valid, reliable, and interval scale. High repeatability and test-retest reliability are characteristics of VAS. [11]
The VAS categorizes pain intensity as none, mild, moderate, or severe; the following cut points have been suggested: no pain (0–4 mm), mild pain (5–44 mm), moderate pain (45–74 mm), and severe pain (75–100 mm). [12]

2. The Western Ontario and McMaster Universities (WOMAC) index: The WOMAC index is a self-administered, disease- specific questionnaire intended to assess the state of health and outcomes associated with knee osteoarthritis. The WOMAC consists of three subscales: the pain subscale, the stiffness subscale and physical functional subscale. The pain subscale comprises of five questions, the stiffness subscale has two questions on stiffness, and there are seventeen questions about the degree of physical function problems. All 24 items are rated on five-point Likert scales (none = 0, slight = 1, moderate = 2, severe = 3, extreme = 4). The overall results might have a value of 0 or 96. Higher scores indicate a more serious condition. It is widely known that the WOMAC questionnaire provides individuals with knee OA with adequate validity, reliability, and responsiveness. [7]

DATA COLLECTION:

A total of 60 participants were included in the study through convenient sampling. The participants were recruited from Ratanlal hospital and Divine hospital, Ghaziabad (UP) as per inclusion and exclusion criteria.

DATA ANALYSIS:

After completion of all (pre-intervention and post-intervention) evaluation, results were collected and data were put in the master chart and analysed by using IBM Statistics Version 26 for statistical significance result. The pre-post analysis of experimental and control group was analysed through parametric test. T-test was used to analyse the pain and functionality scores for analysis of outcome measures VAS and WOMAC.

RESULT:

The analysis of this study where in all the statistical tools below, the probability value of 0.05 is considered a significant level. The descriptive statistics table above provide an overview of the sample consisting of 60 participants. Mean age of the participants was 48.03 years for experimental group and 47.3 years was for control group. Male and female ratio was 10/20 for experimental group and 11/19 for the control group. The mean pretest score, standard deviation and sample variance of VAS scale in experimental group was 4.6, 0.5632, 0.3172 respectively. The mean pretest score, standard deviation and sample variance of VAS scale in control group was 4.6, 0.498, 0.248 respectively. The mean post test score, standard deviation and sample variance of VAS scale in experimental group was 2.3, 0.7944, 0.6310 respectively. The mean postest score, standard deviation and sample variance of VAS scale in control group was 3.0333, 0.809, 0.654 respectively.

The mean pretest score, standard deviation and sample variance of WOMAC scale in experimental group was 55.4333, 11.9588 and 143.0126 respectively. The mean pretest score, standard deviation and sample variance of WOMAC scale in control group was 49.3, 7.747 and 60.010 respectively. The mean post test score, standard deviation and sample variance of WOMAC scale in experimental group was 39.0333, 11.7194 and 137.3437 respectively. The mean postest score, standard deviation and sample variance of WOMAC scale in control group was 38.467, 8.207 and 67.361 respectively.

Table 1.0: Paired t-Test for Pre-Post of VAS scale in Control Group

t-Test: Paired Two Sample for Means						
	Mean	***Variance***	***Pearson correlation***	***df***	**P(T<=t) two-tail**	**t Critical two-tail**
VAS (PRE-INTERVENTION)	4.6	0.2483	0.462	29	1.39E-12	2.045
VAS (POST INTERVENTION)	3.033	0.6540				

Table 2.0: Paired t-Test for Pre-Post of WOMAC scale in Control Group

t-Test: Paired Two Sample for Means						
	Mean	***Variance***	***Pearson correlation***	***df***	**P(T<=t) two-tail**	**t Critical two-tail**
WOMAC (PRE-INTERVENTION)	49.3	60.01	0.711463	29	1.12E-10	2.045
WOMAC (POST INTERVENTION)	38.467	67.36				

Table 3.0: Paired t-Test for Pre-Post of VAS scale in Experimental Group

t-Test: Paired Two Sample for Means						
	Mean	***Variance***	***Pearson correlation***	***df***	**P(T<=t) two-tail**	**t Critical two-tail**
VAS (PRE-INTERVENTION)	4.6	0.317	0.50865	29	3.05621E-17	2.045229642
VAS (POST INTERVENTION)	2.3	0.631				

Table 4.0: Paired t-Test for Pre-Post of WOMAC scale in Experimental Group

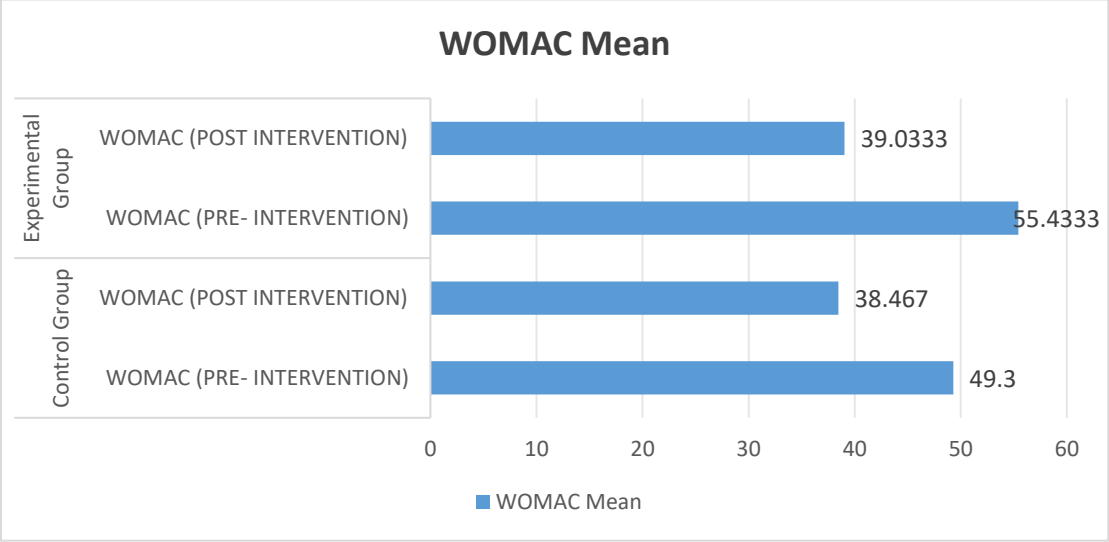
t-Test: Paired Two Sample for Means						
	Mean	***Variance***	***Pearson correlation***	***df***	**P(T<=t) two-tail**	**t Critical two-tail**
WOMAC (PRE-INTERVENTION)	55.4333	143.013	0.79067455	29	1.60053E-12	2.04523
WOMAC (POST INTERVENTION)	39.0333	137.344				

Table 5.0: Comparison of Pre-Post Intervention of VAS and WOMAC scale in Control and Experimental Group:

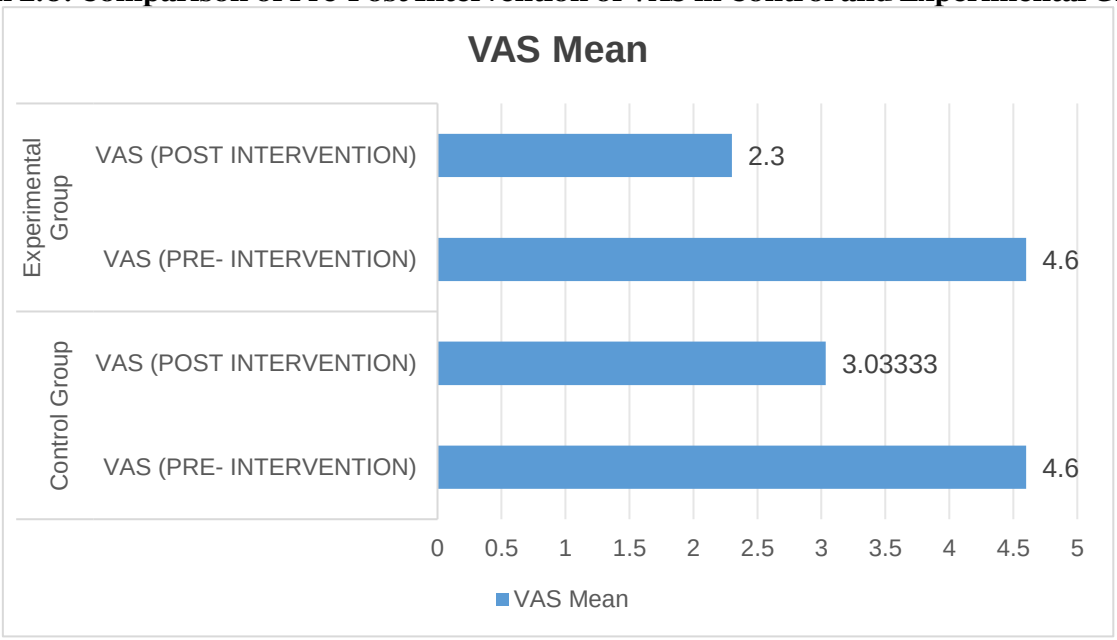
Control Group					**Experimental Group**			
Stats	***VAS (PRE-INTERVENTION)***	***VAS (POST INTERVENTION)***	***WOMAC (PRE-INTERVENTION)***	***WOMAC (POST INTERVENTION)***	***VAS (PRE-INTERVENTION)***	***VAS (POST INTERVENTION)***	***WOMAC (PRE-INTERVENTION)***	***WOMAC (POST INTERVENTION)***
Mean	4.6	3.03333	49.3	38.467	4.6	2.3	55.4333	39.0333

Standard Error	0.091	0.148	1.414	1.498	0.1028	0.1450	2.1834	2.1397
Standard Deviation	0.498	0.809	7.747	8.207	0.5632	0.7944	11.9588	11.7194
Sample Variance	0.248	0.654	60.010	67.361	0.3172	0.6310	143.0126	137.3437

Graph 1.0: Comparison of Pre-Post Intervention of WOMAC in Control and Experimental Group:



Graph 2.0: Comparison of Pre-Post Intervention of VAS in Control and Experimental Group:



DISCUSSION:

The present study explores the effect of hamstring strengthening with conventional occupational therapy program on pain and functionality in individuals with bilateral knee osteoarthritis.

This study was reviewed and approved by the Santosh Occupational Therapy Institutional Ethical Committee. In this study, 60 pre-diagnosed participants were selected from Ratanlal Hospital and Divine Hospital based on inclusion criteria. The subjects were divided into two groups, the control group and the experimental group. The Visual Analogue Scale and The Western Ontario and McMaster Universities (WOMAC) index were administered to participants of both control and experimental group for pre-intervention and post-intervention data collection. After data collection, the pre-intervention and post-intervention data was analysed and interpreted for statistical significance.

In experimental group, the results of VAS scores, which measure pain intensity, the mean score decreased from 4.6 to 3.03 after the intervention, indicating a reduction in pain. The standard deviation and sample variance

provide insight into the variability of these scores. The standard deviation rose from 0.498 to 0.809, suggesting greater variability in pain scores after the intervention. The sample variance also increased from 0.248 to 0.654. Similarly, for the WOMAC scores, which assess pain, stiffness, and physical function, the mean score decreased from 49.3 to 38.467 after the intervention, indicating an improvement in overall function. Post-intervention, standard deviation increased from 7.747 to 8.207, reflecting a slight increase in score variability. The sample variance also rose, from 60.010 before the intervention to 67.361 afterward.

The paired t-test results reinforce these findings, showing a statistically significant reduction in both VAS and WOMAC scores post-intervention. The extremely low p-values (1.39E-12 for VAS and 1.12E-10 for WOMAC) lead to the rejection of the null hypothesis, affirming the intervention effectiveness. The positive Pearson correlation coefficients (0.462 for VAS and 0.711 for WOMAC) indicate that individuals with higher pre-intervention scores tended to have higher post-intervention scores, despite the overall reduction in mean scores, while the intervention effectively reduced pain and improved function, the increased variability in post-intervention scores suggests that the response to the treatment may differ among individuals.

For the control group, the mean VAS score decreased from 4.6 pre-intervention to 3.03 post-intervention, while the mean WOMAC score dropped from 49.3 to 38.47. For the VAS scores, the standard deviation increased from 0.498 to 0.809, suggesting greater variability in pain scores after the intervention. The sample variance also increased from 0.248 to 0.654. The Pearson correlation coefficient between the pre- and post-intervention scores is 0.462, indicating a moderate positive correlation. Similarly, for WOMAC scores, standard deviation also increased from 7.747 to 8.207 after the intervention, indicating a slight increase in the variability of WOMAC scores. The sample variance followed a similar pattern, increasing from 60.010 before the intervention to 67.361 afterward. The Pearson correlation coefficient between the pre- and post-intervention scores is 0.711463, showing a strong positive relationship between the two sets of scores. Overall, both VAS and WOMAC scores show improvement following the intervention, with some increase in the variability of scores as indicated by the standard deviation and variance.

When comparing the control and experimental groups, the experimental group showed a more significant reduction in both VAS and WOMAC scores. For instance, the control group exhibited a decrease in mean VAS scores from 4.6 to 3.03, and WOMAC scores from 49.3 to 38.47. In contrast, the experimental group demonstrated a more pronounced effect, with mean VAS scores reducing from 4.6 to 2.3 and WOMAC scores decreasing from 55.43 to 39.03.

Sadeghi A, Rostami M, Khanlari Z, Zeraatchi A, Jalili N, Karimimoghaddam A, et al in 2023 conducted a study on the effectiveness of muscle strengthening exercises on the clinical outcomes of patients with knee osteoarthritis. This study indicated that a combination of quadriceps and hamstring strengthening exercises was the most effective intervention for reducing pain and morning stiffness in people with OA.[13]

Furthermore, the lower standard deviation and variance in the experimental group suggest a more consistent and reliable reduction in both pain and functional limitations compared to the control group. **Anzari N.** carried out an intervention study on the effectiveness of isometric quadriceps and hamstrings exercise in the treatment of osteoarthritis in 2018. This study found that conducting home-based isometric quadriceps and hamstring exercises on a regular basis can enhance knee joint function and strength in osteoarthritis patients.[14]

Hafez AR, Al-Johani AH, Zakaria AR, Al-Ahaideb A, Buragadda S, Melam GR, Kachanathu SJ conducted a study to assess the effectiveness of ttreatment of knee osteoarthritis in relation to hamstring and quadriceps strength. They found that for individuals with knee OA, strengthening the hamstring muscles in addition to the quadriceps muscles improved range of motion, reduced functional performance limitation, and decreased perceived knee pain.[7]

The results of the paired t-tests clearly show that hamstring strengthening exercises in conjunction with conventional occupational treatment considerably improve outcomes for patients with bilateral knee osteoarthritis.

CONCLUSION:

In conclusion, the findings from the paired t-tests clearly indicate that the combination of hamstring strengthening exercises with conventional occupational therapy significantly enhances outcomes for individuals suffering from bilateral knee osteoarthritis. The result indicated that strengthening the hamstring muscles along with quadriceps and ankle rotators shows more improvement in pain and functionality as compared to the strengthening of only quadriceps and ankle rotators. The statistically significant reductions in both VAS and WOMAC scores in the experimental group, along with the observed improvements in consistency and precision of measurements, underline the importance of this intervention in clinical practice. These results advocate for broader implementation of combined therapeutic strategies to address both pain and functionality in patients with knee osteoarthritis.

LIMITATION OF THE STUDY:

This study did not have a sufficient follow-up period to assess the long-term effects of hamstring strengthening. The occupational background of participants was not considered.

FUTURE RECOMMENDATION:

Future research could be done with objective measures of physical function, such as gait analysis or muscle strength testing, to complement self-reported measures.
Future research could include the assessment of participants in the middle of intervention period and the occupational background could be taken into consideration.

ACKNOWLEDMENT:

I express my gratitude to the following individuals for their assistance and involvement in this project: Dr. P. Mahalingam, Chairman and Vice Chairman of Santosh Medical College, Santosh College of Occupational Therapy, Ghaziabad; Prof. (Dr.) R. K. Sharma, Dean, Paramedical & Principal of occupational therapy college; Dr. Soumita Das, Assistant Professor and the subjects who participated in the study. Thank you also to my parents and God for their blessings. These people provided direction and encouragement, which made the endeavor possible.

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