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Review

Is physical therapy more beneficial than unsupervised home exercise in treatment of post surgical knee disorders? A systematic review

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ABSTRACT

Physical therapy is common following a knee surgery. With rising healthcare costs there is debate as to the appropriateness of outpatient physical therapy following such interventions. Many of the existing controlled trials have concluded that there is no benefit to subjects that receive supervised physical therapy when compared to subjects that perform their exercises at home. The purpose of this systematic review was to consider the existing evidence regarding benefit following knee surgery and evaluate the quality, internal and external validity of such evidence. Ten studies, all randomized control trials, were found to be applicable to our review. Using the PEDro scale all studies were considered at least moderate in quality. Many of the studies had designs that biased the home exercise group, providing supervision similar to that provided by outpatient physical therapy. In select young and healthy population with few co morbidities supervised physical therapy is no more beneficial than a home exercise program following relatively simple knee surgical procedures (arthroscopic meniscetomy). However there is a lack of evidence regarding older populations with co morbidities or for more complicated knee surgical procedures (ACL reconstruction, Total Knee Arthoplasty) prohibiting a conclusion at this time for these populations and/or these procedures.

Contents

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1. Introduction

Surgical procedures targeting the knee are common. Although there are no recent statistics for outpatient anterior cruciate ligament reconstruction surgeries, more than 100,000 were performed in the United States (USA) in 1996 [1]. Total knee arthroplasty is another common surgery. In 2005 alone, 533,808 patients received such surgery in the USA [2]. Meniscal injuries are likely to be the most common type of knee injury that requires surgical intervention. In the USA, surgical procedures for the meniscus are performed on approximately 850,000 patients each year, according to the American Academy of Orthopedic Surgeons research department [3]. Just as common as the surgical interventions are the physical limitations from the surgery and the knee pathology itself. Loss of range of motion, strength, accessory motion, quadriceps atrophy, edema issues, gait, stability, pain, balance and functional limitations are just some of the typical reasons surgeons refer patients for physical therapy following surgical intervention. After knee surgery, supervised physical therapy is usually instituted to promote the patient's successful return to pre morbid status.

It is common for patients to receive supervised physical therapy two to three times a week for weeks or months. The goal of physical therapy after meniscal surgery, anterior cruciate reconstruction and total knee arthroplasty is to address any knee deficiencies and restore function [4]. This is a commitment of time and money by the patient. Co-pays, deductibles and commuting expenses are just some of the upfront costs that patients incur.

Employers and group health insurance companies are increasingly trying to motivate their health insurance subscribers to take measures to control the rising cost of today's health care [5,6]. Cost sharing, high-deductible plans and health savings accounts have increased in popularity to encourage the insured to play an active role in cost containment of their health care [7]. Since health care costs are rising and more patients are their own advocates, physical therapy is being critically observed in terms of needing justification for its effectiveness. Some research has focused on home exercise programs and determined that it may be just as effective and a viable cost-conscious option to supervised physical therapy [8,9].

The many types of knee surgeries, ages of patients receiving surgery, co morbidities of patients, types of physical therapy received, and measurements to show improvements are all variables in determining if supervised physical therapy is more beneficial then a home exercise treatment. Much of the research to date has concluded, with very specific populations and surgeries, there are no appreciable differences between clinic rehabilitation and unsupervised home exercise programs after meniscetomy, anterior cruciate ligament repair or total knee arthroplasty [8–15]. There has been little critical inquiry or a systematic review of this research. The goal of this systematic review is to address this issue by reviewing the research on recovery following knee surgery, comparing supervised physical therapy to an unsupervised home exercise program. The review focuses on this topic for physical therapists who seek to secure their place in health care while on the opposite side of the spectrum, cost-containment gatekeepers push to cut expenses throughout the health care system.

2. Methods

2.1. Search and study selection

An extensive literature search was performed online using Medline (1966–present), Embase (1988–present), CINAHL (1982–present), Cochrane Controlled Trials Register (to December 2007), and the Physical Therapy Evidence Database (PEDro) (to December 2007). The search included key words such as “home exercise program,” “unsupervised physical therapy,” “post surgical knee,” “physical therapy.” Reference lists from identified studies were also searched by hand. The last search was performed Dec. 4, 2007.

The titles were reviewed to identify applicable studies. Abstracts were retrieved for applicable studies and those with titles for which no definitive decision could be made. Abstracts of studies retrieved using these methods were then screened by two reviewers (SC, SMC) for the eligibility criteria. When inclusion/exclusion statuses were not clear from the title and abstract, the full-text version was obtained for review.

2.2. Selection criteria

Inclusion criteria:

- Trials that compare supervised physical therapy with an unsupervised home exercise program.
- English language publications from 1980 to the present.
- Randomized control trials.
- Trials that featured patients who were status post-knee surgery, including total knee arthroplasty, meniscetomy or anterior cruciate ligament reconstruction.

Exclusion criteria:

- Trials in which the subject received additional interventions beyond a home exercise program or supervised physical therapy (i.e., acupuncture).
- Trials in which the supervised physical therapy was provided as a class-based intervention.

Any differences in opinion regarding inclusion or exclusion by the initial two reviewers would have been resolved utilizing a third reviewer; however, this did not occur.

2.3. Quality assessment

To assess the overall quality of the randomized controlled trials, we used the Physiotherapy Evidence Database (PEDro) scale. This scale is commonly used in physical therapy-based systematic reviews and has been determined to have fair to good reliability [16]. The PEDro scale includes 11 questions and is based on a scale of 0 to 10. The first question is used to determine external validity and was not graded on the scale. Articles included were independently assessed by the two reviewers (SC, SMC). Any differences in opinion regarding the quality of the studies would have been resolved utilizing a third reviewer; however, this did not occur.

2.4. Data extraction

The following was extracted from each study: the patient population used (including age, gender, sample size); study characteristics (PEDro scale item scores, total PEDro score, context of the study, dropouts, surgical intervention utilized, time of follow-up); distinction between a home exercise program as defined by instruction in exercise without follow-up instructions versus a home exercise program with follow-up by a physical therapist (either in the clinic or by phone), and outcome measures with associated results (range of motion, strength, atrophy and function). Two reviewers extracted data from each study. If there had been a disagreement between the reviewers (SC, SMC), a third reviewer would have been asked to resolve the differences. However, this did not occur.

2.5. Data analysis

Comparisons of the methodological quality between individual studies were based on the PEDro total score. While all studies were included in the results of this systematic review, PEDro scores were utilized to assess relative strengths and weaknesses juxtaposed to study findings.

Results were analyzed to determine if supervised physical therapy is more effective than an unsupervised home exercise program using a

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Table 1
Quality scores of studies in systematic review

Study	Scores on PEDro scale											Total score
	1	2	3	4	5	6	7	8	9	10	11	
Fischer et al. [10]	Y	Y	N	N	N	N	N	Y	N	Y	Y	4/10
Forster and Frost [11]	Y	Y	Y	Y	N	N	N	Y	N	Y	Y	6/10
Goodwin et al. [12]	Y	Y	N	Y	N	N	Y	N	Y	Y	Y	6/10
Grant et al. [13]	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	7/10
Jokl et al. [14]	Y	Y	N	Y	N	N	N	Y	N	Y	Y	5/10
Kramer et al. [15]	N	Y	N	Y	N	N	Y	N	Y	Y	Y	6/10
Moffet et al. [19]	Y	Y	N	Y	N	N	Y	Y	N	Y	Y	6/10
Rajan et al. [8]	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y	7/10
Schenck et al. [9]	Y	Y	N	N	N	N	Y	Y	N	N	Y	4/10
Vervest et al. [20]	N	Y	N	N	N	N	Y	N	N	Y	Y	4/10

Y — indicates the criterion was clearly satisfied; N — indicates that it was not.
1 — eligibility criteria were specified 2 — subjects were randomly allocated to groups.
3 — allocation was concealed 4 — groups were similar at baseline.
5 — subjects were blinded 6 — therapists who administered the treatment were blinded.
7 — assessors were blinded 8 — measures of key outcomes were obtained from more than 85% of subjects.
9 — data analyzed by intention to treat 10 — statistical comparisons between groups were conducted.
11 — point measures and measures of variability were provided.
The total score is determined by counting the number of criteria that are satisfied, except that scale item 1 is not used to generate the total score, so total scores are out of 10.

rating system with levels of evidence for each extracted outcome [17]. These levels are:

- Strong evidence: consistent findings among multiple high quality RCTs;
- Moderate evidence: consistent findings among multiple low quality RCTs and/or one high quality RCT;
- Limited evidence: one low quality RCT; Conflicting evidence: inconsistent findings among multiple trials;
- No evidence from trials.

For the purpose of this review, consistency was defined as similar results between trials for a particular outcome (i.e., the results of several studies may be consistent for ROM while not being consistent for strength).

A randomized controlled trial using the PEDro scale is considered to be high quality if its total score is 6/10 or better [18]. In this review, since blinding the patient and/or treating therapist would have been unlikely, the cutoff for a high quality trial was 5/10 or better; 4/10 was established as moderate quality and 3/10 or below as low quality.

3. Results

3.1. Selection of studies

Two hundred thirty-five titles were retrieved from searching the selected databases using the identified key words. After reviewing these titles, 39 abstracts were retrieved

Table 2
Selected study characteristics

Study	Sample	Study characteristics	ROM	Outcome measures		
				Strength	Atrophy	Function
Pure home exercise program						
Forster and Frost [11]	86 male subjects; 16 to 45 years old; 1 lost to follow-up	Open medial meniscectomy; both groups received inpatient PT; PT was 3×week/4 weeks; final follow-up 26 weeks	N.S. Diff	Ø	N.S. Diff	N.S. Diff in crouching, gait, running downstairs or time lost from work
Goodwin et al. [12]	100 subjects (86 males); 18 to 60 years old; 14 lost to follow-up	Arthroscopic partial meniscectomy; PT was 3× week/6 weeks; final follow-up 50 days	N.S. Diff	Ø	N.S. Diff	N.S. Diff gait, stairs, jumping
Jokl et al. [14]	30 subjects (23 males); 17 to 63 years old; no mention of loss to follow-up	Arthroscopic partial meniscectomy; PT 3×week for an average of 4.5 weeks; final follow-up 8 weeks,	N.S. Diff	N.S. Diff	Ø	N.S. Diff in gait, return to work, ADL's, or sports
Moffet et al. [19]	35 male subjects; mean (SD) of 40 (±8) years old; 4 lost to follow-up	Arthroscopic partial medial meniscetomy; PT 3×week/3 weeks; final follow-up of all outcome variables 23 days	N.S. Diff	PT group greater strength	N.S. Diff	N.S. Diff in Lysholm or Gillquist questionnaires
Rajan et al. [8]	120 subjects (43 males); 55 to 90 years old; 4 lost to follow-up	Total knee arthroplasty; both groups received inpatient PT; PT provided a mean 4 to 6 visits; final follow-up 1 year	N.S. Diff	Ø	Ø	Ø
Vervest et al. [20]	20 subjects (14 males); mean (SD) of 33.5 (±6) years old; no mention of loss to follow-up	Arthroscopic partial meniscetomy; PT was 3×week/3 weeks; final follow-up 28 days	Ø	Ø	Ø	PT group greater scores for Tegner, Lysholm, SARS, hop test, jumps; N.S. Diff in FORS
Non-pure home exercise program						
Fischer et al. [10]	54 subjects (29 males); 15 to 44 years old; 1 lost to follow-up	ACL reconstruction; nHEP averaged 5 PT visits, supervised PT averaged 19.9 visits; final follow-up 6 months	N.S. Diff	Ø	N.S. Diff	N.S. Diff in Anterior Draw, Lysholm scores, subjective health status
Grant et al. [13]	145 subjects (85 males); 16 to 59 years old; 16 lost to follow-up	ACL reconstruction; nHEP received 4 PT sessions, supervised PT was 17 visits; final follow-up 12 weeks	Greater % of nHEP subjects with acceptable ROM	N.S. Diff	Ø	N.S. Diff in ROM during walking
Kramer et al. [15]	160 subjects (69 males); mean (SD) 68 (±8`) years old; 26 lost to follow-up	Total knee arthroplasty; both groups received inpatient PT; nHEP PT via phone as needed, PT up 2×week/10 weeks; final follow-up 1 year	N.S. Diff	Ø	Ø	N.S. Diff Functional scale of WOMAC; 6 minute walk; stairs
Schenck et al. [9]	37 subjects (28 male) 18 to 32 years old; no mention of loss to follow-up	ACL reconstruction; nHEP PT based on function at physician visits (averaged 2.85 visits), supervised PT averaged 14.2 visits; final follow-up 1 year	N.S. Diff	Ø	Ø	N.S. Diff Lysholm, Hop test

N.S. Diff = no statistically significant difference between the groups at the final follow-up assessment.
Ø = Not measured.

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for review. We then retrieved 14 full-text papers and agreed upon seven that met the criteria for this systematic review [8–10,12–15].

Reference lists of these 14 full-text papers were reviewed to identify additional relevant articles. Eight additional papers were retrieved, and three chosen for inclusion [11,19,20].

3.2. Methodological quality

Table 1 presents the results of the individual item and total PEDro scores. The total scores range from 4/10 to 7/10, with a mode of 6/10. Based on these scores, seven out of 10 trials are considered high quality for this review; and three trials out of 10 are considered moderate quality. The inclusion criteria for this systematic review required that all studies be a randomized controlled trial, so all 10 trials were assessed as a "yes" for Item 2 on the PEDro scale. Also, as expected, none of the trials blinded the subjects or treating therapists to the intervention being provided.

3.2.1. Study characteristics

Table 2 presents extracted data for all included trials. Five trials included subjects following meniscetomy; three following anterior cruciate ligament (ACL) reconstruction; and two following total knee arthroplasty (TKA). Sample sizes ranged from 20 to 160 subjects, and in all studies, they were predominantly male with one exception [8]. Meniscectomy and ACL reconstruction studies included subjects in the 15 to 63 age range; and the TKA studies included subjects 55 and older.

Data in Table 2 is organized based on the major stratification of pure home exercise programs (referred to in table as pure HEP) and non-pure home exercise programs (referred to as non-pure HEP). In pure studies, the home exercise subjects had no supervised physical therapy intervention except to initially implement the home exercise program. The six pure studies were conducted on patients following either a meniscetomy ($n=5$) or a total knee arthroplasty ($n=1$). It should be mentioned that two of the pure studies provided inpatient physical therapy to all patients [8,11]. Of the pure studies, five out of six were considered high quality studies, and one study was considered moderate quality.

In the non-pure HEP studies, the home exercise group received some type of supervised PT intervention. The four non-pure trials were conducted on patients following either an ACL reconstruction ($n=3$) or a TKA ($n=1$). In two studies, there were four to five visits provided for instruction and progression [10,13]. One study provided supervised physical therapy to the home exercise group as needed during routine follow-up physician appointments for an average of 2.85 visits [9]. Kramer et al. provided home exercise program subjects with physical therapy advice over the phone on an as-needed basis [15]. Of the four non-pure studies, two were considered high quality and two were considered moderate quality.

3.3. Outcome measures

Each outcome measure is assessed for the pure and non-pure trials as described in the methods utilizing the rating system by Van Tulder et al. [17]. The level of evidence is determined for the following hypothesis: Supervised physical therapy is more beneficial following knee surgery than a home exercise program.

3.3.1. ROM

3.3.1.1. Pure HEP: Strong evidence against hypothesis. Five of five high quality studies consistently showed there was no significant difference in the knee's range of motion between supervised physical therapy and the home exercise group.

3.3.1.2. Non-pure HEP: Strong evidence against hypothesis. Three of four trials (one high quality, two moderate quality) showed no significant difference in the knee's range of motion between supervised physical therapy and the home exercise group. One trial [13] showed that the home exercise subjects were more likely to achieve acceptable knee ROM.

3.3.2. Strength

3.3.2.1. Pure HEP: Limited evidence — conflicting. Two of the high quality studies analyzed strength and the results are inconsistent. Follow-up by Moffet et al. [19] was early in the rehabilitation process at 23 days and showed greater knee strength compared to Jokl et al. [14], who showed no difference in knee strength at eight weeks.

3.3.2.2. Non-pure HEP: Moderate evidence against hypothesis. One high quality trial showed no significant difference in knee strength between supervised physical therapy and the home exercise group.

3.3.3. Atrophy

3.3.3.1. Pure HEP: Strong evidence against hypothesis. Three of the high quality studies showed no significant difference in atrophy between the home exercise or supervised physical therapy groups.

3.3.3.2. Non-pure HEP: Limited evidence against hypothesis. One moderate quality study showed no significant difference in atrophy between the home exercise or supervised physical therapy groups.

3.3.4. Function

3.3.4.1. Pure HEP: Limited evidence — conflicting. Four high quality trials showed no significant difference in any of the objective functional measures between the home exercise or supervised physical therapy groups.

Vervest et al. [20] supported the hypothesis for Tegner, Lysholm, Sports Activity Rating (SARS) scales, the hop test and distance jumped; but no significant difference for the Factor Occupational Rating Scale (FORS).

3.3.4.2. Non-pure HEP: Strong evidence against hypothesis. Two high quality and two moderate quality trials showed no significant difference in any of the objective functional measures between the home exercise or supervised physical therapy groups.

4. Discussion

The main finding of this review is that the location in which a healthy individual undergoing an uncomplicated arthroscopic meniscetomy does exercises (home or at a physical therapy office) may not matter. However, there is no evidence available regarding the benefit of supervised physical therapy following other knee surgeries, with co morbidities or older subjects. The evidence summarized by this systematic review must be carefully considered when being combined and utilized for generalizing conclusions. While all trials scored moderate to high quality using the PEDro scale, and therefore are individually likely to be internally valid, there is a need to consider the ability to combine these studies in this review (internal validity of this systematic review) and to assess the external generalization of conclusions. Most notably, attempting to combine evidence from the pure and non-pure HEP trials would threaten the internal validity of this systematic review. The pure HEP trials are appropriately combined and together present strong evidence against the hypothesis that supervised physical therapy is more beneficial than a home exercise program following arthroscopic meniscetomy for relatively young, healthy subjects when benefit is restricted in definition to ROM and atrophy. There is a lack of conclusive evidence for making generalizations for other knee surgeries since this involves combining the results of the non-pure HEP trials, or when trials included inpatient physical therapy. This discussion will address how: 1. the operational definition of "beneficial" physical therapy following knee surgery; 2. presence of non-pure HEPs; and 3. inpatient physical therapy; influence the interpretation and generalization of this systematic review and provide suggestions for further study.

Assessments of whether physical therapy is "beneficial" for patients following knee surgery can be interpreted in several ways. This review focused on outcomes assessed by randomized controlled trials that included methods and included strength, range of motion, atrophy and objective functional measurements. Each of these measures alone does a poor job of effectively classifying the benefit in an all-encompassing manner. It should be noted that only one study included all the measured outcomes of ROM, strength, atrophy and function [19]. Scales such as the Lysholm are an attempt to provide a single metric of function, which could arguably approach a measure of benefit. Four studies utilized this scale and they had different methodological approaches [9,10,19,20]. Only two of these studies utilized a pure HEP experimental group following post-arthroscopic meniscetomy [19,20]. These studies demonstrated mixed results — one favored supervised physical therapy [20] and one showed no difference [19]. Therefore, there is conflicting evidence regarding the hypothesis that supervised physical therapy is beneficial as measured by function following arthroscopic meniscetomy.

There is a limitation to drawing conclusions regarding benefit, or lack thereof, based on singular outcome measures and there is no particular agreement on what defines the term "beneficial." For example, based on ROM only, it is a bold conclusion made by the title of Rajan et al. stating, "No Need for Outpatient Physiotherapy Following Total Knee Arthroplasty: A Randomized Trial of 120 Patients." Due to this limitation, this review has focused on the clinically observed and singular outcomes as reported in the included trials, but accepts that any conclusions based on these singular outcomes (i.e., ROM) do not necessarily equate to an overall estimation of benefit.

Of the 10 included trials, four utilized a non-pure HEP group. The comparisons in these four trials were not really about the "supervision."

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Since both home and supervised physical therapy groups received some type of supervision, the focus was really on whether the exercises were done in the home or in an outpatient physical therapy setting. Therefore, these trials cannot be considered as good evidence. Including these studies in the final conclusion of this systematic review threatens its internal validity.

Interestingly, despite the stated goals of the non-pure HEP trials to assess the need for supervised physical therapy, the design of these trials demonstrates the inability of clinical researchers to break away from the paradigm that a physical therapist be involved in recovery following knee surgery. Even in the home exercise groups, a physical therapist was involved in the implementation and facilitation of the home exercise program by either visits to the physical therapist or via phone call. It is not surprising that these four trials were conducted on subjects following more complicated cases such as total knee replacements and anterior cruciate ligament surgeries as opposed to simple arthroscopic meniscetomy procedures.

Of six trials that provided a pure HEP, two had their participants receive inpatient physical therapy [8,11]. Subjects were instructed in their home exercises over several sessions while in the hospital. Therefore, the subjects received supervised instruction from a physical therapist and including these studies threatens the internal validity of this systematic review to truthfully answer the question if supervised physical therapy is more beneficial than a home exercise program.

After excluding non-pure HEP studies and those including inpatient physical therapy, there are four pure HEP studies remaining [12,14,19,20]. These were all conducted following arthroscopic meniscectomy and were at least moderate quality. Two studies support the hypothesis that supervised physical therapy was better than a home exercise program [19,20]. Although Moffet et al. [19] showed no significant difference in ROM, atrophy, Lysholm or Gillquist questionnaire; it showed that participants had better knee strength. Vervest only measured function and showed the supervised physical therapy group scored significantly better in Lysholm, Tegner, SARS, hop test and distance jumped (not FORS) [20].

When limiting our conclusions to these four pure studies, two of them are mixed in their results and two (50%) provide support against the hypothesis [12,14]. From this perspective — there continues to be strong evidence against the hypothesis specific to ROM and atrophy outcomes; there is limited evidence for strength and function.

There is perhaps evidence to suggest that independent home exercise is as beneficial following knee surgery as supervised physical therapy, most clearly for atrophy and ROM; possibly for strength and function. If true, such conclusions can only be generalized to otherwise healthy (no previous knee surgery, absence of medical conditions, etc.) subjects recovering from uncomplicated, arthroscopic meniscetomy surgeries and between the ages of 17 and 63 years old.

An issue that was not systematically (or quantitatively) addressed in any of the reviewed studies was compliance in the home exercise group. Compliance was not measured at all in 7 out of 10 studies [8,11–14,19,20]. Of those that included compliance, Fischer et al. [10] reported collecting compliance data and not excluding anyone due to a lack of compliance (without a definition); Kramer et al. [15] tested compliance with a log and all subjects had high compliance (defined as >90%); and Schenck et al.[9] reported that compliance remained high at a one year follow-up visit (without a particular definition). Based on the question being asked (is there a difference in outcome between exercise performed during supervised physical therapy and unsupervised home programs), a lack of compliance in the home exercise group would bias studies toward the alternate hypothesis (a greater difference in outcomes between the groups). Therefore, a lack of systematic study on compliance in these studies would not change the primary conclusion of this systematic review. We do feel that a study on compliance and outcomes in the post surgical knee population would be helpful to better elucidate potential predictors of compliance and the impact of compliance to unsupervised home exercise on outcomes.

Limitations of this systematic review were primarily two fold. First, we utilized trials that were published in English. Second, we did not seek out studies that were not published. Certainly in both cases we may have had different data to extrapolate and analyze thus potentially changing the ultimate outcome.

5. Conclusion

The physical location that a healthy individual undergoing an uncomplicated arthroscopic meniscetomy exercises (home or at a physical therapy office) may ultimately not matter. However, there is no evidence regarding the benefit of supervised physical therapy following other knee surgeries, with co morbidities or older subjects. For more conclusive evidence on post-meniscetomy, further studies would need to be done with large sample sizes and a greater range of outcome assessments. For further evidence following TKA and/or ACL reconstruction, studies need to either investigate pure HEP or more clearly delineate the role of the physical therapist in providing physical therapy (including supervision) via alternative practice models and then temper the conclusions in light of their methods.

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