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Comparing the effectiveness of prolotherapy and percutaneous dry needling in the treatment of lateral epicondylitis: a retrospective cohort study

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Abstract. – OBJECTIVE: Lateral epicondylitis (LE) can result in a functional loss in patients because of pain and has recently become more prevalent. This study compared the effects of minimally invasive prolotherapy (PRO) and percutaneous dry needling (PDN) on LE treatment.

PATIENTS AND METHODS: Patients were divided into three groups; Group 1 included patients undergoing PDN, Group 2 included those undergoing PRO, and Group 3 included those undergoing PDN+PRO. All these treatments were administered three times and at a 3-week interval in each patient. Data on the visual analog scale (VAS) and patient-rated tennis elbow evaluation (PRTEE) scale scores of the patients were collected at weeks 0, 3, and 6 and month 6 and retrospectively analyzed.

RESULTS: The VAS and PRTEE scores decreased in all groups. The decrease in Group 3 was higher than that in the other groups ($p<0.001$). Upon evaluating within-group differences in VAS and PRTEE scores, the scores at week 3, week 6, and month 6 gradually decreased compared with the baseline in all groups ($p<0.001$).

CONCLUSIONS: PDN and PRO are minimally invasive and can successfully treat LE. A combination of PDN+PRO provides better results than PDN or PRO alone. As the materials we used in these treatments are relatively inexpensive and readily available, we believe our study will help reduce the national healthcare costs allocated for the treatment of LE.

Key Words:
Prolotherapy, Percutaneous dry needling, Lateral epicondylitis, Tennis elbow.

Introduction

Lateral epicondylitis (LE) is often referred to as tennis elbow as it is commonly observed in tennis players. In primary care, the annual incidence of LE is 1-2%[21,27]. Workers and athletes who conduct repeated and weight-bearing upper extremity tasks are the most affected[8]. LE may result in substantial pain as well as functional difficulties. Although LE is highly prevalent, there is currently no standard treatment. The loss of labor due to LE imposes a significant socioeconomic burden, and some patients may be unable to work for weeks[12]. LE most frequently occurs in adults aged 40-50 years, and both men and women are affected equally[6]. Although the etiology of LE has not been fully established, it is frequently linked to repetitive microtrauma in the supine position of the forearm because of excessive gripping or wrist extension[7,13]. In LE, the most afflicted muscle is the extensor carpi radialis brevis (ECRB)[24]. Along with the mechanical forces that occur during elbow and wrist movement, repetitive movements also put the tendon surface in danger of abrasion, because the undersurface of the ECRB is in contact with the lateral edge of the capitellum during elbow extension and flexion[29]. For pain management in LE, conservative treatment is initially recommended, and this strategy is considered to be effective in most cases[5]. Injection therapies can be used if patients continue to experience pain or functional impairments despite conservative treatment[16]. Prolotherapy (PRO), which was first utilized by Dr. George Hackett[9], has been used to treat various chronic musculoskeletal conditions for many years[14]. In recent years, the use of PRO injections has rapidly gained significant popularity[17]. The exact mechanism underlying the action of PRO is unknown. The injected proliferant causes a local inflammatory cascade by triggering the release

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of growth factors at the injection site. Tissue repair is hypothesized[19] to activate the natural tissue repair process by stimulating the inflammation, proliferation, and remodeling cascade as a result of this process. PRO is particularly used for painful musculoskeletal injuries thought to be caused by tissue degeneration and ligament weakening. This method requires regenerative injections of hypertonic dextrose solutions into the soft tissue and joint cavities to ensure functional improvement. Dextrose is the most commonly used proliferant in PRO and is highly safe owing to its compatibility with human biochemistry. Therefore, dextrose can be safely used on various joints and tissues. Accessibility and affordability of PRO are further variables that influence its popularity[10]. The term dry needling is used to emphasize that percutaneous dry needling (PDN) does not include the injection of any substance. It is a relatively recent therapeutic strategy used by orthopedic and physical therapy physicians[11]. Traditionally, encouraging localized bleeding with tendon PDN can reverse the chronic degenerative process. This increases fibroblast proliferation, aiding in the regeneration of the degenerated tendon by triggering biological repair[4].

Although there are many methods in the treatment of lateral epicondylitis, no treatment has been almost 100% successful; therefore, there is still a need for new methods or combined treatments in this regard. This study aimed to compare the effects of PDN, PRO, and a combination of both on pain and functional outcomes in LE treatment.

Patients and Methods

Ethical approval was obtained from the Ethics Committee of Turgut Ozal University Malatya Training and Research Hospital (Approval number: 2022/17). The data of 80 patients diagnosed with LE who visited Training and Research Hospital Orthopedics Outpatient Clinics between 2019 and 2021 and underwent minimally invasive intervention were retrospectively evaluated. Informed consent was obtained from the patients for the procedure to be performed before the injection. Patients with lateral elbow pain, difficulty in wrist resistance extension, and a decrease in handgrip strength who met the Southampton criteria[28] were included in the study. Informed consent had been obtained from the patients before the procedures. The handgrip strength of the patients was evaluated by Jamar hand dynamometer. To rule out potential cartilage pathologies, such as radiohumeral joint arthritis and osteonecrosis, each patient underwent direct X-ray imaging of the elbow. Patients were evaluated according to the inclusion and exclusion criteria (Table I), and 61 patients were included in the study. Within the scope of these inclusion criteria, the focus was on patients who had chronic pain and continued pain despite the use of non-steroidal anti-inflammatory drugs for a while. The patients were divided into three groups: Group 1 received PDN, Group 2 received PRO, and Group 3 received both PDN+-PRO. In PDN, to ensure standardization, patients received needling at the attachment site of the common extensor tendons to the lateral epicondyle of the humerus five times using a 22-gauge needle. In PRO, patients received a percutaneous injection of 5 ml of 5% dextrose with a 22-gauge needle at the attachment site of the common extensor tendons to the lateral epicondyle of the humerus. In the combined administration of PDN + PRO, patients first received five repeated needling at the attachment site of the common extensor tendons to the lateral epicondyle of the humerus using a 22-gauge needle in each treatment, following which 5 ml of 5% dextrose was injected at the same site. The patients were informed that, after therapy, they might experience a temporary

Table I. Comparison of general data of patients in PMMA and RTP groups.

Inclusion Criteria	Exclusion Criteria
1. Between the ages of 18 and 65 years 2. Pain lasting between 6 months and a year 3. Pain in the lateral epicondyle during forced (resisted) wrist extension. 4. Decrease in handgrip strength 5. Tenderness to palpation along the common extensor origin 6. Those whose pain persists despite using NSAID for 3-6 weeks	1. Any injections within 1 year prior to the intervention 2. The presence of active infection 3. Systemic disorders (rheumatoid arthritis, diabetes, immunodeficiency, and coagulopathy) 4. Acute and severe elbow trauma 5. Pregnancy and pregnancy suspicion 6. Any elbow surgery in the past 7. The presence of cervical radiculopathy 8. Patients with posterior interosseous nerve compression

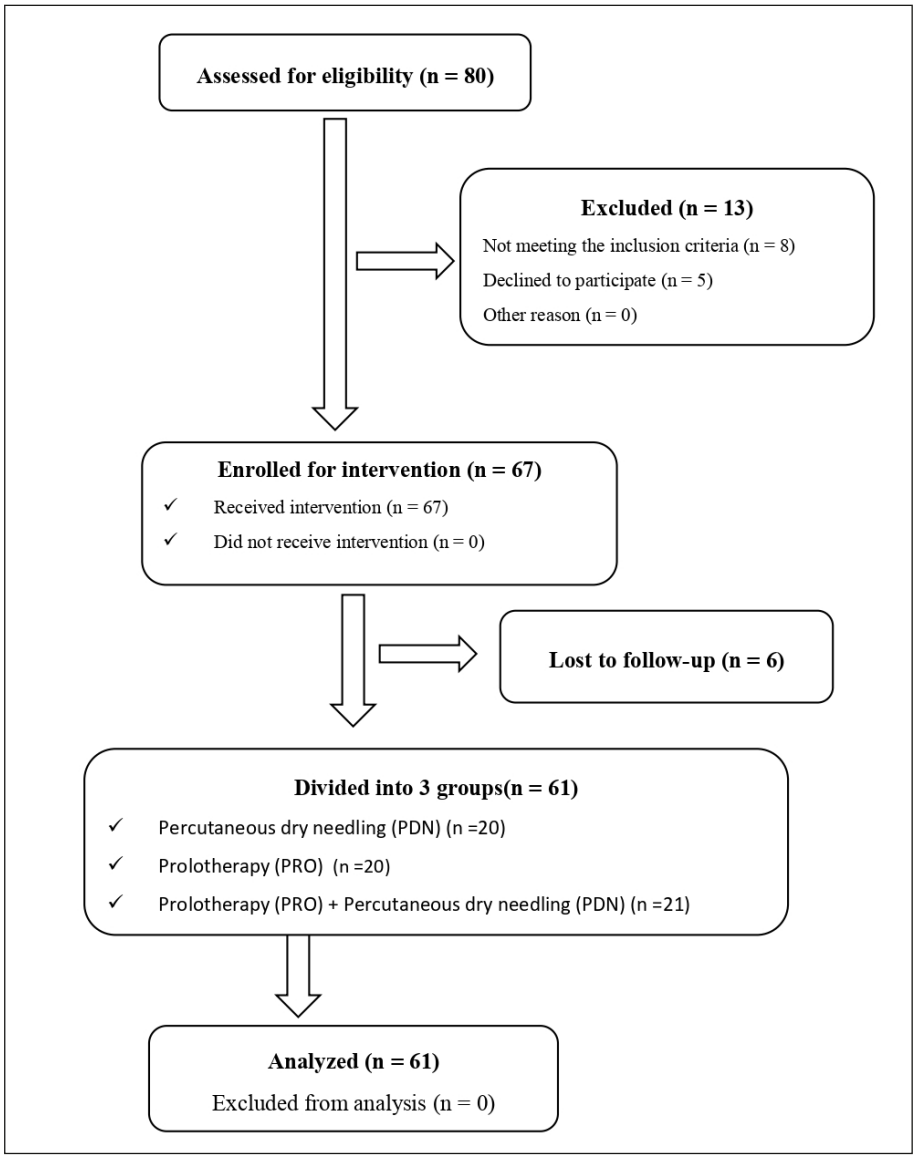

Figure 1. Study flow diagram.

increase in pain for a few days. It was advised to avoid taking anti-inflammatory medicines during the treatment period as these medicines could potentially lessen the effect of the injections. Cold therapy was recommended to patients on the first day of injection. No functional restriction was made after treatment. All patients were treated three times at an interval of 3 weeks. The patients were evaluated at 0, 3, and 6 weeks and 6 months after treatment using the visual analog scale (VAS) and patient-rated tennis elbow evaluation (PRTEE) scale scores. PRTEE is a specific questionnaire for the assessment of LE. The total score for this assessment is the sum of the pain and function scores. The maximum total score for this assessment is 100. Power Analysis and Sample Size were used to determine the sample size. A total of 20 patients per group would provide 90% statistical power and a 5% significance level (effect size d=1.05) according to the algometer scores. These data were analyzed retrospectively.

Interventions

The patient was positioned supine on the examination stretcher, with the hand in a supine position and the elbow in a 90° flexion position. From the center to the periphery, the administration areas of the patients in each group were disinfected with povidone-iodine (Platex® İhlas Chemical Medical Solutions, Adana, Turkey). Palpation

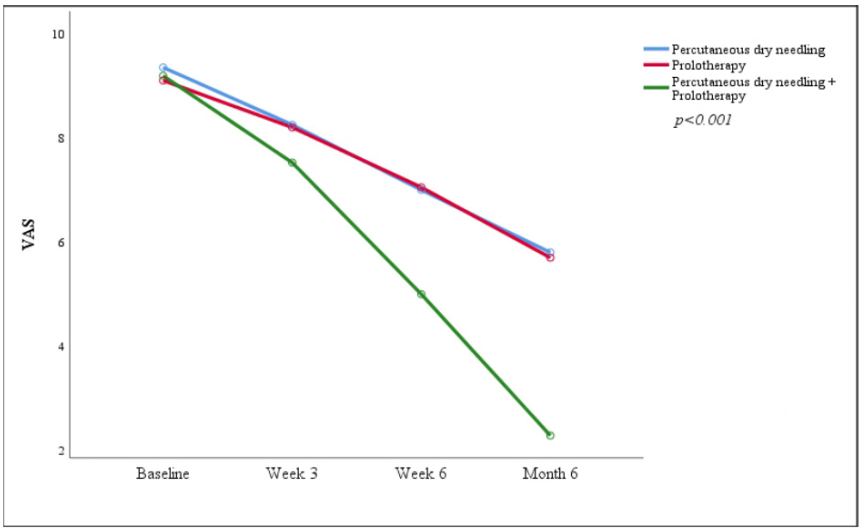

Figure 2. VAS scores by groups over time.

was performed to locate the most painful site on the humerus lateral epicondyle. Group 1 received PDN. For standardization, five injections were made each time. Group 2 received PRO with 5 ml of 5% dextrose (Medifleks® Kocak Farma Pharmaceuticals and Chemical Industry Inc., Istanbul, Turkey). Group 3 received five repeated PDNs, followed by 5 ml of 5% dextrose PRO. All treatments in the three groups were administered using 22-gauge needles. It took approximately 5 minutes from the time the patient was prepared to the time the administration was completed. After the administration, passive elbow flexion and extension exercises were performed. After treatment, the patients were placed in the supine position on a stretcher and monitored for 10 minutes for any early complications and hypotension. No side effects or complications occurred in the patients during the injection.

All patients were treated by the same surgeon. Patients were followed up by a physician who was not involved in the administration process. At 0, 3, and 6 weeks and 6 months after the administration, all patients were assessed using the VAS

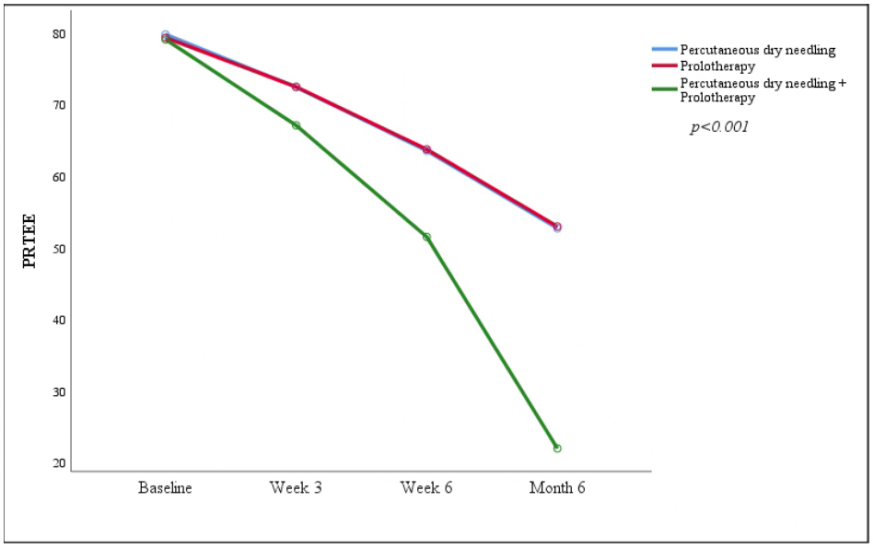

Figure 3. PRTEE scores by groups over time.

Table II. Demographic characteristics of the groups.

Group	n	%	p^1
Percutaneous dry needling (PDN)	20	(32.79)	
Prolotherapy (PRO)	20	(32.79)	
PDN+PRO	21	(34.43)	
Sex			
Male	30	(49.18)	**0.736**
Female	31	(50.82)	
Direction			
Right	38	(62.30)	**0.217**
Left	23	(37.70)	
*Age (years)	45.95±8.79	46.00	**0.986**[2]

[1]Chi-Square Test, [2]Kruskal-Wallis test, *n is replaced by mean±standard deviation, % is replaced by median.

and PRTEE scales. Patients' demographic characteristics, complications, and side effects during therapy were documented.

Statistical Analysis

SPSS software version 17.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Histograms and the Kolmogorov-Smirnov test were used to assess the variables' fit for a normal distribution. Mean, standard deviation and median values were used to present the descriptive analyses. Categorical variables were compared with Pearson's Chi-square test. In cases where the data did not have a normal distribution, the Mann-Whitney U test was used to compare two groups, and the Kruskal-Wallis test was used to compare more than two groups. Within-group and between-group differences in the measured values were evaluated using Friedman's test and a repeated measures analysis, respectively. The Spearman's correlation test was used to compare the measurable data. A p-value <0.05 was considered statistically significant.

Results

Of the 80 participants at the beginning of the study, 61 were retrospectively evaluated as per the inclusion and exclusion criteria and loss in follow-up (Figure 1). Of the 61 patients included, 20 received only PDN, 20 patients received only PRO, and 21 patients received both PDN and PRO. No post-treatment complications occurred in any patient. Among the patients, 30 were males and 31 were females, with a mean age of 45.95±8.79 years, 38 were right-affected and 23 were left-affected. Gender, age, and injection sides were compared between the groups, and no significant difference was found between the groups. (Table II).

The baseline, week 3, week 6, and month 6 outcomes of the VAS and PRTEE scale were compared among Groups 1, 2 and 3. Between-group and within-group differences in the VAS and PRTEE scale outcomes were compared.

Regarding the between-group comparisons, the VAS and PRTEE scores in Group 3 were lower than those in Groups 1 and 2, especially in weeks 3, week 6, and month 6 (Figures 2 and 3) (p<0.001). Further, the scores of both scales at week 3, week 6, and month 6 decreased in all three groups compared with the baseline, with Group 3 receiving PDN + PRO demonstrating the greatest decline.

Regarding the within-group comparisons, the VAS and PRTEE scores in all three groups gradually decreased compared with the baseline at week 3, week 6, and month 6 (Table III) (p<0.001).

Discussion

In this study, we administered PDN, PRO, and PDN+PRO to patients with LE who did not respond to traditional conservative therapies. Elbow pain and functional impairment improved significantly in comparison to that before the treatment. Furthermore, percutaneous administrations were shown to be reliable in terms of side effects and complications. The main reasons for the popularity of these methods are that they are minimally invasive, quick to administer, ac-

Table III. Comparison between baseline and post-treatment values of the groups.

	PDN			PRO			PDN + PRO				
	Mean + SD		Median	Mean + SD		Median	Mean+SD		Median	p^1	p^2
VAS Baseline	9.35	±.59	9.00	9.10	±.72	9.00	9.19	±.75	9.00	0.555	**<0.001**
VAS Week 3	8.25	±.64	8.00	8.20	±.62	8.00	7.52	±.87	7.00	**0.006**	
VAS Week 6	7.00	±.56	7.00	7.05	±.69	7.00	5.00	±.77	5.00	**<0.001**	
VAS Month 6	5.80	±.77	6.00	5.70	±.92	6.00	2.29	±1.27	2.00	**<0.001**	
p^3		**<0.001**			**<0.001**			**<0.001**			
PRTEE Baseline	79.85	±4.77	81.25	79.40	±5.24	80.00	79.14	±3.73	79.00	0.655	**<0.001**
PRTEE Week 3	72.48	±4.23	72.50	72.53	±5.19	72.25	67.14	±4.65	67.00	**0.001**	
PRTEE Week 6	63.60	±5.00	63.75	63.80	±5.29	65.00	51.57	±5.98	50.50	**<0.001**	
PRTEE Month 6	52.78	±3.34	52.50	53.03	±4.87	51.50	22.02	±7.43	20.00	**<0.001**	
p^3		**<0.001**			**<0.001**			**<0.001**			

[1]Kruskal-Wallis test; [2]Analysis of repeated measures; [3]Friedman's Test. VAS: visual analogue scale, PRTEE: patient-rated tennis elbow evaluation scale, SD: standard deviation, PDN: percutaneous dry needling, PRO: prolotherapy.

cessible, and inexpensive. The materials we used in these therapies are relatively inexpensive and readily available, so they do not require hospitalization. We think that this will make a positive contribution to the country's health expenditures in terms of cost-effectiveness. The pathophysiology of LE is not yet fully understood. Recent studies[30] have indicated that the main pathophysiology of tendinopathy is neovascularity and irregularity in collagen fibers. However, the etiology of pain and degenerative changes that result in functional problems is unknown. Minimally invasive treatments such as PDN, platelet-rich plasma, and PRO injections are viable choices in cases where surgical and anti-inflammatory options do not function in the treatment of LE[15,18,25]. Uygur et al[25] administered PDN to 92 patients with LE in a prospective randomized controlled trial (RCT), and long-term results revealed that PDN significantly reduced pain. In an RCT, Uygur et al[26] compared PDN with corticosteroid (CS) injections in 101 patients with LE and found that PDN resulted in better long-term results than CS injections. In a retrospective study, Suzuki et al[23] performed PDN to treat LE patients who were resistant to traditional conservative treatments, and the clinical and functional impairment of the elbow improved significantly compared with that before treatment. In a systematic review, Sousa Filho et al[22] indicated that PDN was significantly more beneficial than CS injections in the treatment of LE in terms of pain level and functional outcomes. Consistent with the literature, our study on patients with LE who did not benefit from conservative treatment showed that both pain and clinical outcomes significantly improved in patients who received PDN.

Gül et al[20] in their study of 41 patients who developed osteoarthritis secondary to developmental dysplasia of the hip (DDH), divided the subjects into two groups, PRO and control group. As a result of the study, it was revealed that the group that received PRO was more effective in reducing hip pain than the control group. Bayat et al[3] randomized 30 patients with LE into two groups receiving CS and PRO, and compared the effects of the injections in an RCT. Both treatments were found to be effective in the treatment of LE in the short term, although PRO was more effective than CS injection in the long term. In a clinical study, Apaydin et al[2] randomized 32 patients with LE into two groups receiving hyaluronic acid (HA) and 15% dextrose PRO and compared the effects of these injections. Both HA and PRO injections were effective in reducing pain and improving grip strength and function in patients with LE. They also reported that PRO was more effective than HA injection in the short term in terms of pain relief and functional outcomes. In an RCT, Akcay et al[1] randomized 60 patients with LE into two groups receiving saline and 15% dextrose PRO and compared the effects of the injections. PRO was found to be more efficient than saline in reducing pain while also improving grip strength and function. Solmaz et al[31] in their study, applied a 5% dextrose injection to 654 patients with chronic low back pain and lumbar disc herniation and showed that the patients had a significant reduction in pain and a significant improvement in their musculoskeletal system functions. In our study, we used 5% dextrose PRO, which was also used in previous studies[32] and has a significant effect on reducing pain. Based on the findings in the literature, both PDN and PRO are effective

in the treatment of LE. Although there are multiple studies on the treatment of LE over the years, we were unable to identify any study comparing PDN and PRO with the combination of these two treatments when reviewing the literature. We thus believe our study is significant in this regard.

In our study, we found that treating LE with PRO, PDN, or a combination of the two was successful. In addition to significant improvements in VAS and PRTEE scores in all three groups, we found that the PDN+PRO group had significantly better short- and medium-term results than the other two groups.

The primary limitations of this study were the small sample size and the short follow-up duration. In the future, further studies with larger patient populations and longer follow-up durations will be needed.

Conclusions

LE is a common condition that results in loss of function and labor. We believe that minimally invasive treatment options should be employed more frequently as they do not necessitate hospitalization and provide satisfactory results. Furthermore, the materials we utilized in these therapies are relatively inexpensive and readily available, thus reducing the loss of labor and functional loss after treatment. We believe that our study will help reduce the national health costs allocated for the treatment of LE.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that may appear to affect the work reported in this article.

Ethics Approval

Ethical approval was obtained from the Ethics Committee of Turgut Ozal University Malatya Training and Research Hospital (Approval number: 2022/17). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Informed Consent

Informed consent was obtained from the patients for the procedure to be performed before the injection..

Availability of Data and Materials

Data are available upon request to the corresponding author.

Authors' Contributions

Conceptualization: Boz M. Data curation: AA Sahin. Formal analysis: AA Sahin. Funding acquisition: Boz M, AA Sahin. Investigation: Boz M. Methodology: Boz M, AA Sahin, Software: AA Sahin. Validation: Boz M. Visualization: Boz M. Writing - original draft: Boz M. Writing - review and editing: Boz M, AA Sahin.

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