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Effects of Some Types of Smoking on the Outcome of Non-Surgical Periodontal Therapy of Periodontitis Patients.

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Effects of Some Types of Smoking on the Outcome of Non-Surgical Periodontal Therapy of Periodontitis Patients.

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ABSTRACT

Purpose: The aim of the current study was to compare and contrast the effects of various smoking types. This study focused on traditional cigarettes, electronic cigarettes and heated tobacco products compared with non-smokers on the outcome of non-surgical treatment of moderate generalized periodontitis. **Subjects and methods**: The present study included a total of sixty (60) patients with moderate generalized chronic periodontitis. They were divided into four equivalent groups to be managed with non-surgical mechanical debridement. The clinical results of the study were evaluated using Plaque Index, Gingival Index, Pocket depth measurements, and Clinical attachment level. The clinical measurements were obtained at the baseline, 1 month, 3 months, and 6 months intervals. Samples of gingival crevicular fluid were collected from periodontal pockets at the site of periodontal treatment at the same intervals of clinical evaluation. The collected samples were analyzed for detection of interleukin 8 (IL8), and Tumor necrosis factor (TNF-α) levels. **Results**: Non-smoker group showed the best improvement of the clinical parameters and the lowest level of the inflammatory cytokines followed by the HTPs smokers then E-cigarette smokers'. Furthermore, traditional smokers showed the least improvement of the clinical parameters and highest level of the inflammatory cytokines. **Conclusion**: The present study revealed that different types of smoking affect the outcome of non-surgical periodontal therapy. Comparing between HTPs, vaping, and traditional smoking, HTPs have the least effect on periodontal therapy, vaping has the moderate effect and traditional smoking has the strongest effect.

KEYWORDS

Non-Surgical Periodontal Therapy, TNF-α, IL8

1. Paper extracted from Master thesis titles "Effects of Some Types of Smoking on the Outcome of Non-surgical Periodontal Therapy of periodontitis patients".

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INTRODUCTION

Periodontal diseases are chronic inflammatory conditions of the periodontium, including periodontal ligament destruction, and alveolar bone loss in its later stages. Tooth loss can be the result of these disorders, and periodontal disease is one of the two most serious dangers to the oral health. There are about 800 types of bacteria in the oral cavity, and periodontal disease is believed to result from a complex interaction between bacterial infection and host response, influenced by behavioral factors like smoking [(1)].

The breakdown of the tooth-supporting structures, indicated by clinical attachment loss and radiographic bone loss, is widely accepted as the epidemiologic hallmark of periodontitis. Additionally, a crucial biologic feature of periodontitis is the presence of chronic inflammation in the periodontal tissues, which is clinically manifested by bleeding on probing – triggered when a mechanical stimulus (insertion of a periodontal probe into the periodontal pocket) hits a subgingivally located inflammatory infiltrate. Another biologic aspect of periodontitis is the proliferation and down growth of the junctional epithelium, which converts to pocket epithelium as the gingival crevice transforms into a periodontal pocket, as measured by increasing probing depth[(2,3)].

Periodontal tissue destructions may be caused either directly by periodontal pathogens or indirectly elicits host's immune inflammatory response to infections. Inflammatory mediators such as cytokines, chemokines, and proteolytic enzymes are secreted by White Blood Cells (WBCs) such as macrophages, which can cause tissue disintegration and bone resorption [(4)].

Tobacco use is one of the significant risk factors for the development and progression of chronic periodontitis. Changes in bacterial composition and the host's immunological inflammatory response have been linked to the detrimental effects of smoking. Nicotine in cigarettes leads to inflammation, vasoconstriction, and scar formation. Other cytotoxic substances included in cigarettes have an important role in cell migration and secretion of inflammatory mediators [(5)].

Cigarette smokers (CS) experienced inferior non-surgical and surgical periodontal therapy outcomes in comparison to non-smokers (NS), according to the results of numerous studies. According to one theory, CS causes periodontal fibrosis and impairs periodontal motility. In addition, long-term cigarette smoke exposure has been shown to inhibit the proliferation of human gingival fibroblasts. Additionally, smoking causes the development and accumulation of advanced glycation end products (AGEs) in periodontal tissues. Human gingival fibroblasts produce pro-inflammatory cytokines including matrix metalloproteinase (MMP)-1 and interleukin (IL)-6 as a result of interactions between AGEs and their receptors (RAGE) [(6-8)].

In recent years, the usage of electronic cigarettes (E-cigs), also known as e-cigarettes or "vapes," has increased among traditional cigarette smokers in addition to persons who have never smoked cigarettes, owing to safety promises. E-cigs use a device called an "atomizer" to heat a liquid (e-liquid). The e-liquid is composed of water, flavorings, propylene glycol, and glycerin. It comes in various nicotine dosages or it can be nicotine-free. Upon activation of the E-cig, the vapors condense into an aerosol that the user inhales. Because there is no combustion, "vaping" produces fewer chemical compounds than (cigarette smoking). Some researchers imply that E-cig is a less dangerous nicotine source than traditional cigarettes. However, no sufficient data is available to support their long-term safety [(9)].

It has been proven that nicotine has anti-proliferative effects. Also, it has an impact on fibroblasts in vitro. This implicates that E-cigs containing nicotine influence the differentiation of oral myofibroblasts in e-cig users, potentially affecting their wound healing capacity as this impact reduces the ability of myofibroblasts to contract wounds [(10)].

A few studies have focused on how e-cigarette use affects dental health. Most studies had small sample sizes. According to a new study, e-cigarette use is not as dangerous to periodontal health in comparison with (cigarette smoking), and the periodontal health of e-cigarette smokers may be equivalent to that of nonsmokers. One study showed that quitting traditional cigarettes and use of E-cigs for about 4 months prior to the study showed progressively improved periodontal indices. However, according to another study, in a broader cross-sectional analysis utilizing data from the 2016 Behavioral Risk Factor Surveillance System survey, the use of e-cigarettes was connected to the elevated risk of tooth loss that has been caused by decay or gum disease [11, 12].

Clinical improvement with periodontal treatment has been reported in smokers using various therapeutic techniques. However, even after oral hygiene levels were corrected, the extent and predictability of clinical improvement decreased dramatically in comparison to non-smokers. Smokers are less likely to respond positively to nonsurgical and surgical periodontal therapy than non-smokers [13].

On the other hand, according to the American Food and Drug Administration, Heat Not Burn (HNB) tobacco products are electrically heated rather than burning at much lower temperatures than heat in traditional cigarettes, thus they lower the exposure to dangerous or potentially dangerous components and at the same time they provide the same nicotine taste, mood, and a sensation that is equivalent to those in cigarettes [14, 15]. According to the researchers' findings, Heat Not Burn cigarettes deliver less chemical chemicals than conventional cigarettes do [16, 17].

The current study's goal was to analyze and show the differences between the effects of some distinctive forms of smoking which are traditional cigarettes, electronic cigarettes and HTPs, with the non-smokers on the outcome of non-surgical mechanical debridement of moderate generalized periodontitis.

SUBJECTS AND METHODS

Patients Selection:

The present study included 60 patients with generalized moderate periodontitis collected from the Outpatient Clinic, Oral Medicine, Periodontology and Diagnosis department, Faculty of Dentistry, Al-Azhar University (Girls Branch), Cairo Egypt. All the patients in the trial were of the same age. Each patient was informed about the treatment protocols. Each participant who voluntarily agreed to participate signed the consent papers before to the trial's start. The Ethics Committee, Faculty of Dentistry, and Al-Azhar University all accepted the study's design. The patients were chosen clinically based on specific inclusion and exclusion criteria.

Inclusion criteria [6]:

- Participants with the age range 25 to 50 years.
- Patients diagnosed as having moderate generalized periodontitis according to periodontal disease classification 2018.
- Smokers with rates of at least five cigarettes a day during the last 12 months.
- Participants who have been exclusively on E-cigs for at least 1 year and have no history of tobacco abuse.
- Individuals who have been exclusively on HTPs for at least 1 year and have no history of tobacco abuse.
- Individuals that denied the use of any tobacco use throughout their life (non-smoker patients).

Exclusion criteria [18]:

- Cigar, pipe, and/or water pipe (narghile/hookah) smokers.
- Dual smoking (traditional cigarettes and e-cigarettes).
- Individuals with any systemic diseases such as diabetes which could affect the result of non-surgical periodontal therapy.

- Individuals with a history of any periodontal therapy in the last 6 months.
- Patients with a history of using a drug that can affect periodontal tissues as antibiotic, non-steroidal, or anti-inflammatory drug during the last 6 months.

Sample size:

A Power calculation test was performed, setting an effect size = 0.80, α=0.05, and power at 80%. The sample size calculation showed a requirement for 13 subjects per group. So, in the present study, 15 patients will recruit per group.

Patient grouping:

A total sample size of 60 patients was divided according to the smoking status into four groups:

1. **Group (A):** Included 15 periodontitis patients with a history of smoking five cigarettes or more for a minimum of a year before the study.
2. **Group (B):** Included 15 periodontitis patients that only used E-cigs for at least 1 year before the study and with no history or current tobacco use of any other tobacco products.
3. **Group (C):** Included 15 periodontitis patients with a history of using only heated tobacco products for a minimum of 12 months before the study.
4. **Group (D):** Included 15 periodontitis patients with no history of tobacco use (non-smoker patients).

All the selected patients at the four groups were treated with conventional non-surgical periodontal therapy which includes the following:

1. Supra-gingival and sub-gingival scaling and root planing using ultrasounic scaler and curettes.
2. Anti-inflammatory mouth wash for 1 week post periodontal therapy.
3. Oral hygiene instructions include brushing teeth with soft dental brush 3 times daily and using dental floss once a day.

Clinical evaluation:

The clinical results of the present study were evaluated using Plaque Index (Silness & Loe 1964)[19], Gingival Index (Loe & Silness, 1963)[20], Pocket depth measurements [21], (Fig.1) and Clinical attachment level [22]. The clinical measurements were obtained at the baseline, 1month interval, 3 months interval and 6 months intervals.

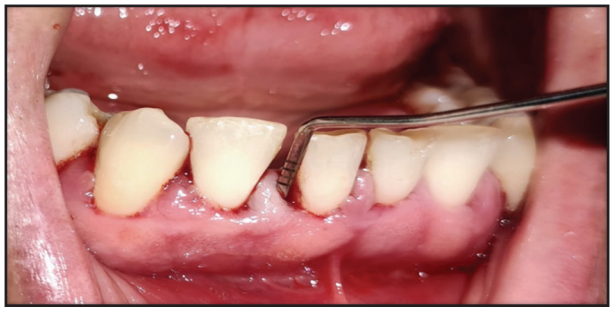

Figure (1): Preoperative photo showing pocket depth (PD) = 7mm using William's graduated periodontal probe.

Gingival crevicular sampling and biochemical analysis:

Samples of gingival crevicular fluid were collected from periodontal pockets by paper point strips at the site of periodontal treatment at the same intervals of clinical evaluation. The used technique of analysis for the collected samples was Enzyme Linked Immunosorbent Assay (ELISA) technique for evaluation of the following cytokines: Interleukin 8 (IL8), and Tumor Necrosis Factor (TNF-α) [23].

Statistical analysis

The different clinical and biochemical, parameters results for all subjects in all groups during different follow-up intervals, were analyzed statistically using Student t-test and ANOVA test.

RESULTS

The study included 45 systemically healthy periodontally affected smoking patients and 15 periodontally affected non-smoking patients. They were divided into four groups, each group has 15 patients. Group A included (cigarette smoking) patients, group B included vape smoking patients group C included heated tobacco smoking patients and group D included the nonsmokers' patients. All the patient groups were treated with the conventional periodontal regimen. All the patients completed the study.

Clinical parameters namely; Plaque Index, Gingival Index, Pocket depth, and attachment level, were recorded at baseline, 1 month, 3 months, and 6 months intervals. Samples of Gingival crevicular fluid were collected at the same time of clinical parameter to evaluate the IL8 and TNF-α levels.

As regards to mean values of plaque index for all groups at base line, it recorded 2.1+0.25, 2.2+0.75, 2.2+0.2, 1.9+0.65 at groups A, B, C, D, respectively. After 6 months of non-surgical periodontal therapy, group D recorded 0.0 showing the best record followed by group C that recorded 0.2+0.75 then group B that recorded 0.4+0.85. Group D showed the least improvement as it recorded 1.0+0.15 (Fig. 2).

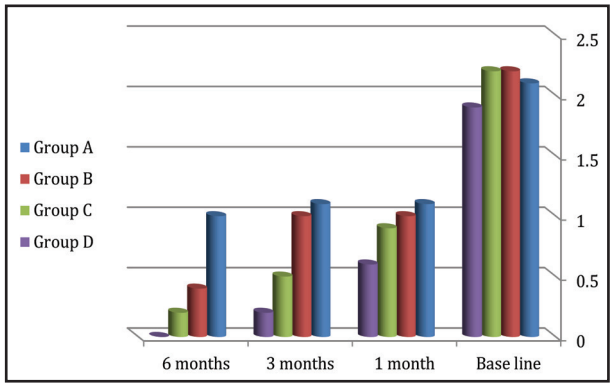

Figure (2) Mean values of Plaque Index records in all groups during the different follow-up periods of the study.

In groups B, C, and D gingival index values showing a statistically significant differences between the base line and 6 months follow-up. It recorded 2.4+0.35, 2.2+0.35, 2.3+0.75, 2.1+0.25 at groups A, B, C, D, respectively. After 3 months of non-surgical periodontal therapy, group D recorded 0.3+0.35 and after 6 month it recorded 0.2+0.55 showing the best results when compared to other groups, (Fig. 3).

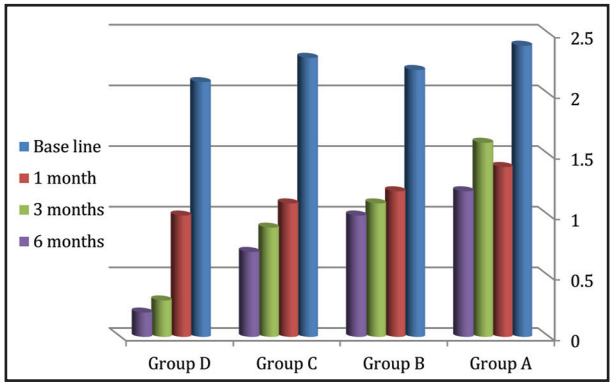

Figure (3) Mean values of Gingival Index in all groups during the different follow-up periods of the study.

As regards to mean values of pocket depth for all groups at baseline, it recorded 4.6+0.35, 4.4+0.45, 4.2+0.65, 3.9+0.35 at groups A, B, C, D, respectively. After 1 month of mechanical debridement, group C and group D showed better records when compared with baseline records as they recorded 2.0+0.45 and 2.0+0.35, respectively. This improvement continues during 3 months and 6 months intervals (Fig. 4).

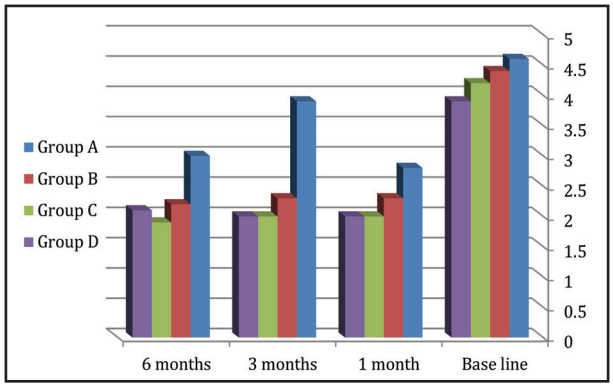

Figure (4): Mean values of pocket depth records in all groups during the different follow-up periods of the study.

As regards to mean values of attachment level for all groups at baseline, it recorded 2.7+0.65,

2.4+0.25, 2.3+0.45, 2.1+0.45 at groups A, B, C, D, respectively. After 6 months of non-surgical periodontal therapy, group C and group D recorded 1.1+0.35 and 1.0+0.4 respectively. A statistically significant difference is found between the baseline records and 6 months interval records at both C and D groups (Fig. 5).

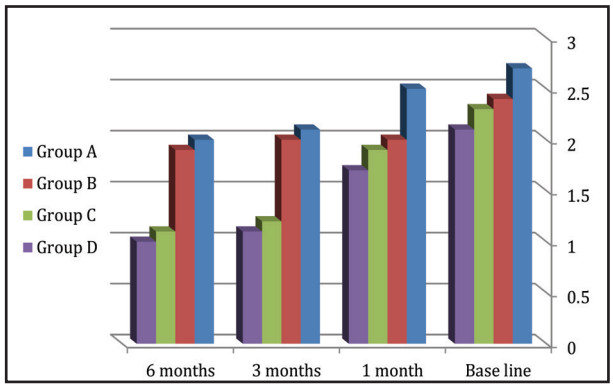

Figure (5): Mean values of attachment level records in all groups during the different follow-up periods of the study.

The examined cytokines IL8 and TNF-α showed higher values at the baseline for all groups. These cytokines decreased at all groups after 6 months. Groups D and C showed a statistically significant difference between the values recorded at the base line and at the end of the study for both IL8 and TNF-α (Fig. 6 and 7).

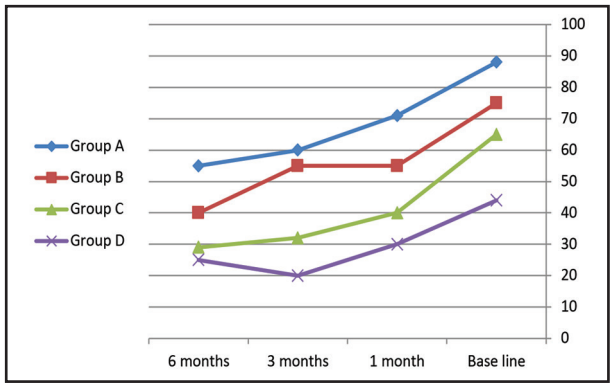

Figure (6) Mean values of IL8 levels (pg/lL) recorded at GCF, in all groups during the different follow-up periods of the study.

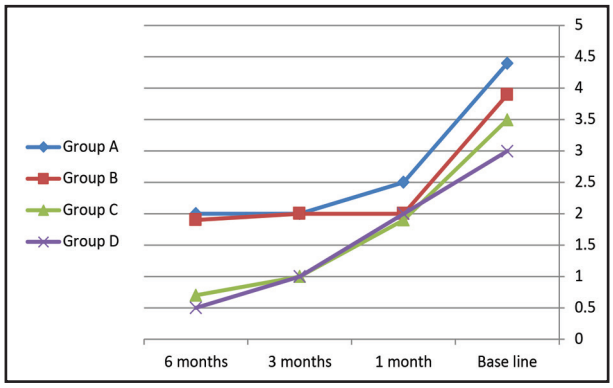

Figure (7) Mean values of TNF-α levels (pg/lL) recorded at GCF, in all groups during the different follow-up periods of the study

DISCUSSION

Smoking is an old habit that increases the risk of getting multiple disorders including those of oral cavity such as periodontitis. The greatest major modifiable risk factor for periodontal conditions is probably smoking. The typical characteristic of smoking-associated periodontal disease is the destruction of the supporting tissues of the teeth, with the ensuing clinical symptoms of bone loss, attachment loss, pocket formation, and eventually tooth loss [24].

The present study was carried out on 60 moderate chronic periodontitis patients seeking periodontal therapy. According to smocking status, patients were divided into four equal groups. The four examined groups were treated with non-surgical periodontal treatment. Group A, involved patients who smoke five cigarettes or more for a minimum of a year before the study. Group B involved users of vaping for at least 1 year. Group C, involved patients who had been exclusively using heated tobacco products. Group D involved nonsmoker patients.

The study sample included patients who are age-matched between 25 to 50 years old which is the most common age group for smoking and also for development of chronic periodontitis [25].

All the selected patients were treated in the present study with non-surgical periodontal therapy (scaling, and root planing). This therapeutic regimen commonly used to treat periodontal diseases and remained largely unchanged for decades.

The clinical parameters used in assessing the periodontal conditions before and after therapy, are those commonly used in clinical trials; namely the Plaque Index, Gingival Index, Pocket depth and clinical attachment level was used. These reversible Indices have proved to be useful means of screening the gingival condition. These Indices also provide the possibility of selecting specified area or teeth when large numbers are examined, or utilizing all areas of all teeth in the examination of a small sample. They also combine the degree of inflammation with the assumed main etiologic factor; dental plaque [26].

According to Bunaes et. al., non-smokers respond to mechanical debridement and surgical periodontal therapy more favorably than smokers, particularly in plaque-positive areas. According Johnson et. al., smokers are less responsive to periodontal therapy and less improvement in probing depths and clinical attachment levels after non-surgical and surgical modalities of therapy is achieved. Chang et. al, revealed in the year 2020 that smoking had a negative impact on clinical results after periodontal mechanical therapy. Non-smokers with periodontitis have a substantially more Pocket Depth (PD) reduction and CAL gain than smokers [27-29].

Samples of gingival crevicular fluid were collected from periodontal pockets at the site of periodontal treatment at the same intervals of taken clinical parameters. The collected samples were analyzed for detection of interleukin 8 (IL8), and Tumor necrosis factor (TNF-α) levels. Gingival crevicular fluid (GCF) is a periodontal tissue-derived inflammatory fluid. It's made up of serum as well as locally produced substances like tissue destruction products and inflammatory mediators. For this reason, GCF was selected to be an ideal non-invasive diagnostic indicator for IL8 and TNF-α levels. IL-8 and TNF-α are important cytokines that have been linked to elevated GCF levels in periodontitis patients [30].

Boström L et, al confirmed that current smokers showed significantly high level of TNF-α in GCF. Also, M Lütfioğlu et. al, in 2015 found that the levels of IL-8 in GCF were considerably higher in smokers with chronic periodontitis than non-smokers with chronic periodontitis [31, 32].

As demonstrated that the level of IL-8 correlates with the degree of inflammation [30], IL8 level is found to be considerably different between the four groups of the present study.

After 6 months of the study, it showed that the IL-8 level was higher in Group A (cigarette smokers) in comparison to other examined groups. At the same time, the lowest levels are recorded at non-smokers group. In line with the result of the present study, Fredriksson et. al, proved that peripheral neutrophil sensitivity to activate IL-8 is decreased by the effect of smoking, this is considered as an explanation for the lowest levels of IL-8 in Group D and the greatest levels in Group A [33].

A significant correlation for mean TNF-α levels is found in the analyzed groups in the current investigation. Group A had the highest levels of TNF- α and Group D had the lowest, followed by Groups B and C with the same levels, a finding that is corroborated by a study that found that smokers had greater levels of TNF-α than non-smokers[34].

At the end of the study, the mean values of AL and PD showed significant differences between group A and D, on the contrary, there were no significant differences that have been found between group B (vape) and group C (heated tobacco).

The traditional smoking group showed a less gain in attachment level when it is compared to non-smoker patients and also less than that recorded in other groups. This was in line with previous research by Chi Pui Wan et. al, who found that smok-

ers had less favorable probing depth reduction at deep sites after non-surgical periodontal therapy in 2009, and Labriola et. al, who found that the mean difference in probing pocket depth in non-smokers decreased with an initial probing depth of 5 mm or more in 2005 [35, 36]. The idea that traditional smoking directly affects the regenerating ability of periodontal tissues following therapy supports this result.

The GI scores among the groups showed high significant difference with a lowest value recorded at group D, followed by group B and C. The higher GI scores in smoker patients can be the result of induction of gingival vasoconstriction caused by (cigarette smoking).HTPs and e-cigs liquid have less vasoconstrictive effect on gingival blood vessels than that from (cigarette smoking).

CONCLUSION

The present study revealed that the different discussed types of smoking had unfavorable effects on the periodontal condition and the inflammatory cytokines, which affect the outcome of non-surgical periodontal therapy. Comparing HTPs, vaping, and the traditional smoking, HTPs has found to have the least effect on periodontal therapy, vaping has moderate effect and traditional smoking has the strongest effect.

RECOMMENDATIONS:

Based on the findings and conclusions presented, the following recommendations are suggested:

1. Research interested in periodontology should do further investigations on recent types of smoking such HTPs that may not have the same deleterious effects as traditional smoking on supporting structures.
2. Researchers should extend the follow-up periods of deep periodontal pockets to more than 6 months especially in smoker patients as based on this study; it may help to achieve more PD reduction.

Declaration of Competing Interest

The authors declare that they have no conflict of interest.

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