CLINICAL AND RADIOLOGICAL EVALUATION OF IMMEDIATE IMPLANT PLACEMENT FOLLOWING TOOTH EXTRACTION USING PHYSICS FORCEPS

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ABSTRACT

INTRODUCTION: A traumatic dental extraction preserves bone, gingival architecture, and allows for the option of future or immediate dental implant placement. A number of tools and techniques have been proposed for minimally invasive tooth removal such as the physics forceps. The biomechanical design of the physics forceps decreases the incidence of root fracture, and maintains the buccal bone plate, which is essential for the proper healing of an immediately placed dental implant.

OBJECTIVE: This study was designed to clinically and radiologically evaluate immediate implant placement into fresh extraction sockets of maxillary anterior teeth following extraction by physics forceps.

MATERIALS AND METHODS:10 adult patients seeking immediate implant placement in anterior maxillary region were selected and randomly allocated into two groups; a study group: included 5 patients, in this group extraction was done using physics forceps, and a control group: included 5 patients, in this group extraction was done using conventional forceps.

RESULTS: Clinical results revealed that there was statistically no significant difference between the two groups according to plaque and gingival indices throughout the follow up period. There was no mobility of the implants in both groups. Interproximal papillae of all cases were intact during implant placement and throughout the study. According to the probing depth ,there was a statistically significant difference in favor to the study group immediately and after one week then became non significant after 1, 3 and 6 months. Radiographic results revealed that there was a statistically significant difference between the two groups in favor to the study group, Immediately post-operative, then, became non significant after 3 and 6 months in relation to the mean values of both bone density and marginal bone level.

CONCLUSION: Immediate implant placement following tooth extraction using Physics forceps showed superior results in the immediate post-operative phase only.

KEYWORDS: Atraumatic extraction, physics forceps, conventional forceps, immediate implantation.

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INTRODUCTION

Placement of implants immediately after tooth extraction has a high percentage of clinical success (1). It has several advantages, like preserving the alveolar anatomy, maintaining the bony crest which helps to preserve the ridge dimensions as height and width, thus minimizing the amount of bone resorption which may affect the alveolar crest mainly in the buccal direction during the first six months following extraction (2,3).

However, in order to ensure an esthetically pleasing treatment outcome when immediate dental implants are placed, the preservation of an intact labial plate is one of the most critical factors (4). The extraction of teeth by standard techniques or the surgical removal of retained root fragments by conventional surgical methods (elevators and forceps) may result in damage to the labial plate of alveolar bone (5-7). Moreover, bone removal may become necessary,especially when root fragments are scheduled for extraction (8).

Recently, an atraumatic forceps was developed that primarily uses the biomechanical advantages of a first class lever, creep, and stress distribution. The principles of biomechanics are the basis for the development of the Physics Forceps (9).

The Physics forceps was designed by Dr. Richard Golden in 2004; it enables to predictably remove even the most grossly broken down teeth with little or no trauma to the surgical site. The biomechanical design of this instrument decreases the incidence of root fracture, and maintains the buccal bone plate, which is essential for the proper healing of an immediately placed dental implant (9,10).

The Physics forceps use first class level mechanics to atraumatically extract a tooth from its socket. One handle of the device is connected to a "bumper", which acts as a fulcrum during the extraction. This “bumper” is usually placed on the facial aspect of the dental alveolus, typically at the mucogingival junction. The beak of the forceps is positioned most often on the lingual or palatal root of the tooth and into the gingival sulcus. Unlike conventional forceps, only one point of contact is made on the tooth being extracted. Together the “beak and bumper” design acts as a simple first class lever. A squeezing motion is not to be used with these forceps. By contrast, the handles are actually rotated as one unit using a steady yet gentle rotational force with wrist movement only. Once the tooth is loosened, it may be removed with traditional instruments such as a conventional forceps or rongeur.(9)

Therefore, this study was designed to clinically and radiologically evaluate immediate implant placement following tooth extraction using physics forceps.

MATERIALS AND METHODS

A randomized clinical trial was conducted on ten adult patients of both sexes having maxillary anterior teeth indicated for extraction and immediate implant rehabilitation. Patients were selected from the Out Patient Clinic of the Oral & Maxillofacial Surgery Department, Faculty of Dentistry, Alexandria University. Patients were fully informed about

the treatment procedures and follow up examination. Appropriate institutional ethical clearance and written informed consent were obtained.

Inclusion criteria

Patients' age ranged from 20-40 years, good oral hygiene, adequate apical bone volume (at least 4 mm from the apex) to achieve primary stability of the immediate implant, adequate inter-occlusal space at the implant site (at least 8-10 mm) to accommodate the fixed prosthesis following immediate implant placement.

Exclusion criteria

Uncontrolled systemic diseases such as uncontrolled diabetes and osteoporosis, chemotherapy and radiotherapy, pregnancy, poor oral hygiene, drug or alcohol abuse, active inflammation or infection in the sites of implant insertion, heavy smokers (smoking >10 cigarettes/day), parafunctional habits such as bruxism and clenching.

Patients were divided into two groups; each group contained 5 patients (a study group and a control group). In the study group, teeth extraction was performed using the maxillary anterior physics forceps, while in the control group extraction was performed using the maxillary anterior conventional forceps.

Materials

1-Physics forceps (Golden dental solutions company. Gatriot avenue. Michigan USA.) (Fig.1)

Fig (1): A photograph showing maxillary anterior physics forceps.

It consists of two handles, the beak, the bumper and the bumper guard. The bumper guard of the forceps is disposable, it is FDA approved Plastisol which is made with non-latex materials and packaged in blister pack easy to use packaging and come in a box of 24 bumpers, 48 bumpers or 96 bumpers

2. **Implant system**

Ten Dentium superline (Dentium implant system company, Samseong Street, Seoul, Korea) endosseous root-form implants were used in this study. This implant is formed of two pieces; the implant body and the abutment with an internal hex connection.

The implant body surface is sandblasted with large grit and acid etched (S.L.A), Self-threading in pure titanium grade 4, available with lengths range from 7.0 mm to 14.0 mm and with diameters range from 3.6 mm to 7.0 mm, packaging are color coded by diameter and sterilized with gamma rays.

The abutments are made of titanium alloy and can be prepared if necessary. They are available in two lengths; 4 and 5.5 mm, and in three diameters 4.5, 5.5 and 6.5 mm. they also have different angulations; zero degree, 15degree and 25 degree. They have wide external hex for anti-rotational telescopic fixation to the implant body internal hex.

Methods

Pre-operative phase

1- Clinical assessment of the patients' general health, oral condition and evaluation of the implant site before extraction including inspection, palpation of the tooth to be extracted, the surrounding oral mucosa, occlusion and adjacent teeth. Primary impressions were taken for maxillary and mandibular arches and diagnostic study models were casted to evaluate the jaws relationship and inter-occlusal space.

2- Radiographic evaluation included:

a) Orthopantomogram (OPG).

b)Standardized periapical radiographs using Extension Cone Paralleling technique (X.C.P) (Rinn Co. Dentsply Division, USA

Operative phase

Operation was performed under local anesthesia Mepivacaine Hcl 2% and Levonordefrin 1: 20000 (Mepecaine-L. Alexandria Co. for Pharmaceuticals and Chemicals Ind., Alexandria. Egypt). Teeth were extracted by the Physics forceps (Fig.2a) in the study group and by the conventional forceps in the control group.

- In the study group; the beak of the forceps is positioned on the palatal root aspect of the tooth and into the gingival sulcus. The bumper acts as a fulcrum during the extraction and is placed on the labial aspect of the dental alveolus, typically at the mucogingival junction. Using only wrist rotation in a buccal-only direction with no physical force, the tooth began to disengage from the socket. Once the tooth was partially released from the socket, it could be finally removed by any pincer-like device such as a pliers or a hemostat.
- Curettage of the socket was performed to remove any debris and proper irrigation with warm sterile saline was performed.
- Integrity of the socket walls and socket depth from the alveolar crest of bone to the socket apex were checked with osteotomy probe and depth of the socket was measured to determine the drilling needed after root apex. Also, the length of the implant was determined by measuring the root of the extracted tooth.
- The osteotomy was prepared through the socket opening by drilling (Fig.2b) beyond socket apex 3-4 mm using sequential drills according to the manufacturers' instructions with adequate cooling.
- Then, the Dentium superline implant was screwed into the osteotomy and final seating of the implant was achieved by ratchet wrench (Fig.2c).
- Then, implant abutment with suitable angulation was seated and tightened manually (Fig.2d).
- The implant was immediately restored with a provisional acrylic crown over the implant abutment with a thin layer of temporary cement. The temporary crown was to be free from occlusion (Fig.2e).

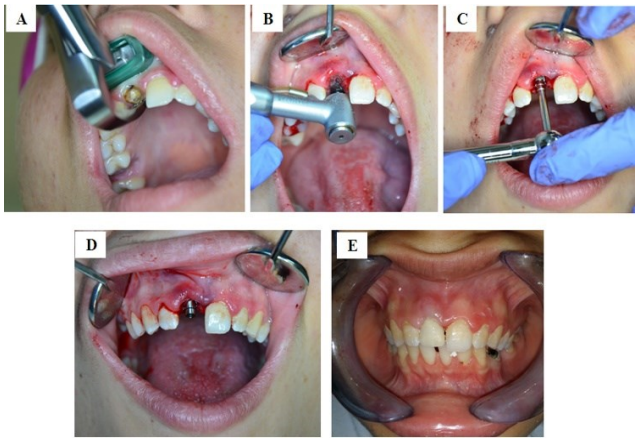

Fig (2): (A) A photograph showing extraction of maxillary right central incisor using physics forceps.
(B) A photograph showing drilling of the extraction socket.
(C) A photograph showing placement of implant body using ratchet wrench.
(D) A photograph showing implant abutment after placement.
(E) A photograph showing temporary crown after cementation.

Post-operative phase

1- Post-operative instructions were given to the patients, which include:
- Applying ice packs extra-orally intermittently every 10 minutes for 2 hours on the first day to minimize edema.
- Start administration of the prophylactic broad-spectrum antibiotic in the form of 500 mg of amoxicillin (Amoxil 500 mg, GlaxoSmithKline. Cairo, Egypt) capsules 3 times daily and the analgesic non-steroidal anti-inflammatory drug in the form of 50 mg diclofenac potassium (Cataflam 50 mg tablet, NovartisPharma, Cairo, Egypt) 3 times daily, for seven post-operative days.
- Oral hygiene instructions including warm mouth wash using chlorhexidine Hcl 0.12% (Hexitol mouth wash, the Arab Drug Company.Cairo. Egypt) as an antiseptic mouthwash twice daily from the day of implant placement and continued for the whole treatment period.
- Using a soft tooth brush and gentle cleaning with dental floss.
- Avoid biting on the provisional crown

Follow-up phase

Clinical evaluation

All patients were evaluated clinically immediately post-operative and on intervals of one week, 1, 3 & 6 months, for

1) Presence of pain, tenderness or discomfort using Visual Analogue Scale (VAS)(11). The VAS scores ranging from 0 to 10 which are:
(Score 0) No pain.
(Score 2) Mild and annoying pain.
(Score 4) Nagging, uncomfortable and troublesome pain.
(Score 6) Distressing and miserable pain.
(Score 8) Intense, dreadful and horrible pain.
(Score10) Worst possible, unbearable and excruciating pain.
2) Presence of swelling, inflammation or infection.
3) Plaque accumulation using the Silness and Löe plaque index(12).
4) Gingival inflammation using the Löe and Silness Gingival Index(13).
5) Implant mobility was tested according to Mickney and Koth(14).
6) Interproximal papillary size adjacent to single implant restoration according to Jemt(15).

Probing pocket depth around the implant according to Glavind and Löe(16).

Radiographic evaluation

All the implants involved in this study were radiographically evaluated by direct standardized periapical radiographs immediately post operative and on intervals of 3 & 6 months (Fig. 3 a ,b, c) to assess the bone density and marginal bone defect around the implants by using image J software (Image J, U. S. National Institutes of Health, Bethesda, Maryland, USA).

The Image J program translates the degree of darkness and lightness in the radiograph into a numerical value. The degree of blackening and whitening (radiolucency and radio-opacity) indicates the degree of bone density. The numerical value range from 0 (darkest) to 255 (lightest).

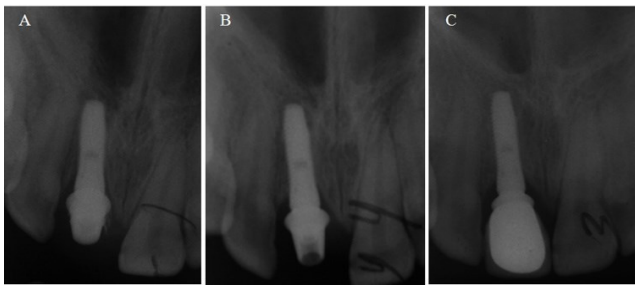

Fig (3): (A) A photograph showing immediately post-operative peri-apical radiograph.
(B) A photograph showing peri-apical radiograph at 3 months.
(C) A photograph showing peri-apical radiograph at 6 months.

Prosthetic phase

1- After 6 months, the acrylic temporary crowns were removed by a crown remover.
2- The final impression was taken using rubber base impression material directly over the implant abutment after blocking the abutment screw access holes with a temporary filling.
3- The shade of the permanent crowns was selected according to Vita 3D-master shade guide.
4- The final porcelain fused to metal crowns were cemented by glass ionomer cement material(Fig.4)

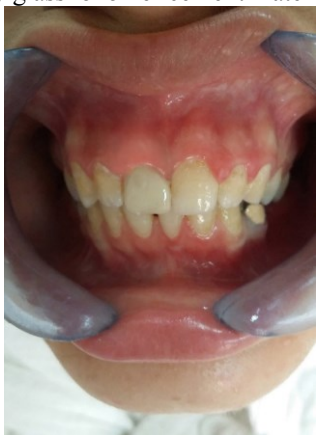

Fig (4): A photograph showing final porcelain crown after cementation.

STATISTICAL ANALYSIS

The results of all examinations were registered on a case record form and were entered into an electronic database to be analyzed statistically. The quantitative values along the different periods of the follow-up for each group were tested by ANOVA with repeated measures test, while the comparison between the two groups along the different periods of the follow-up was tested by student t-test. P value ≤ 0.05 considered statistically significant.

RESULTS

In this study ten immediate implants were placed and loaded in a total of ten patients with age ranged from 20-40 years (3 females and 2 males with a mean age of 28 in the study group and 4 females and 1 male with a mean age of 29 in the control group).

All patients had been examined periodically during the follow-up period up to 6 months. Healing was uneventful in all cases with no post-operative complications.

A- Operative Clinical results

All patients had been operated under local anesthesia, immediate implant placement was done, and no complications had been recorded during the operation except for mild gingival lacerations during extraction in all patients of the study group at the mucogingival margin where the bumper of the physics forceps rested.

B- Post-operative clinical results

1- Presence of pain, tenderness or discomfort.

All patients of the two groups felt very mild or no pain during surgery and on the first post-operative day (VAS ≤ 2). After one week, all patients felt no pain (VAS = 0).

2-Presence of swelling, inflammation or infection.

On the first post-operative day, edema was very minimal and unobserved in all patients of the two groups. After one week, no edema was present in all patients.

3-Plaque index (PI)

Mean Plaque index values and standard deviation for both groups were measured immediately post-operative, after one week and after 1, 3 and 6 months.values were (0.00 ± 0.00, 1.15 ± 0.34, 0.90 ± 0.22, 0.60 ± 0.14 and 0.55 ± 0.11) respectively for the study group and (0.00 ± 0.00, 1.30 ± 0.21, 1.10 ± 0.29, 0.75 ± 0.18 and 0.65 ± 0.14) respectively for the control group. The difference in the mean plaque index values between the two groups was found to be statistically non significant throughout the evaluation period.

4-Gingival index (GI)

Mean gingival index values and standard deviation for both groups were measured immediately post-operative, after one week and after 1, 3 and 6 months. They were (1.40 ± 0.29, 0.95 ± 0.21, 0.60 ± 0.29, 0.40 ± 0.22 and 0.20 ± 0.21) respectively for the study group and (1.40 ± 0.29, 1.05 ± 0.21, 0.70 ± 0.21, 0.40 ± 0.14 and 0.20 ± 0.21) respectively for the control group. The difference in the mean gingival index values between the two groups was found to be statistically non significant throughout the evaluation period.

5-Implant mobility

None of the implants of both groups showed signs of mobility throughout the evaluation period.

6- Probing depth

Mean probing depth values and standard deviation for both groups were measured (in millimeters) immediately post-operative, after one week and after 1, 3 and 6 months. They were (2.55 ± 0.21, 2.12 ± 0.18, 2.05 ± 0.21, 1.85 ± 0.22 and 1.60 ± 0.14) respectively for the study group and (2.95 ± 0.21, 2.55 ± 0.21, 2.25 ± 0.18, 1.90 ± 0.14 and 1.80 ± 0.21) respectively for the control group. The difference in the mean probing depth values between the two groups was found to be statistically significant immediately and after one week, and became non significant after 1, 3 and 6 months (Table 1) (Fig5).

7. Papilla index score (PIS)

In all cases of the two groups the interproximal papillae filled the entire interproximal space, and were in good harmony with the adjacent papillae. The interproximal papillae of all cases were intact during implant placement and throughout the study.

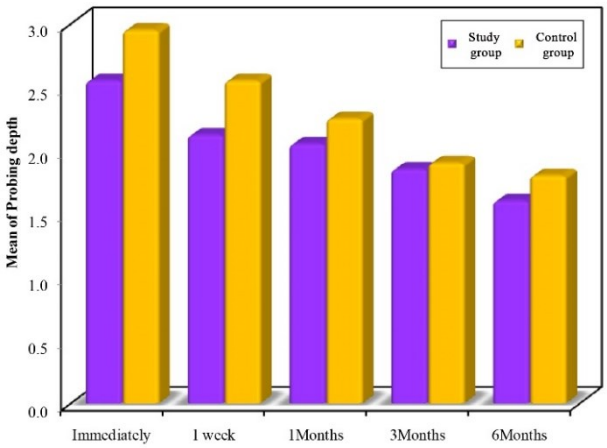

Fig (5): A photograph showing comparison between the two groups accoding to the probing depth at each period.

Table (1): Comparison between two studied groups according to the probing depth at each period.

Probing depth	Study group (n = 5)	Control group (n = 5)	t	p
Immediately				
Min. – Max.	2.25 – 2.75	2.75 – 3.25		
Mean ± SD.	2.55 ± 0.21	2.95 ± 0.21	3.024*	0.016*
Median	2.50	3.0		
1 week				
Min. – Max.	1.90 – 2.30	2.25 – 2.75		
Mean ± SD.	2.12 ± 0.18	2.55 ± 0.21	3.523*	0.008*
Median	2.05	2.50		
1months				
Min. – Max.	1.75 – 2.25	2.0 – 2.50		
Mean ± SD.	2.05 ± 0.21	2.25 ± 0.18	1.633	0.141
Median	2.0	2.25		
3months				
Min. – Max.	1.50 – 2.0	1.75 – 2.0		
Mean ± SD.	1.85 ± 0.22	1.90 ± 0.14	0.426	0.681
Median	2.0	2.0		
6months				
Min. – Max.	1.50 – 1.75	1.50 – 2.0		
Mean ± SD.	1.60 ± 0.14	1.80 ± 0.21	1.789	0.111
Median	1.50	1.75		

t: Student t-test

*: Statistically significant at p ≤ 0.05

A- Radiographic results

1- Assessment of bone density

Mean bone density values and standard deviation for both groups were measured immediately post-operative, after 3 and 6 months. They were (135.0 ± 7.13, 148.0 ± 4.64 and 153.20 ± 5.17) respectively for the study group and (119.60 ± 12.97, 135.60 ± 7.33 and 149.20 ± 6.30)) respectively for the control group. The difference in the mean bone density values between the two groups was found to be statistically significant immediately post-operative and became non significant after 3 and 6 months.

2-Assessment of marginal bone level

Mean marginal bone level values and standard deviation for both groups were measured immediately post-operative, after 3 and 6 months. They were (3.64 ± 0.40, 3.16 ± 0.46 and 2.74 ± 0.45) respectively for the study group and (4.56 ± 0.69, 3.46 ± 0.48 and 2.86 ± 0.56) respectively for the control group. The difference in the marginal bone level values between the two groups was found to be statistically significant immediately post-operative and became non significant after 3 and 6 months. (Table 2) (Fig. 6).

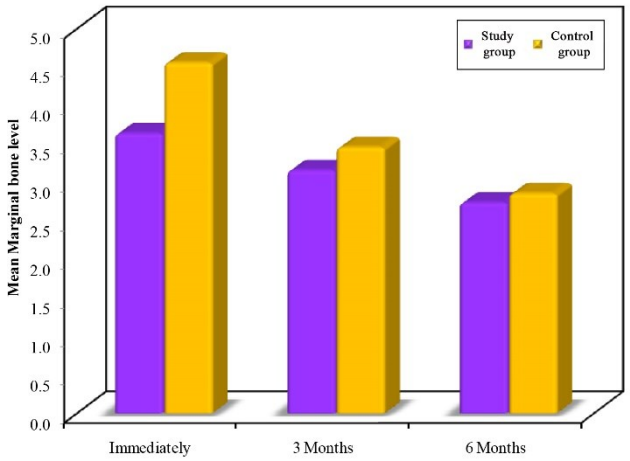

Fig (6): A photograph showing comparison between the two groups accoding to the marginal bone level at each period.

Table (2): Comparison between two studied groups according to marginal bone level at each period.

Marginal bone level	Study group (n = 5)	Control group (n = 5)	t	p
Immediately				
Min. – Max.	3.10 – 4.10	3.90 – 5.40		
Mean ± SD.	3.64 ± 0.40	4.56 ± 0.69	2.569*	0.033*
Median	3.70	4.30		
3Months				
Min. – Max.	2.60 – 3.70	2.90 – 4.10		
Mean ± SD.	3.16 ± 0.46	3.46 ± 0.48	1.010	0.342
Median	3.20	3.50		
6Months				
Min. – Max.	2.10 – 3.20	2.20 – 3.50		
Mean ± SD.	2.74 ± 0.45	2.86 ± 0.56	0.374	0.718
Median	2.80	2.90		

t: Student t-test

DISCUSSION

Physics forceps is the most innovative oral surgery instrument in recent years, completely changing the physics behind dental extractions; hence it is named as physics forceps. It was developed by Dr. Richard Golden in 2004. It reduces trauma to the adjacent bone and preserves buccal plate of bone intact during tooth extraction, which is essential for immediate implantation(17,18).

This study was conducted on ten adult patients of both sexes with age ranged between 20-40 years, having maxillary anterior teeth indicated for extraction and immediate implant rehabilitation. Patients were divided into two groups; each group contained 5 patients (a study group and a control group), in the study group, teeth extraction was performed using the maxillary anterior physics forceps while in the control group extraction was performed using the maxillary anterior conventional forceps. Clinical evaluations were done immediately post-operative, after one week, after 1, 3 and 6 months. Radiographic evaluations were done immediately post-operative, after 3 and 6 months.

Clinical results revealed that there were statistically significant results obtained in each group separately throughout the evaluation period. There was no statistically significant difference between the two groups according to the presence of pain, infection, plaque index, gingival index, mobility of the implants and integrity of the interproximal papillae throughout the evaluation period. There was a statistically significant difference between the two groups according to the probing depth around the implants in favor to the study group immediately post-operative and after one week, then became non significant after 1, 3 and 6 months.

Radiological results revealed that there were statistically significant results obtained in each group separately throughout the evaluation period. There was also statistically significant difference between the two groups according to the mean values of both the bone density and the marginal bone level in favor to the study group immediately post-operative and then became non significant after 3 and 6 months.

In the present study, mild gingival lacerations resulted during extraction in all patients of the study group at the mucogingival margin where the bumper of the physics forceps rested. Similar result was obtained by Yehea et al in 2015 (19) in their evaluation study of the extraction using physics forceps.

The physics forceps applies a constant and steady pressure with the wrist only, that helps to decrease the incidence of buccal bone fracture. In addition the bumper applies a compressive force at the buccal bone as it was positioned on the buccal alveolar ridge, resulting in holding and supporting the bone in its place. This result was in agreement with the result of Kosinski (20) in (2012) who stated that the buccal movement applied by physics forceps was slow and generally insufficient to fracture the buccal bone plate.

CONCLUSIONS

Immediate implant placement following tooth extraction using Physics forceps showed superior results in the immediate post-operative phase only.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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