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COMPARISON OF OUTCOME OF ZYGOMATIC BONE FRACTURE MANAGED BY TWO DIFFERENT TREATMENT PROTOCOLS KEEN'S APPROACH AND PERCUTANEOUS HOOK METHOD.

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ABSTRACT

OBJECTIVE: The objective of this study was to compare the outcome of zygomatic bone fracture managed by Keens/Buccal sulcus approach and Percutaneous hook method with respect to facial aesthetic and functional occlusal stability. **MATERIALS AND METHODS:** This randomized control trial was conducted at Department of Oral and Maxillofacial Surgery, Liaquat University of Medical and Health Sciences, Hyderabad/ Jamshoro, Sindh, Pakistan from 5th November 2020 to 13th September 2021. Total 60 patients were included. Postoperative x-rays PNS view or CT scan showed exact approximation of fractured segments. Patients were recalled after 1st, 2nd and on 3rd week for assessment of functional outcome. Mouth opening was measured by metallic ruler. Cheek flattening and facial asymmetry were clinically assessed by Holmes and Mathew's classification system respectively. Stratification was done using Chi square test considering *p*-value ≤ 0.05 as significant. **RESULTS:** Seventy per cent patients had grade-III in Group-A, while 66.7% patients had grade-III in Group-B. 60% patients had class-II in Group-A and 63.3% patients had class-II in Group-B. The cheek flattening grade was insignificantly associated with the study group. The mouth opening class after 1st week was significantly associated with the study group while no significant association was found after 2nd and 3rd week. **CONCLUSION:** The Keen intraoral approach offers had good functional outcome with the advantage of avoiding skin incisions.

KEYWORDS: Zygomatic Bone Fracture, Keens/Buccal Sulcus Approach, Percutaneous Hook Method, Facial Aesthetic, Functional Occlusal stability

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INTRODUCTION

The zygomatic bone is roughly diamond shaped the outer surface is convex and the inner surface is concave bone. It comprises of maxillary, frontal, temporal and sphenoid bone and serve as the main bridge amongst these structures.[1,2] Due to its protruding malar prominence and convex profile it is liable to injuries quite commonly and predisposes to be the most frequent site of midface fracture after nasal bone fracture.[2-4] Additionally, it provides attachments for temporalis , masseter , zygomaticus major and zygomaticus minor muscles.[5] It accounts for 42% of facial fractures and 64% of all midface fractures.[6] The causes of zygomatic bone fracture differ from developed and underdeveloped countries but usually found in young adult males and road traffic accident is the most common cause.[2,6,7] Other less common causes are industrial injuries, sports and falls etc.[2] Zygomatic arch fractures accounts for 5% in all patients having facial fractures.[8] As the contour of face is greatly influenced by the zygomatic bone therefore fractures of this region should be diagnosed properly and treated as soon as possible within 7 to 14 days or when swelling subsides.[3] Previous study suggests different techniques that can produce good results. Intraoral keen's approach and extraoral percutaneous hook approach for reduction of zygoma fracture were preferred previously. Other techniques are Gillie's temporal approach, lateral eyebrow approach. However zygomatic bone fracture management depends upon degree of displacement and stability after reduction. Mostly fractures of significant displacement require proper reduction and fixation.[2,4]

Keens/buccal approach, described by Keen in1909 using the upper sulcus technique, is an intraoral technique and one of the useful approaches for open treatment of zygomatic bone fractures. The approach is simple, fast and cost effective with no visible scar after surgery providing complete anatomic reduction.[9]

However, like other techniques, infection to the infra temporal fossa is one of its disadvantages.[4] Percutaneous bone hook method is useful when zygoma is twisted laterally and does not cause injury to the anatomic risky areas, decreasing amount of skin incisions and soft tissue dissection. Also, it cannot be used in comminute fractures, predisposes to scaring and injury to branches of facial nerve.[10] It is preferred because patients like scar free surgery for aesthetic reasons.[11] In ZMC (Zygomaticomaxillary Complex) fracture patients have pain, swelling, periorbital edema, ecchymosis, tenderness, paraesthesia or anaesthesia of cheek, flattening of cheek, limited mouth opening, and diplopia. Facial aesthetics and functional occlusal stability are the major concerns of the patients.

The purpose of this study is to maintain aesthetics and functional occlusal stability by two different methods intraoral keens approach and extraoral percutaneous hook method. The Keens/buccal approach is suitable for patients because it does not give any visible scar after surgery and provide complete anatomic reduction along with cost effectiveness so it could be used for treatment in patients of zygomatic bone fracture which will give better results in future.

MATERIALS AND METHODS

Following the receipt of ethical approval from the institutional ethical committee, this randomized controlled trial—an experimental study—was conducted at the Department of Oral and Maxillofacial Surgery at Liaquat University of Medical and Health Sciences in Hyderabad/Jamshoro (LUMHS) from November 5, 2020, to September 13, 2021. The study utilized a non-probability consecutive sampling method. By using Open EPI sample size calculator and taking statics of stability (reduction)

reported by Punjabi SK, et al., 99% level of confidence interval and 95% power of test the sample size of 60 (30 in each group) is finalized.[12]

The inclusion criteria of patients were confirmed clinically and radiographically. The Patients of Age range from 18 to 60 years of either gender, having displaced zygomatic bone fractures examined clinically having facial swelling, pain, tenderness, numbness of cheek, diplopia and limited mouth opening and confirmed radiographically by discontinuity in zygomatic bone, or any type of suture associated with zygomatic bone on occipitomental view, submentovertex view, and 3D CT scan of Face were included.

The Patients having bilateral displaced fractures of zygomatic bone, non-displaced zygomatic fractures, major head injuries, Comminuted zygomatic fracture, diabetes mellitus, hypertension and obesity were excluded.

The Flattening of cheek, circumorbital echymmosis, edema, subconjunctival haemorrhage, and intraoral exam were performed to see occlusion and functional stability. The final diagnosis of zygomatic bone fracture was done by clinical examination and radiographic evaluation. The Randomized allocation was done by lottery method. Odd numbers were treated with percutaneous bone hook method and even numbers were treated with keens/ buccal sulcus approach. Patients were admitted in the hospital one day prior to the surgery and kept on nil per oral (NPO) for 6 hours. The standard and universal protocol for drapping and preparation was followed. After giving local anaesthesia in the fracture region, incision was given by the sterile surgical blade to assess the fracture area.

For Percutaneous bone hook method 2 mm transverse skin incision was placed at inferior border of zygoma. Keens/ buccal sulcus method of reduction access was gained intraorally by an incision of about 1cm in length at the reflection of upper sulcus just beneath the Zygomatic buttress. In both cases, the patient was put on standard antibiotics and painkillers for one week postoperatively and then recalled three time in consecutive weeks for assessment of functional effects.

Mouth opening was measured by metallic ruler in mm where Class 1 is denoted as 35-50 mm, Class 2 as < 35-25 mm and Class 3 as < 25-10 mm. Class 2 and class 3 were labelled as positive.

Cheek flattening assessed clinically by Holmes and Mathew classification ; Grade 1: Outstanding cosmetic outcome with no malar asymmetry, Grade 2: Good cosmetic outcome with subtle malar asymmetry upon close examination, Grade 3: Unsatisfactory cosmetic result featuring noticeable malar asymmetry, Grade 4: Severe malar asymmetry. Grade 3 and Grade 4 were labelled as positive and confirmed radiographically by occipitomental view and submentovertex view on first three weeks consecutively.

Total 60 patients of either gender between the 18 years to 60 years of age encounter the inclusion criteria were evaluated to compare the outcome of zygomatic bone fracture managed by Group A i.e., Percutaneous hook method and Group B i.e., Keens/Buccal sulcus approach with respect to cheek flattening and Mouth Opening.

Data were analysed by statistical software package (SSPS) Version 25.0. Detailed Descriptive statistics were calculated. The mean and standard deviation were computed for quantitative variables such as age (in years) and the duration of fractures (in days). For qualitative variables, including gender and age groups, frequency and percentages were determined. site of fracture pre-operative assessment and outcome i.e., post-operative assessment of Cheek flattening and mouth opening for three time up to three weeks consecutively. Qualitative variables are Effect modifiers which were controlled through stratification by

applying chi-square test and taken *p*-value ≤0.05 as significant.

RESULTS

The overall mean age of all the patients was 28.51±9.08 years. There were 76.7% male and 23.3% female patients. In total, 33.3% patients had right side zygomatic bone fracture and 66.7% patients had right side zygomatic bone fracture. The cheek flattening grade was distributed as 15% patients had grade II, 68.3% patients had grade III, and 16.7% patients had grade IV. The mouth opening class was distributed as 23.3% patients had class I, 61.7% patients had class II, and 15% patients had class III. The descriptive statistics of age are presented in Table 1. Age Stratification with respect to study groups is shown in Figure 1.

Figure 2 shows the frequency distribution of Gender and Fracture Zygomatic Bone side.

The detailed association of preoperative and postoperative cheek flattening grade and Mouth Opening Class with the study group are presented in Table 2 and Table 3 respectively.

For Cheek Flattening Grade: (i) Preoperative assessment was highly associated with the study group (p<0.001), (ii) Were insignificantly associated with the study group after 1st week (p=0.417), 2nd week (p=1.000) and 3rd week (p=1.000).

For Mouth Opening Class: (i) Highly significant association was found between preoperative assessment and the study group (p<0.001), (ii) Were significantly associated with the study group after 1st week (p=0.005) and showed insignificance after 2nd week (p=0.436) and 3rd week (p=0.228).

Stratification was done with respect to gender, fracture side, and age group to see the effect of these factors on association of both functions that are cheek flattening grade and mouth opening class preoperatively and Postoperatively with the study group.

Most of the stratification results showed insignificance for both functions. So, only significant results are mentioned in Table 4.

Figure 3 and Figure 4 represent the Frequency Distribution charts of Cheek Flattening Grade and Mouth Opening Class preoperative and postoperative assessment for Right and Left Fracture Zygomatic Bone, respectively.

Figure 5 and Figure 6 represent the Frequency Distribution charts of Cheek Flattening Grade and Mouth Opening Class preoperative and postoperative assessment for both gender and Age groups, respectively.

TABLE 1: FREQUENCY DISTRIBUTION OF PREOPERATIVE AND POSTOPERATIVE CHEEK FLATTENING GRADE.

		A n(%)	B n(%)	*p*-value
Cheek Flattening Preoperatively	Grade II	9 (30)	0 (0)	<0.001*
	Grade III	21 (70)	20 (66.7)	
	Grade IV	0 (0)	10 (33.3)	
Cheek Flattening After 1st week	Grade I	18 (60)	21 (70)	0.417
	Grade II	12 (40)	9 (30)	
Cheek Flattening After 2nd week	Grade I	27 (90)	26 (86.7)	1.000
	Grade II	3 (10)	4 (13.3)	
Cheek Flattening After 3rd week	Grade I	27 (90)	27 (90)	1.000
	Grade II	3 (10)	3 (10)	

TABLE 2: FREQUENCY DISTRIBUTION OF PREOPERATIVE AND POSTOPERATIVE MOUTH OPENING CLASS

		A n(%)	B n(%)	*p*-value
Mouth Opening Preoperatively	Class I	12 (40)	2 (6.7)	<0.001*
	Class II	18 (60)	19 (63.3)	
	Class III	0 (0)	9 (30)	
Mouth Opening After 1st week	Class I	12 (40)	2 (6.7)	0.005*
	Class II	18 (60)	28 (93.3)	
Mouth Opening After 2nd week	Class I	15 (50)	18 (60)	0.436
	Class II	15 (50)	12 (40)	
Mouth Opening After 3rd week	Class I	28 (93.3)	25 (83.3)	0.228
	Class II	2 (28.6)	5 (16.7)	

*Chi Square Test was applied. *Significant at 0.01 levels. P-value ≤0.05 considered as Significant.*

TABLE 3: SIGNIFICANT P-VALUES OF STRATIFICATION FOR BOTH FUNCTIONS

Functions	Factors		Assessment	*p*-value
Cheek Flattening Grade	Gender	Male	Preoperative	<0.001*
		Female	All values were insignificant	
	Zygomatic Bone Fracture	Right Side	All values were insignificant	
		Left Side	Preoperative	<0.001*
	Age	<=25 years	Preoperative	0.009*
		>25years	Preoperative	0.001*
Mouth Opening Class	Gender	Male	Preoperative	<0.001*
			After 1st Week	0.015*
		Female	All values were insignificant	
	Zygomatic Bone Fracture	Right Side	After 2nd Week	0.037*
		Left Side	Preoperative	<0.001*
			After 1st Week	<0.001*
	Age	≤25 years	Preoperative	0.004*
			After 1st Week	0.014*
		>25years	Preoperative	0.005*

Chi Square Test was applied.
**Significant at 0.01 levels. P-value ≤0.05 considered as Significant*

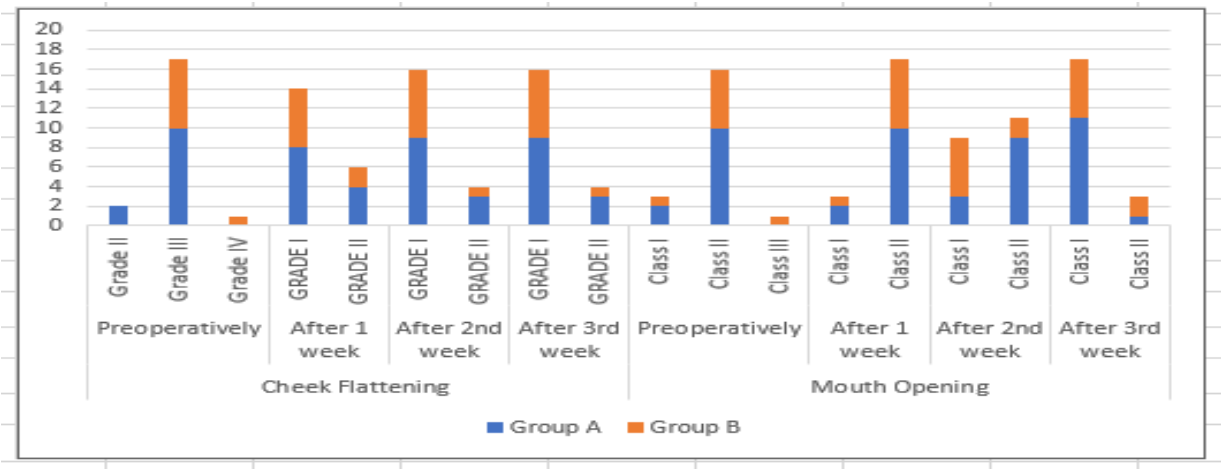

Fig. 1: Frequency Distribution of Cheek Flattening Grade and Mouth Opening Class After first three consecutive weeks according to treatment Group for Right Fracture Zygomatic Bone (n = 20)

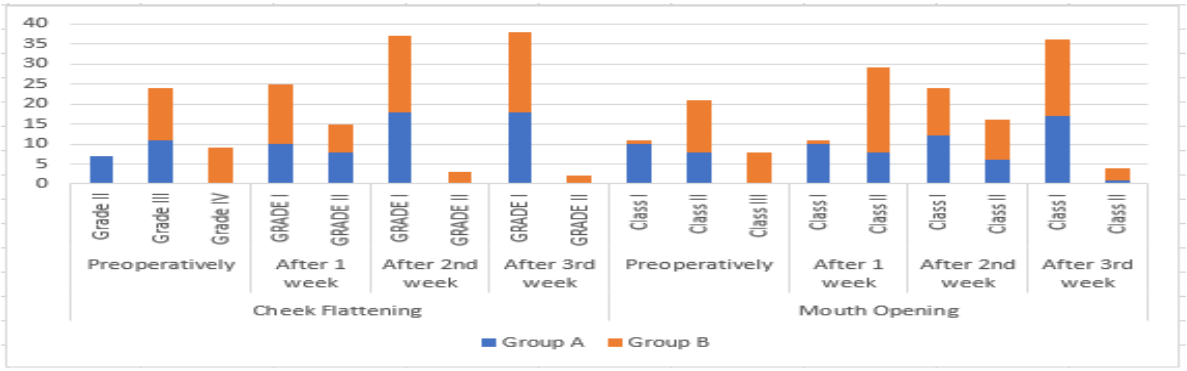

Fig. 2: Frequency Distribution of Cheek Flattening Grade and Mouth Opening Class after first three consecutive weeks according to treatment Group for Left Fracture Zygomatic Bone (n = 40)

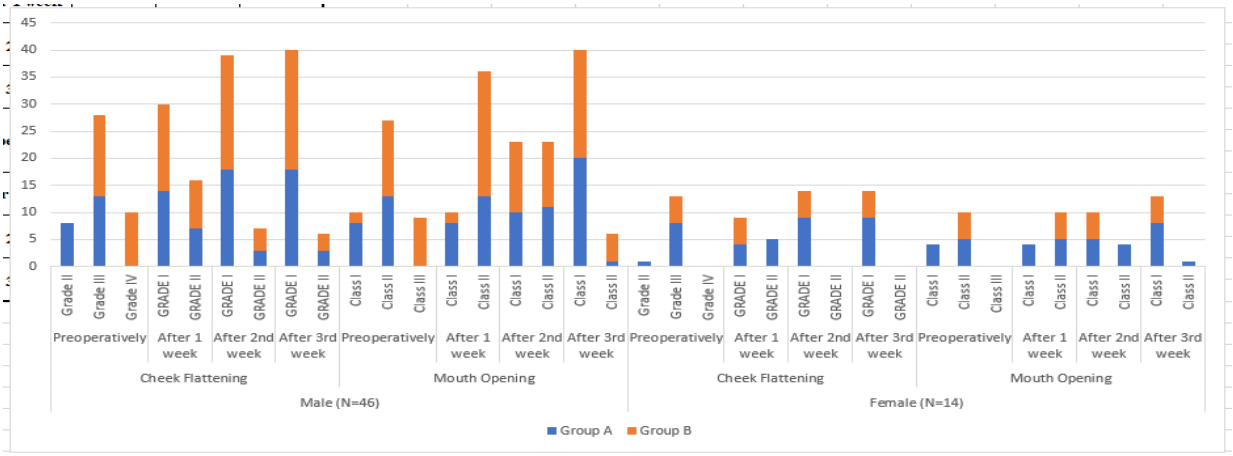

Fig. 3: Frequency Distribution chart of Cheek Flattening Grade and Mouth Opening Class for Gender

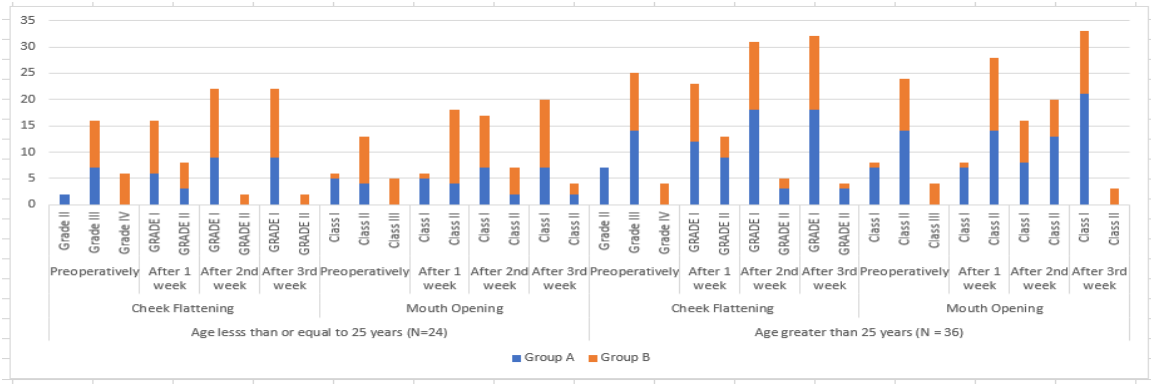

Fig. 4: Frequency Distribution chart of Cheek Flattening Grade and Mouth Opening Class for Age

DISCUSSION

The zygomaticomaxillary complex subject to the protect of the contents of orbit and the mid face esthetic. Zygomatic complex Fracture is second most common facial fracture in midface trauma after the nasal fracture and it principally common in male adolescent. The most frequent causes of zygomaticomaxillary complex fractures are sports injuries, assaults, falls, and traffic accidents.13-1 . However, due to socioeconomic, cultural, and environmental factors, there is geographic and sociocultural diversity in the aetiology of maxillofacial fractures. Mostly zygomaticomaxillary complex fractures appears with clinical features of diplopia, extraocular muscle entrapment, enophthalmos, subconjunctival ecchymosis, esthetic deformity with loss of projection of malar prominence, widening of middle third of face, occlusion disturbance, restricted mouth opening and neurosensory impairment of the infraorbital nerve. The diagnosis of zygomatic bone fractures is typically made clinically and verified by a computed tomography (CT) scan.[18] The protrusion of the cheek and the width of the midface are maintained by the zygomatic bone .In most cases, conservative management is used for Zygomatic bone fractures with no or little displacement., while fractures with functional or aesthetic problems in the form of diplopia, extraocular muscle entrapment, neurosensory disturbance of infraorbital nerve, disturbed occlusion, the diminished extension of the malar prominence and the constrained mouth opening often requires surgical intervention.[19]

The surgical approach used for the anatomic reduction of zygomaticomaxillary complex fractures must allow for proper exposure of the fractured segments and minimise the risk of facial structure injury, and ensure a optimum functional and cosmetic outcomes. Surgical reduction of zygomatic fractures by a transoral surgical approach was first given in 1909 by Keen[20], and many studies have subsequently documented the treatment outcome after open reduction of zygomatic complex fractures by an transoral surgical approach.[21] To obtain a satisfactory treatment outcome and an ideal anatomic alignment of the zygomatic complex fracture, a number of surgical techniques and treatment plans have been suggested.[16-19] The most common treatment for displaced and comminuted zygomatic complex fractures is open reduction and internal miniplate fixation. The factors affect the treatment outcome are fracture anatomy, functional impairment, fracture severity, aesthetic impairment, the course of treatment, surgical techniques, and the quantity and placement of mini plates for fixation. In comparison to the extraoral method, the transoral surgical approach has many benefits, including the ability to see the fracture line at the zygomaticomaxillary buttress and the infraorbital nerve without leaving a skin scar , the operator can apply force more closely and precisely, fixation plates can be placed at the fracture site through the same intraoral incision, and morbidity is reduced when compared to the extraoral approach. Significantly dislocated zygomatic complex fractures, however, call for more rigid fixation or orbital floor restoration, which calls for more exposure of the zygomaticofrontal junction or the inferior orbital rim..[22] In one study, where proper anatomic alignment could not be obtained exclusively by the intraoral approach, The initial strategy used a progressive surgical treatment plan to expose the zygomaticomaxillary buttress, then either the frontozygomatic junction or the infraorbital rim. After an open reduction of zygomatic complex fractures, the 1-year clinical and radiographic evaluation revealed that 98% of patients had a optimum facial esthetic outcomes and that the zygomatic complex was anatomically aligned. Minor persistent flattening of the

malar projection was seen in one patient with a highly displaced zygomatic complex fracture requiring three-point fixation and orbital floor repair. The eyeballs of all patients were positioned in the same position without enophthalmos, had normal mandibular range of motion, pre-injury occlusion, and normal extra-ocular muscle action. A dissimilar position of the orbital floor was observed in 38% of patients undergoing orbital reconstruction, and permanent infraorbital sensory abnormalities were observed in 41% of these individuals.[22] One retrospective analysis with 379 patients found that 203 patients who had zygomatic complicated fracture alignment utilizing a transoral method experienced a favorable treatment outcome.[23] The small sample size was main limitation of study. The results may not be generalizable to bigger populations because the study was conducted in an urban setting.

CONCLUSION

The study results showed that mouth opening class after 1st week was significantly good in Keen intraoral approach, while the mouth opening class after 2nd week and 3rd week was not significantly different among the two groups. The cheek flattening grade was not significantly different among the two groups at postoperative. Hence it can be concluded that The Keen intraoral approach offers had good functional outcome with, the benefit of avoiding skin incisions and, thus, noticeable scarring.

ETHICS APPROVAL: The ERC gave ethical review approval.

CONSENT TO PARTICIPATE: written and verbal consent was taken from subjects and next of kin.

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AUTHORS' CONTRIBUTIONS:

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated in the work to take public responsibility of this manuscript. All authors read and approved the final manuscript.

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